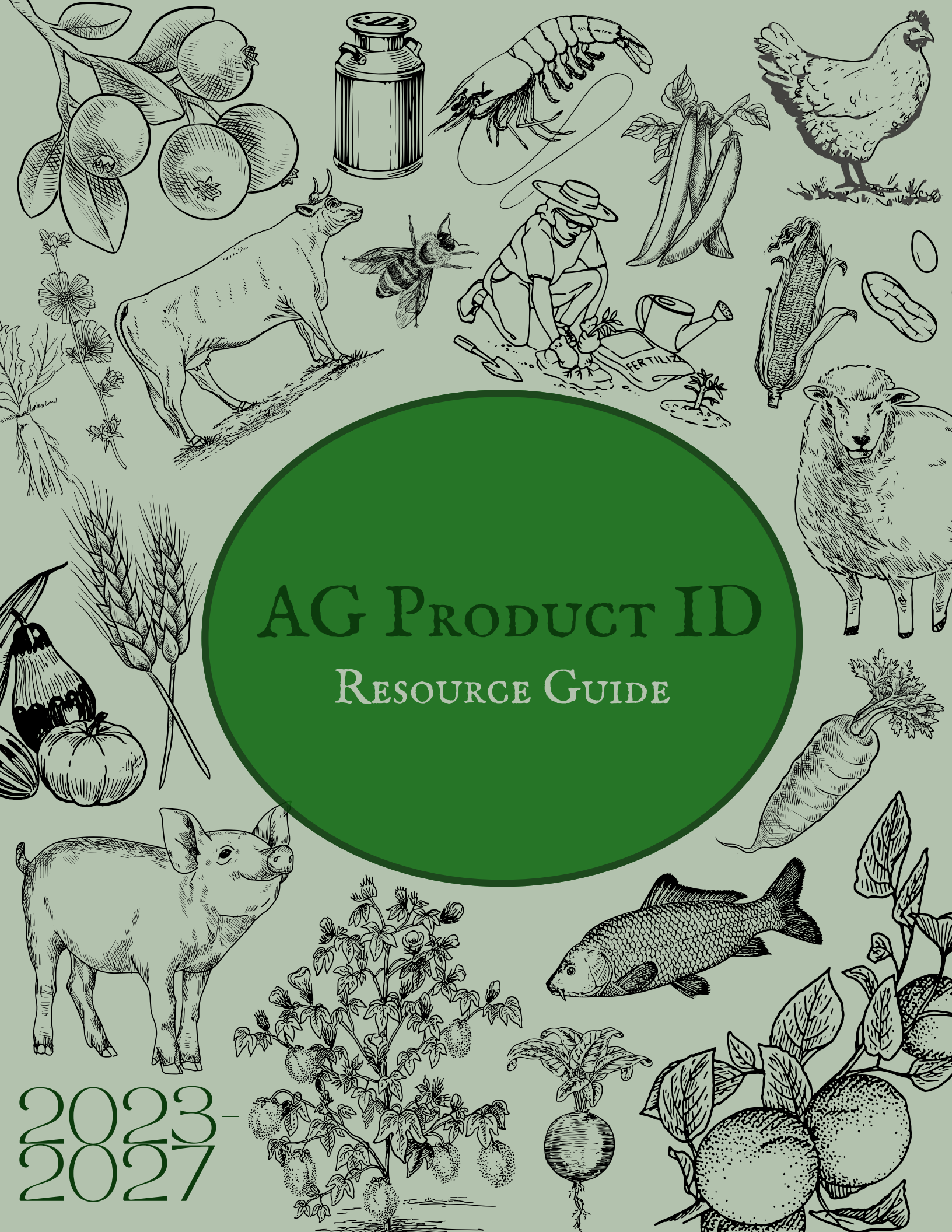


AG Product ID

Resource Guide

2023-
2027

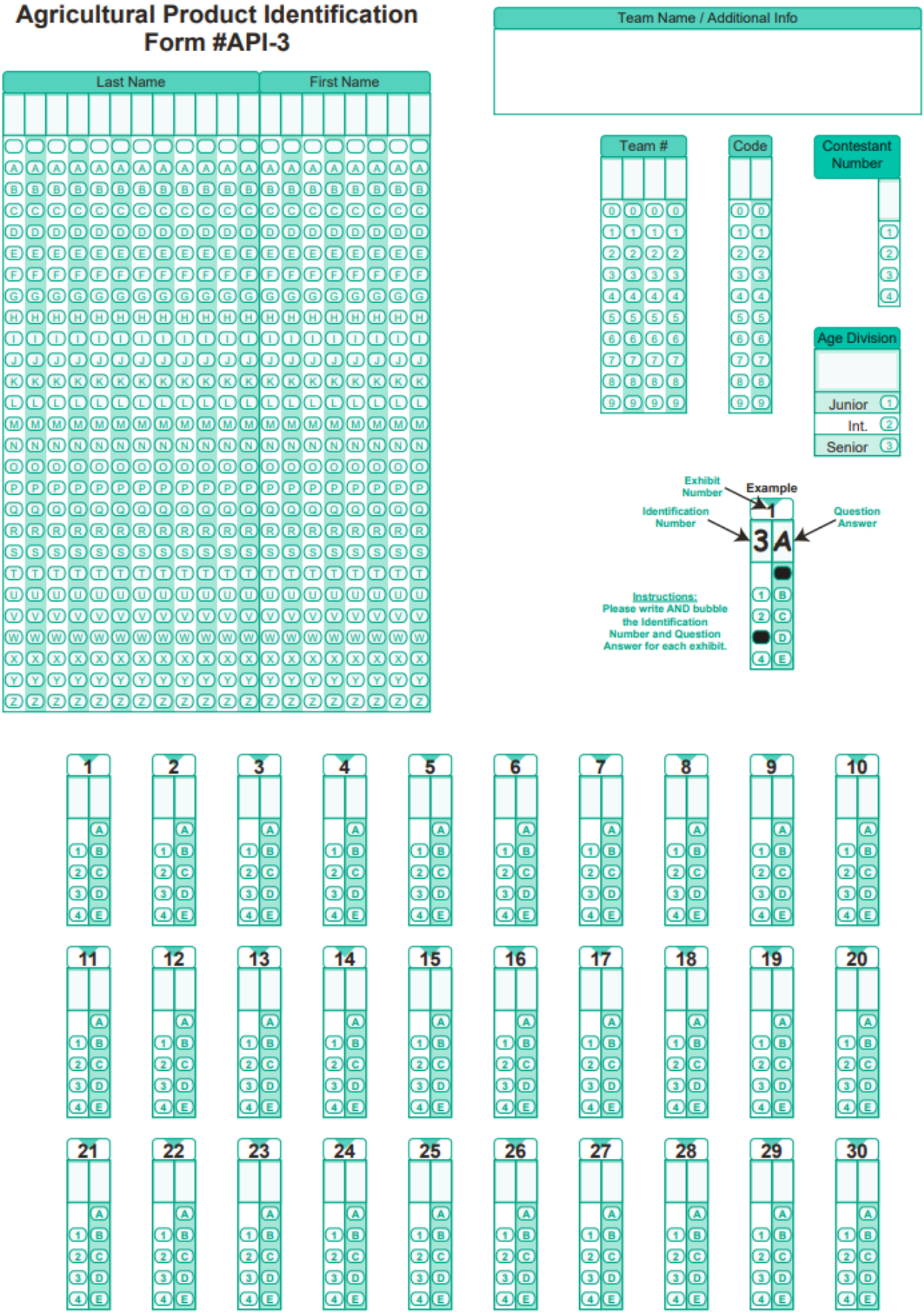
The Agricultural Product Identification contest is designed to enhance participants' knowledge about agricultural products, their characteristics, uses, and industry-related information. It also provides an engaging way to learn and interact with various agricultural products commonly found in Texas. The contest was established under the leadership of Dr. Chris Boleman, Dr. Amy Dromgoole Mehaffey and Jodi McManus, District 11 4-H Specialist in 2011 as part of the Houston Livestock Show and Rodeo. 50 4-H members and FFA students made up the 14 teams from around the state that competed. Since then, the contest continues at HLSR but is also now also offered at the State Fair of Texas, Heart of Texas Fair and Rodeo, Rio Grande Valley Livestock Show and Houston Livestock plus many District and County Extension Programs host contest as well as the Texas 4-H Roundup state contest for senior level 4-H members.

Photo from the 2011 HLSR inaugural contest (left to right) Jodi McManus, Dr. Chris Boleman and Dr. Amy Mehaffey.

Contest Rules:

1. Up to 30 agricultural products are chosen and displayed at separate stations from the 2023-2027 Ag Product ID Guide.
2. Contestants need to correctly identify each product from four possible answers.
3. Additionally, each station has a multiple-choice question related to the product on display.
4. These questions cover both general industry knowledge and specific details about the product such as but not limited to
    a. Texas' national ranking in Production
    b. Economic impact
    c. Nutritional content
    d. Cooking methods
    e. Uses
    f. Growing season
    g. Specific nutrition
5. Questions are 5 points each.
    a. Contestants will receive five (5) points for each product that is correctly identified and five (5) points for each question that is correctly answered.
    b. Points will only be awarded on the follow up questions (pertaining to the product displayed) if the product is correctly identified.
6. Contestants have 30 seconds at each station to answer both the identification and the multiple choice questions.
7. Seven (7) stations will be selected as tie breakers in advance of the contest. The highest cumulative scores for these classes followed by the lowest standard deviation of all classes will be used for both individual and team ties.
8. The products selected for the contest can vary widely, from items like garlic to a rib-eye steak based on the contest coordinator’s preferences.
9. Resources related to the contest may be found at https://texas4-h.tamu.edu/events/roundup/ under Ag Product Guide. Teams will also benefit from their own web searches and by visiting supermarkets to view products.

10. Uses Ag Product ID (API-3) Scansheet. New for 2022.



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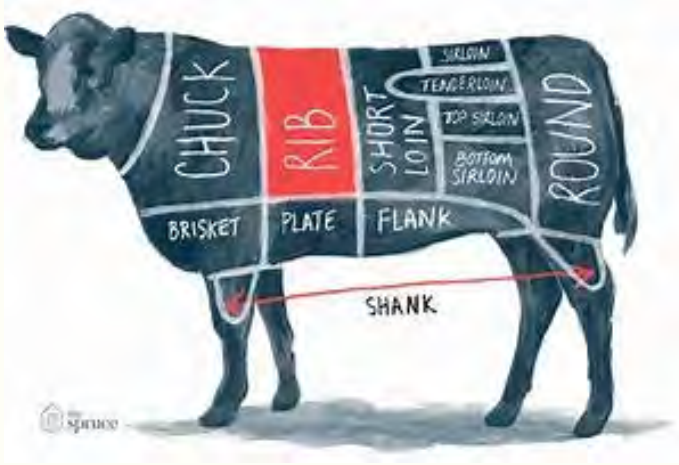
Animal Products

Beef

As of 2017, cattle is Texas's leading ag commodity, with market value of $12.3 billion. Raising beef is a complex process, but throughout the entire journey, one thing remains constant – the shared commitment to raising cattle in a safe, humane and environmentally sustainable way. Currently, more than 90% of U.S. farms and ranches are family-owned and operated, and today beef is produced using fewer resources than ever before.

Eating beef promotes health and helps prevent nutrient deficiencies, and cattle themselves play a unique role in our food system by upcycling inedible plants to high-quality protein. On average, 3 ounces of cooked beef provides 10 essential nutrients in about 170 calories including 25 grams of high-quality protein, zinc, iron, and B vitamins.

Beef is divided into large sections called primal cuts. These "primals" are then broken down further into subprimals, also called "food-service cuts." They are then sliced and chopped into individual steaks, roasts, and other retail cuts.



In this section, the primal cuts will be discussed, followed by a collection of popular beef cuts (subprimals) from each primal , cooking methods, handling, and labeling.

7-Bone Chuck Roast

Also known as: 7 Bone; 7-Bone Roast; Beef Pot Roast; Center Cut Pot Roast; Chuck 7 Bone Pot Roast, Bone In; Chuck 7-Bone Pot Roast; Chuck Arm Pot Roast, Bone-In; Chuck Roast Center Cut; 7 Bone Roast

Identified by the 7-shaped bone it contains. Rich and flavorful, it's ideal for the slow cooker.

Cooking methods:
Braising or Pressure Cooking.

Butchers Note
The 7-bone it contains is made by cutting roasts across the scapula or blade bone.

Arm Chuck Roast

Also Known As Arm Roast; Chuck 7-bone Pot Roast; Chuck Arm Pot Roast; Chuck Arm Roast; Chuck Blade Pot Roast; Chuck pot roast; Chuck, Shoulder (Clod), Arm Roast; Clod Heart; Cross Rib Roast; Short Clod; Shoulder Center; Shoulder Clod Roast; Shoulder Pot Roast

Economical and flavorful. Best when slow-cooked.

Cooking methods:
Oven Roasting, Braising, or Pressure Cooking.

Butchers Note
Name originates from the Arm bone (Humerus) of the upper forelimb.

Blade Chuck Roast

Also Known As Beef Pot Roast; Blade Chuck Pot Roast Bone In; Chuck 7-bone Pot Roast; Chuck Arm Pot Roast; Chuck Blade Pot Roast; Chuck pot roast; Chuck Roast 1st Cut; Chuck Roast Blade Cut; Shoulder Pot Roast

A relatively inexpensive cut with loads of beef flavor. Moist and tender when slow-cooked.

Cooking methods:
Braising or Pressure Cooking.

Butchers Note
Cut location is the flat bone portion of the Blade that comes from Ribs 4 through 5.

Chuck Tender Steak

Also known as Chuck Filet Steak; Chuck Tender Steak; Fish Steak; Mock Tender Steak.

Lean cut resembling Tenderloin Steak, but not as tender. Marinate before cooking.

Cooking methods: Grilling, Braising, or Broiling .

Butcher's Note
Referred to as "mock tender" because it is similar in appearance to tenderloin steak.

Chuck Tender Roast

Also known as Chuck Filet ; Medallion Pot Roast; Scotch Tender; Mock Tender Roast.

Lean roast that requires slow-cooking to tenderize.

Cooking methods: Braising, or Pressure Cooking.

Butcher's Note
Referred to as "mock tender" because it is similar in appearance to tenderloin roast.

Chuck Eye Roast

Also Known As America's Beef Roast; Beef Chuck, Chuck Eye Roast, Boneless; Boneless Chuck Fillet; Boneless Chuck Roll; Chuck Eye Roll; Chuck Roll; Inside Chuck Roll;

This cut is a good value with loads of beef flavor. Roast to highlight natural tenderness and flavor.

Cooking method: Braising

Butcher's Note
The top portion of the Chuck Roll that most resembles a Ribeye Roll.

Top Blade

Home of the second most tender muscle and cut into Top Blade and Flat Iron Steaks.

Butcher's Note
Consists of the second most tender muscle in the animal; However, internal connective tissue should be removed to preserve that tenderness.

Cooking method: Braising

Chuck Short Ribs

Also Known As Beef Ribs; Braising Ribs; Short Ribs;

A crowd favorite, known for their richness and meatiness. Flavorful, moist and tender when slow-cooked.

Butcher's Note
Can be offered bone-in and/or boneless.

Cooking method: Oven Roasting; Braising; Grilling; Smoking; Pressure Cooking.

Shoulder Petite Tender

Juicy and tender, it is shaped like the Tenderloin but is smaller and more affordable. Perfect to grill or broil.

Butcher's Note
Smallest muscle of the Shoulder Clod that is tender when left whole or cut end to end into portions.

Cooking methods: Grilling; Oven Roasting; Skillet to Oven; Broiling; Smoking; Indirect Grilling; Sous Vide.

Ribeye Roast

Also Known As Newport Roast; Prime Rib; Rib Roast; Rib Roast Bone-In, Small End; Rib Roast, Oven-Ready; Standing Rib Roast; Savory and fine-textured with generous marbling. A classic holiday roast.

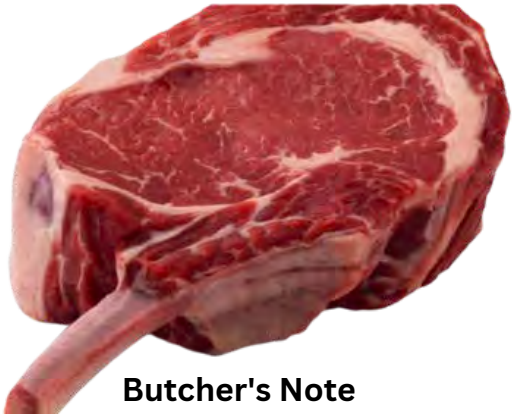
Cooking method: Oven Roasting; Indirect Grilling; Smoking.

Butcher's Note
"Ribeye" is an anatomical name meaning Eye of the Rib.

Rib Steak

Also known as: Beef Rib, Rib Steak, Bone In, Frenched; Cowboy Steak; Tomahawk Steak

Tender steak from the Rib with marbling that adds flavor. Simply season grill.



Cooking method: Grilling; Skillet; Broiling.

Butcher's Note
If frenched, referred to as Cowboy Steak. If frenched and full rib bone attached, referred to as Tomahawk Steak.

Ribeye Roll

Also known as Beef Rib; Ribeye; Lip-on; Prime Rib; Ribeye Roast; Boneless.

Exceptionally tender and flavorful boneless roast consisting of 3 muscles fabricated into steaks, fillets, or roasts.

Cooking method: Grilling; Oven roasting; Broiling; Smoking.

Butcher's Note
Located above the short ribs in the Rib Primal between the Chuck and Loin Primals.

Back Ribs

Also Known As Beef Rib Back Ribs; Beef Riblets; Beef Ribs; Dinosaur Ribs; Finger Ribs; Rib Bones

A great value and beef's signature ribs for the BBQ, this flavorful cut is great with a dry rub on the grill.

Cooking methods:
Grilling, Braising, or Broiling.

Butcher's Note
Portioned by the number of rib bones. Can be offered as whole or half.

Rib Short Ribs

Also Known As Beef Ribs; Ribs; Short Ribs;

Full of beef flavor and fall-off-the-bone tender, but also available boneless. Grill or slow-roast for a succulent beef dish.

Cooking method:
Grilling; Braising; Pressure Cooking; Sous Vide; Broiling.

Butcher's Note
Name originates from the short length of the Ribs, thus the name "Short Ribs"

Prime Rib Roast

Also known as Export Rib; Prime Rib; Lip-on; Prime Rib; Rib Roast; Bone-In; Standing Rib Roast.

Bone-in rib perfect for roasting and entertaining.

Cooking Method: Oven Roasting

Tenderloin Roast

Also Known As: Center Cut Tenderloin Roast; Filet Mignon Roast; Tenderloin Roast

The most tender beef roast that is well known for being lean and succulent. Easy to carve with its fine texture.

Cooking method: Oven Roasting; Grilling; Sous Vide; Broiling.

Butcher's Note
Roast cut from the larger Tenderloin, the least exercised and most tender cut.

Tenderloin Steak (Filet Mignon)

Also Known As: Beef Loin, Tenderloin Steak, Side Muscle Off, Skinned; Chateaubriand Filet De Boeuf; Filet Mignon

This is the most tender steak, lean yet succulent, with a fine buttery texture. Sold boneless. This steak also meets government guidelines for lean.

Cooking method: Grilling; Skillet; Broiling; Sous Vide.

Butcher's Note
Steak cut from the Tenderloin, the least exercised and most tender cut.

Tenderloin Tails

Also Known As: Tenderloin Tips

Tapered ends of the Tenderloin, the most tender beef muscle.

Cooking method: Grilling; Oven roasting; Broiling; Smoking.

Butcher's Note
Cut from the thin, tapered end of the Tenderloin.

Strip Roast

Also Known As: Strip Loin Roast; Top Loin Roast

This centerpiece roast is tender, juicy and full of flavor.

Butcher's Note
"Strip" is a traditional name that originated from Delmonico's restaurant in New York City in the 18th century.

Cooking method: Oven Roasting.

Strip Steak

Also Known As: Ambassador Steak; Club Steak; Hotel Cut Steak; Kansas City Strip Steak; New York Strip Steak; Shell Steak; Top Loin Steak

Tender, lean and perfect for grilling.

Butcher's Note
Cut from the top loin or strip loin into uniform steaks perfect for the grill.

Cooking methods:
Grilling; Skillet; Broiling; Sous Vide.

Tenderloin Steak, Bone-in

Also known as Bone-in Fillet; Bone-in Fillet Mignon; Center Cut Bone-in Fillet.

The most tender beef steak. Lean yet juicy, with a fine texture . A popular lean cut for cooking at home or choosing when dining out.

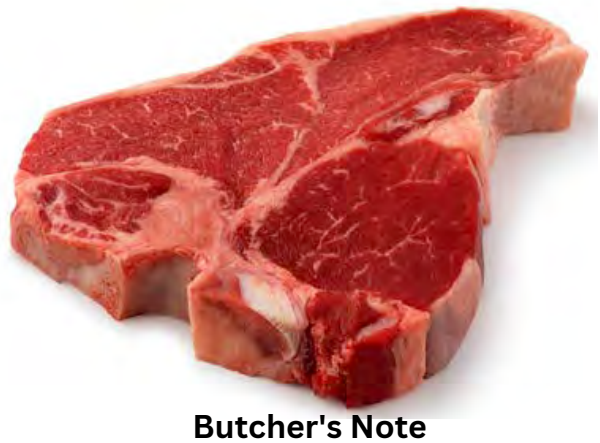
Cooking methods:
Grilling; Oven roasting; Broiling; Smoking.

Porterhouse Steak

Also Known As: 1st Cut Porterhouse; King Steak; Porter House

Big flavor and often big enough for two. Simply season this sublime combination of Strip and Tenderloin for the grill or oven.

Cooking method:
Grilling; Skillet; Broiling.



Butcher's Note
Differentiated from the T-Bone steak by its larger Tenderloin muscle.

T-Bone Steak

Also Known As: Loin, T-Bone Steak; T-Bone

Smaller than the Porterhouse, but delivers the same optimal tenderness and satisfying flavor – all in a lean package that's ready to be grilled or broiled.

Cooking method: Grilling; Skillet; Broiling.

Butcher's Note
Name originates from the characteristic T-shape of its bone.

Loin Steak Tail

Cut from the underside or flank portion of the beef hindquarter, ventral, or short loin. Fat trim level is specified by buyer.

Cooking method: Grilling; Skillet; Broiling.

Butcher's Note

Most often used for further processing into ingredient beef; often cut into strips.

Tri-Tip Roast

Also Known As: Bottom Sirloin Roast; Newport Roast; Santa Maria Roast; Tri Tip; Triangle Roast

Boneless and fairly tender with full flavor. Roast or grill then slice across the grain.

Cooking method:
Grilling; Oven Roasting; Indirect Grilling; Broiling; Smoking; Sous Vide.

Butcher's Note
Its triangular shape gives it the name “Tri-Tip”.

Tri-Tip Steak

Also Known As: Newport Steak; Santa Maria Steak; Tri Tip; Triangle Steak

Boneless and fairly tender with full flavor. Grill then slice across the grain.

Cooking method: Grilling; Skillet; Stir-fry; Broiling.

Butcher's Note
Its triangular shape gives it the name “Tri-Tip”.

Petite Sirloin Steak

Also Known As: Ball Tip Steak; Sirloin Steak

A great value steak. Grill after marinating.

Cooking method: Grilling; Broiling.

Butcher's Note
The name “Petite” comes from the small size of the Sirloin cut.

Top Sirloin Steak

Also Known As: Boneless Top Sirloin Steak ; Top Sirloin Butt Steak, Boneless; Top Sirloin Center-Cut Steak; Top Sirloin Steak Boneless Cap Off; Top Sirloin Steak Cap Off

A flavorful cut that's versatile and juicy. Great served as a steak or cut into kabobs.

Cooking method: Grilling; Skillet; Broiling; Stir-fry; Sous Vide.

Butcher's Note
Name originates from its anatomical location on the "Top" (dorsal) of the Sirloin.

Top Sirloin Butt, Center-Cut

Also Known As: Center Cut Top; Top Sirloin Heart.

Top Sirloin Butt with cap, mouse muscle and external fat removed to aid in further fabrication.

Cooking method: Oven roasting; Smoking.

Butcher's Note
Remove all external muscles and fat to create this center-cut portion.

Top Sirloin Steak, Center-Cut

Also Known As: Center Cut Sirloin; Top Sirloin, Sirloin Steak, Cap Off.

This steak is cut from the cap off Top Sirloin Butt and is a tender and lean cut that is ideal for several cooking methods and dishes.

Cooking method: Grilling; Skillet; Stir-fry; Broiling; Sous Vide.

Butcher's Note
This center cut steak can also be used for Kabobs.

Top (Inside) Round

Also Known As: Beef Round, Top (Inside); Inside Round.

This cut comes from the inside of the rear leg and is very lean. It can be fabricated into steaks, which benefit from tenderization or marination, but is commonly roasted and sliced for Roast Beef.

Cooking method: Grilling; Oven roasting; Skillet; Broiling; Sous Vide; Stir-fry.

Butcher's Note
Given the name “Top” because anatomically it is located directly above the Bottom Round and the Eye of Round in the Round primal.

Eye of Round

This extremely lean cut is shaped similar to a Tenderloin, but is much less tender. It's often packaged as a roast or steaks, but can be fabricated into Stew Meat or Cubed Steak.

Cooking method: Oven roasting; Braising

Butcher's Note
An elongated muscle located in the center of the Round, thus the name “Eye.”

Sirloin Tip

Also Known As: Knuckle; Round Tip; Sirloin Tip.

Although its name suggests otherwise, this cut comes from the Round primal, and is found on the front end of the rear leg. Often fabricated into roasts, which are great when braised, but can also be cut into steaks or used for Ground Beef.

Cooking method:
Oven roasting; Grilling; Skillet; Broiling; Braising.

Butcher's Note
Also known as Knuckle and formerly known as Round Tip

Flank Steak

Also Known As: Beef Flank; Flank Steak Filet; Jiffy Steak; Plank Steak.

Lean and boneless with lots of intense beef flavor. Best when marinated and grilled or sliced thin and stir-fried.

Cooking method:
Grilling; Stir-fry; Broiling; Smoking; Sous Vide.

Butcher's Note
Slicing beef against the grain is always important, but even more so for thin, coarse cuts such as the Flank Steak.

Plate Short Ribs

Also Known As: Dino Ribs; Flanken Style Ribs; Short Ribs.

Good beef flavor. Good braised or on the grill with your favorite rub.

Cooking method:
Oven roasting; Braising; Smoking.

Butcher's Note
The name originates from the short length of the Ribs thus the name “Short Ribs.”

Inside/Outside Skirt

Also Known As: Arrachera; Fajita Meat; Fajita Steak; Skirt Steak

These cuts are known for their robust flavor profile. Marinate and grill hot for fajitas or use for stir-fry.

Cooking method:
Grilling; Skillet; Stir-fry; Broiling.

Butcher's Note
Slicing beef against the grain is always important, but even more so for thin, coarse cuts such as the Skirt Steak.

Brisket Flat Half

Also Known As: Beef Brisket Middle Cut, Boneless; Brisket Center-Cut; Brisket First Cut; Brisket Flat Cut; Brisket Front Cut.

The leaner half of the whole Brisket also known also as the “first cut,” this full-flavored meat can be sliced or shredded.

Cooking method: Oven roasting; Braising; Pressure Cooking; Smoking; Sous Vide.

Butcher's Note
The posterior flat portion of the Brisket thus the name “Flat.”

Brisket Point Half

Also Known As: Brisket Nose Cut; Brisket Point Cut.

The less lean half of the whole Brisket that’s juicy with full flavor.

Cooking method:
Oven roasting; Braising; Smoking; Sous Vide.

Butcher's Note
The anterior Point portion of the Brisket, thus the name “Point.”

Ground Beef

Also Known As: Chopped Steak; Ground Chuck; Ground Round; Ground Sirloin; Ground Steak; Market Trim

Versatility and rich flavor make it ideal for burgers, tacos or wraps. Perfect for breakfast, lunch and everything in-between.

Cooking method: Grilling, Oven Roasting, Skillet cooking, Braising, and Broiling

Butcher's Note
Versatile ingredient that's beef's most popular item.

Stew Meat

Also Known As: Beef for Stew; Diced Beef; Stew Beef

A full-flavored staple. Great for slow-cooking, chili and stews.

Cooking method: Braising, Pressure Cooking, Sous vide, Stewing

Butcher's Note
The name "Stew" originates from a method of cooking where small pieces of meat are simmered in water or other liquid until its tender.

Labels

Meat labels show:

- what you are buying.
- grade of the meat.
- how much you pay for a pound.
- how much the packaged portion of a pound.
- cooking instructions (possibly).

The food label provides a variety of information designed to make shopping as easy as possible. Depending on the type of product purchased, the label provides the following:

- Product description
- Sell-by-Date
- Safe handling/Cooking/Eating information
- Nutritional information

Description of Beef Cut

The label on raw beef cuts contains the name of the primal cut the beef was taken from, the name of the retail or market ready cut, a short description [bone-in or boneless], the total weight, and cost per pound. If you are familiar with the different beef cuts, having the name of the cut on the label will help you determine if it is the proper leanness and/or tenderness for the type of recipe that you have planned.

The name of the cut and whether it is bone-in or boneless will help you determine the quantity to by according to the weight contained in the packages. A boneless cut will contain more serving than the bone-in cut, so it is important to take this into consideration when determining your needs. A bone-in cut may be lower in cost per pound, but when determining your best value, you should compare cost per serving. Another important point to consider is that the bone and fat help give beef great flavor and tenderness, so it may be worth paying a little extra per serving for the bone-in cut. To determine the cost per serving, use the following equation :

cost per pound / number of servings per pound = cost per serving.

Some packaged beef that is labeled “lean” may simply refer to the fact that the excess fat has been trimmed from the beef and may not indicate that the cut of beef is actually a lean cut. If you purchase cuts from the tenderloin or round, you can be sure that they are lean. The tenderloin will not only be lean, but it will be very tender and very expensive. Although round cuts are lean, they are not naturally tender, but they are much more affordable. Proper preparation and cooking helps to tenderize them.

Much of the beef intended for stewing is simply labeled “stew meat” without describing the cut from which the beef was obtained. In most cases, the meat is taken from tougher cuts such as the bottom round, brisket, or plate.

Sell-By Date

Packaged fresh beef will have a “sell-by-date” printed on the food label, which represents the last day recommended for selling the product. Generally the store will pull any products left on the shelf the day of the “sell-by-date” but if it is not to be used within that time, it should be frozen. Some labels may have a “use-by-date” rather than a “sell-by-date”, which indicates the meat should be cooked or frozen by that date.

Fully Cooked/Ready-to-Eat/Heat and Eat

Some beef products are precooked, so the food label will indicate that the product is “fully cooked” or “ready-to-eat”. A product such as beef luncheon meat is ready-to-eat, but it can be stored at room temperature. Other products, such as canned goods, are precooked, but taste much better if they are heated before consumed. These products are know as “heat and eat”.

Nutritional Labeling

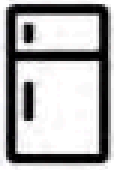
All commercially prepared and packaged beef products are required to provide nutritional information on the food label. Raw meat cuts in a food store or butcher shop are exempt from this requirement. The nutritional information shown on the label includes calories, fat and cholesterol content, protein, fiber, sugars, sodium, and various vitamins and minerals.

Safe Handling Instructions

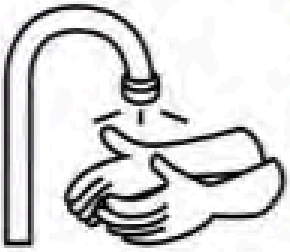
The food label on raw beef or beef that is not fully cooked, will also contain food safety and handling instructions, which are required by the USDA.

Safe Handling Instructions

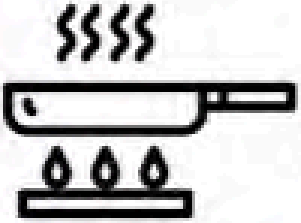
This product was prepared from inspected and passed meat and/or poultry. Some food products may contain bacteria that could cause illness if the product is mishandled or cooked improperly. For your protection, follow these safe handling instructions.



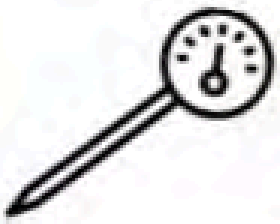
Keep refrigerated or frozen.
Thaw in the refrigerator.



Keep raw meat and poultry separate from other foods. Wash working surfaces (including cutting boards), utensils, and hands after touching raw meat or poultry.



Cook thoroughly.



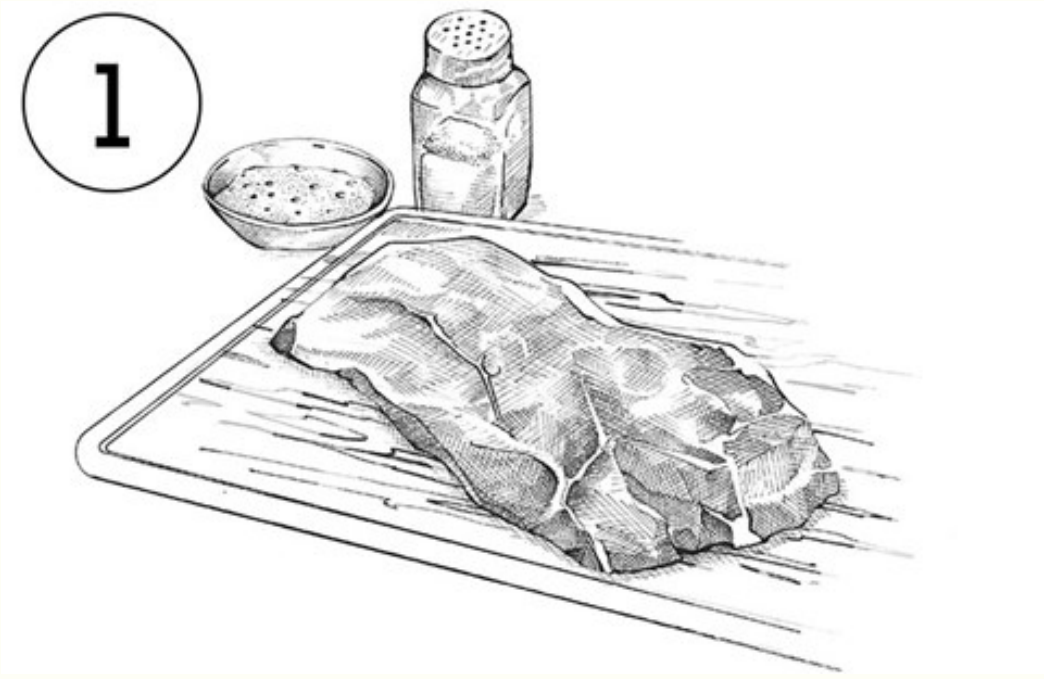
Keep hot foods hot. Refrigerate leftovers immediately or discard.

BROILING BASICS

With just a pinch of seasoning and one strong heat element in your oven, broiling is the sure-fire way to impress your family with a delicious meal in just a matter of minutes.

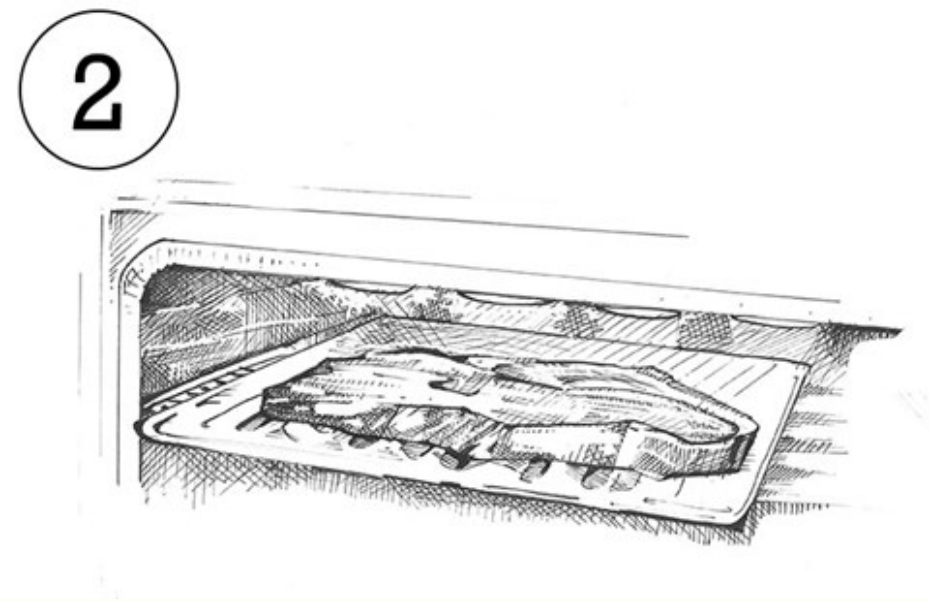
BROILING BASICS

Broiling is similar to grilling in that it uses direct dry heat—only the heat comes from above instead of below. You'll have the best results with cuts that are relatively flat and of even thickness. Check out our broiling cooking chart for more recommendations and guidelines.



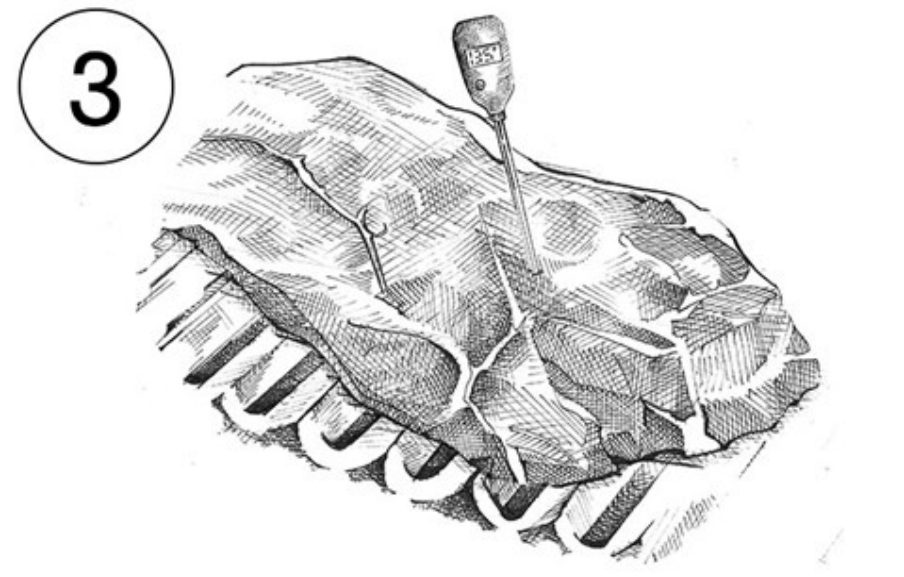
PREHEAT & PREP

Pull your steak from the fridge and season generously, per your recipe. Then turn on the broiler (we recommend reviewing the owner's manual for your oven if you have any questions about how this function works). It's best to use a broiler pan for even cooking and to catch drippings. Keep a timer handy.



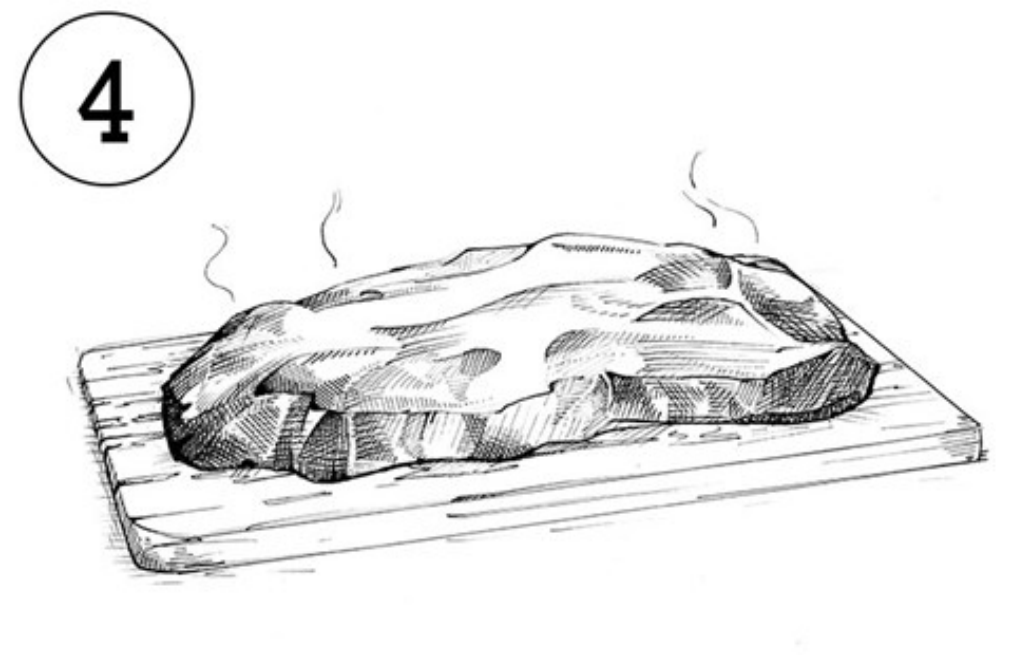
UNDER THE BROILER

Broiling works best if the beef is close to the broiler, about 2–4 inches. Start the timer when you slide the steak under the broiler. Depending on your oven, you may need to keep the door open slightly. Follow the timing in your recipe or our cooking chart, flipping the beef once halfway through.



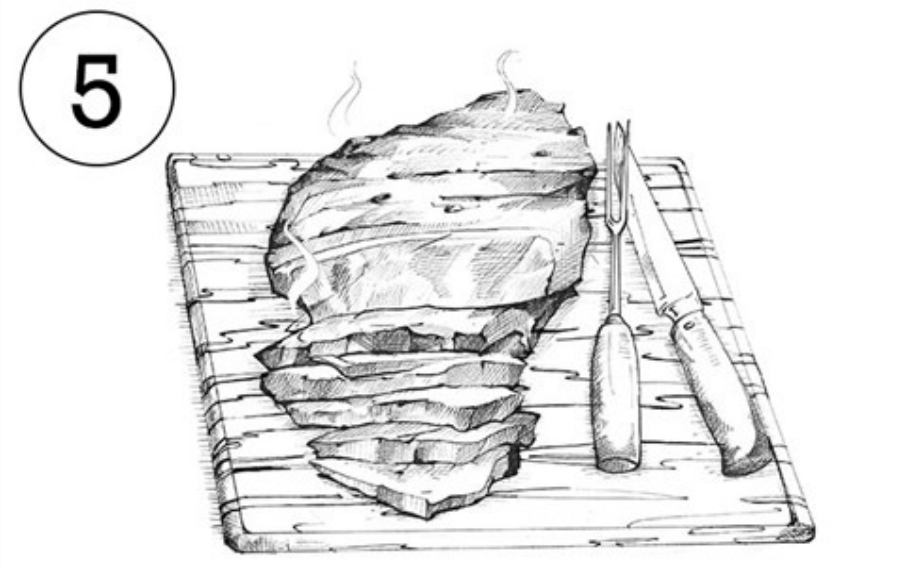
ARE WE DONE YET?

A couple minutes before you reach the recommended time, quickly check your steak for doneness. An instant-read thermometer is your best bet. Keep in mind the internal temperature of your steak will continue to rise for a few minutes after pulling it out of the oven.



GIVE IT A REST

Even though it's going to look delicious (and you're probably getting hungry), be sure to let the steak rest for at least five minutes before cutting into it. Set it on a serving plate and cover it loosely with aluminum foil. This step is essential because it helps keep your steak juicy, rather than having all those juices drain out onto your plate.



FINISHING TOUCHES

Be sure to slice your steak across the grain—that is, most steak cuts are longer than they are wide, so slice across the narrow part of the steak. Then top your broiled steak with a bit of compound butter or serve with your favorite sauce.

CUTS USED FOR BROILING:

GROUND BEEF

Versatility and rich flavor make it ideal for burgers, tacos or wraps. Perfect for breakfast, lunch and everything in-between.

T-BONE STEAK

Smaller than the Porterhouse, but delivers the same optimal tenderness and satisfying flavor – all in a lean package that's ready to be grilled or broiled.

TOP SIRLOIN STEAK

A flavorful cut that's versatile and juicy. Great served as a steak or cut into kabobs.

DENVER STEAK

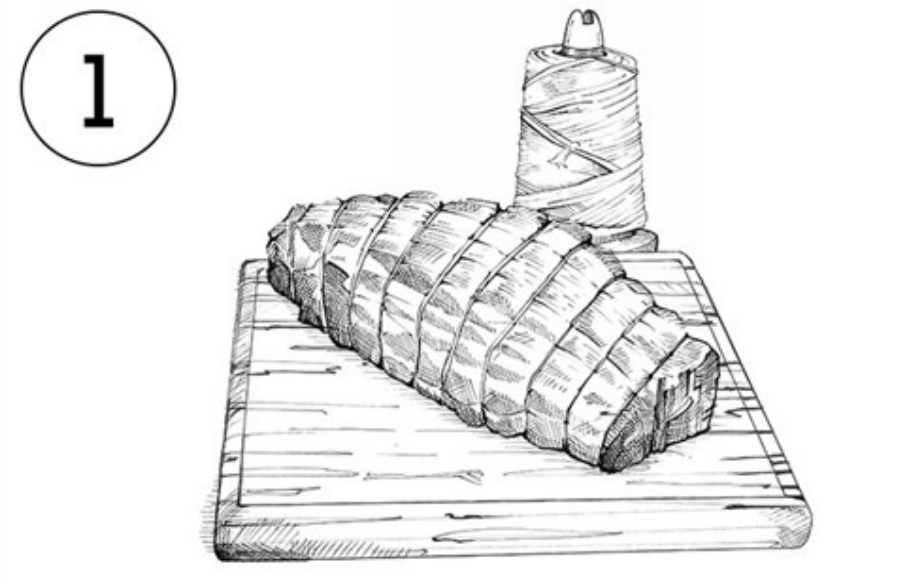
Cut from the center of the Under Blade, these steaks are extremely tender with a good amount of marbling and beef flavor. Best when cooked over high heat on the grill.

INDIRECT GRILLING BASICS

Indirect grilling requires little hands-on attention, but gives you maximum flavor. It's like slow cooking, but on the grill!

INDIRECT GRILLING BASICS

This technique is called indirect grilling which means indirect heat, lower temps and longer cooking times. Check out our indirect grilling guidelines for more cooking time information.

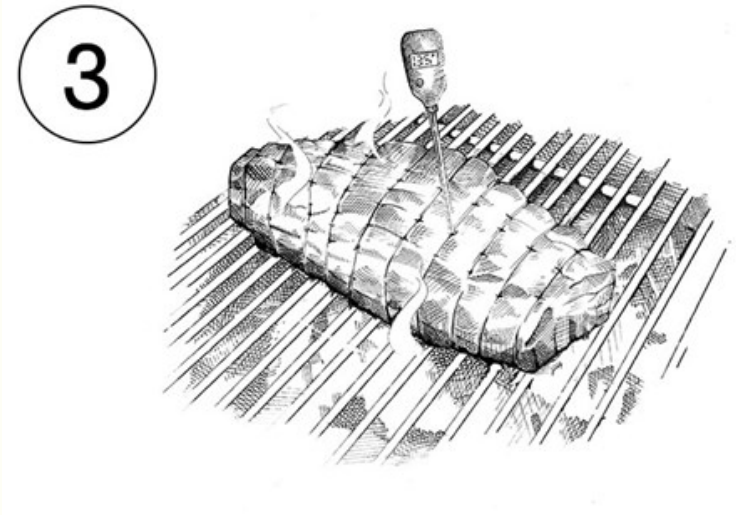


PREPARE THE BEEF

When you’re ready to get started, pull the beef out of the fridge and season well. Depending on your recipe, now’s the time to apply a rub, herbs or other spices.

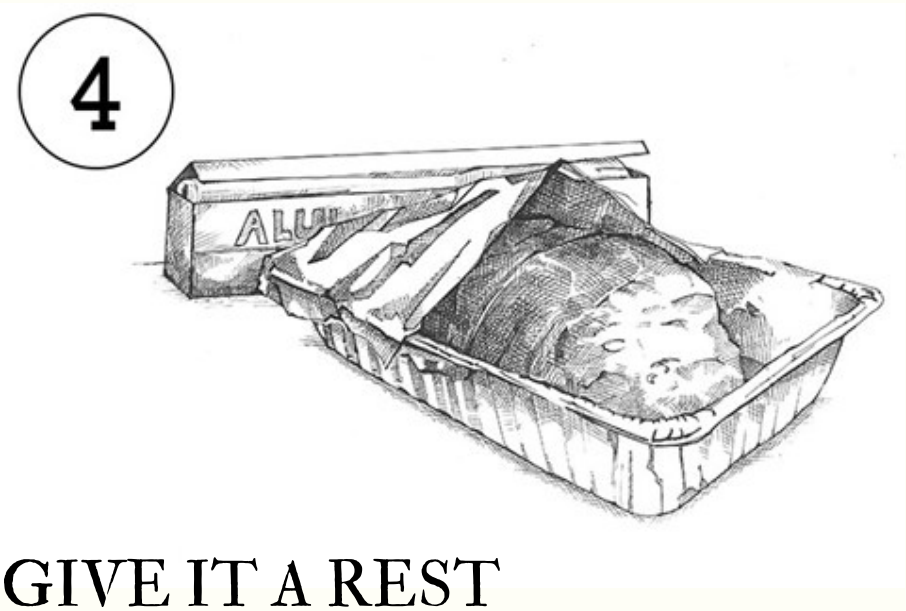
READY THE GRILL

Take a few minutes to configure your grill. As the name suggests, indirect grilling positions the beef away from the heat source instead of directly over it. If you're using charcoal, this means arranging the coals off to one side of the grill and cooking on the opposite side. If you're using gas, refer to your owner's manual and bring the grill to medium heat on one side only.



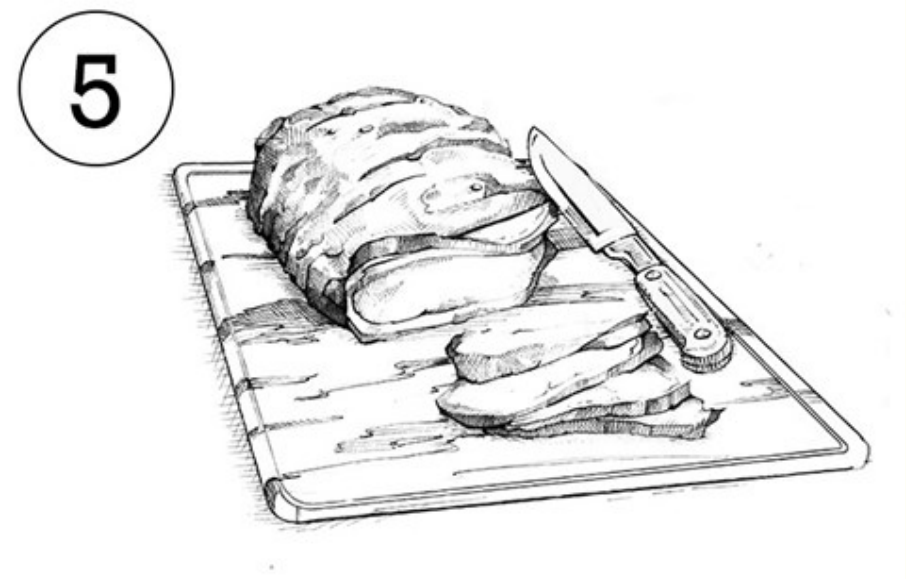
LET IT BE (MOSTLY)

Keep the lid closed for best results. You should follow your recipe for timing, but also may want to use an oven-proof meat thermometer to confirm when time's almost up. Be careful not to overshoot your target temperature because it will continue to rise for several minutes after coming off the grill. Larger roasts will take longer to cook using indirect grilling.



GIVE IT A REST

Don’t skip this step! Resting is essential to keep all those delicious juices from draining out of the meat, and makes the next step easier. The larger cuts that work best for indirect grilling generally need more time to rest—often up to 15–20 minutes. Set the meat on your cutting board or a serving tray and cover it loosely with aluminum foil (this is called “tenting”).



CARVE & SERVE

When you’re ready to carve, take care to not pierce the beef with a fork. Instead just use tongs to hold the roast in place. Depending on your recipe or desired presentation, slice the beef thinly across the grain and serve on a warm plate or tray.

CUTS USED FOR INDIRECT GRILLING:

SANTA FE STEAK

Steak cut from the thin, lean muscle that covers the Top Round. Can be used as an alternative to Skirt or Flank Steaks. Benefits from tenderization.

CHUCK FLAP/EDGE ROAST

Richly flavored and finely textured. Best for slow-cooking whole or grilling if very thinly sliced across the grain.

SIRLOIN BAVETTE/FLAP

A boneless cut with a hearty texture that’s a good source for fajita meat. Marinate and grill or broil.

CHUCK EYE STEAK (DELMONICO)

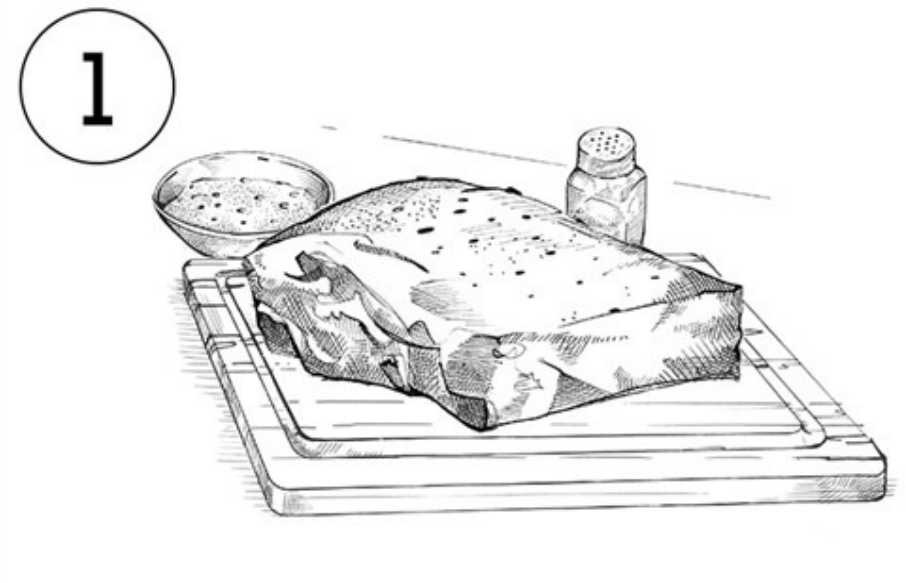
A low-cost alternative to the Rib Eye Steak. A tender and savory cut great for grilling.

PRESSURE COOKER BASICS

Rediscover how pressure cookers can deliver fork-tender results in a fraction of the time needed for braising or slow cooking.

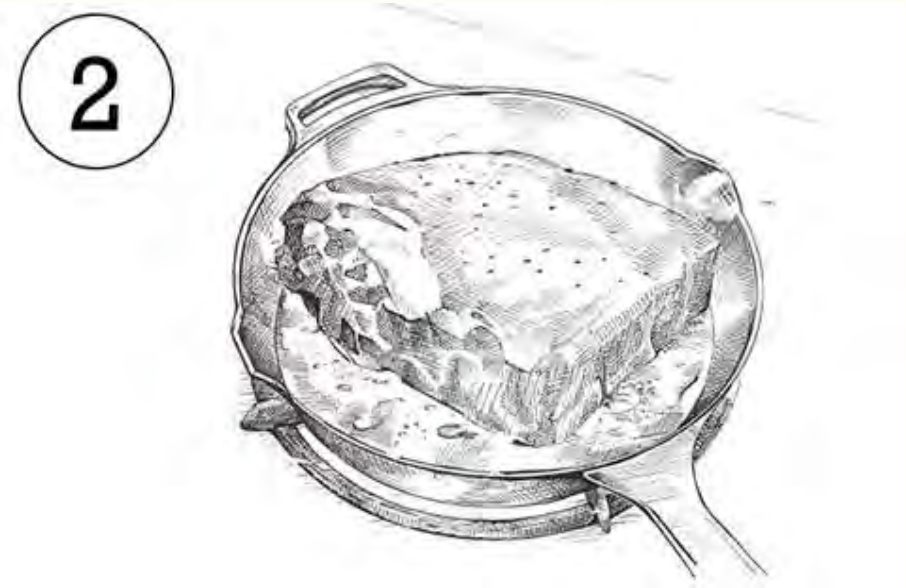
PRESSURE COOKER BASICS

Thanks to the popularity of new programmable electric models, busy home cooks are rediscovering how pressure cookers deliver fork-tender results in a fraction of the time needed for braising or slow-cooking. As always, carefully follow the manufacturer's recommendations for safe operation.



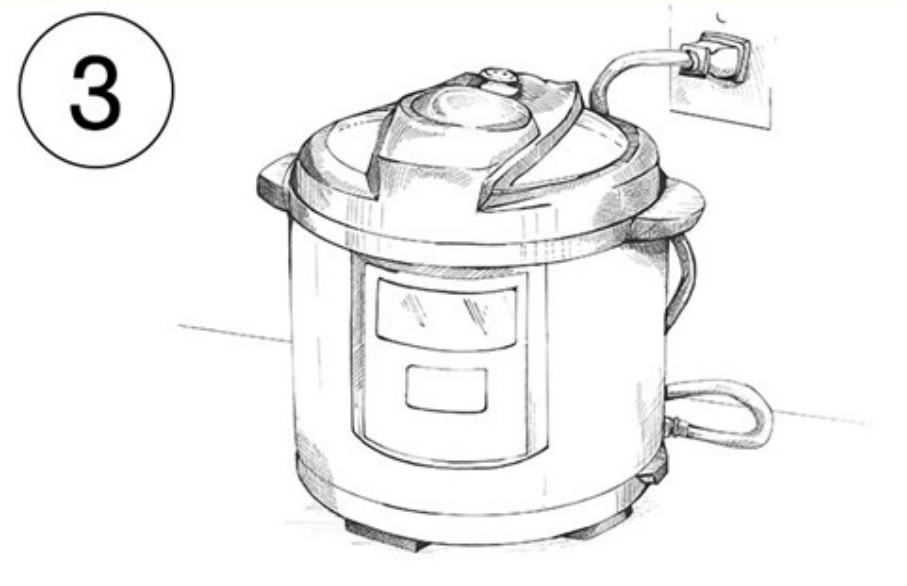
COVER THE BASICS

Double-check to make sure the gasket on your pressure cooker is clean and crack-free, and the vent tube isn't clogged. Remember that pressure cookers require a minimum amount of liquid and a maximum amount of food to function properly. Depending on the model and recipe, your pressure cooker may take up to 20 minutes to build up pressure.



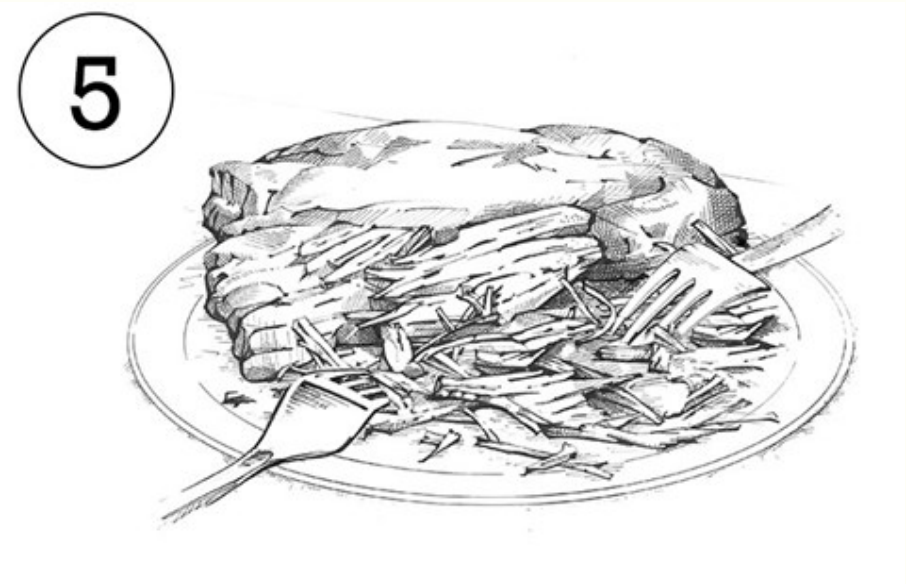
BROWN & DEGLAZE

Many modern pressure cookers have a "brown" setting, but you can always give your beef a quick sear on the stovetop. For extra flavor, add a small amount of liquid — such as beef broth, wine, juice or even water — to the hot pan and scrape up any crusty bits sticking to the bottom before transferring it to the pressure cooker.



SET & FORGET

Follow recipe guidelines and trust the timer. Keep in mind most pressure cookers include a safety feature that prevents the lid from being opened while the contents are under pressure.



SERVE & SAVOR

Many pressure cooker recipes are for one-pot meals that can go straight to the table, while some recipes make ingredients to be used in other recipes. Either way, when you follow the guidelines for preparation and safe operation, you're sure to get a great-tasting dish.

CUTS THAT USE PRESSURE COOKING:

CHUCK ROAST
Great, rich flavor perfect for slow and low cooking.

UNDER BLADE ROAST, CENTER-CUT
Extremely tender with a good amount of marbling and beef flavor. Season generously and roast for best results.

BLADE CHUCK ROAST
A relatively inexpensive cut with loads of beef flavor. Moist and tender when slow-cooked.

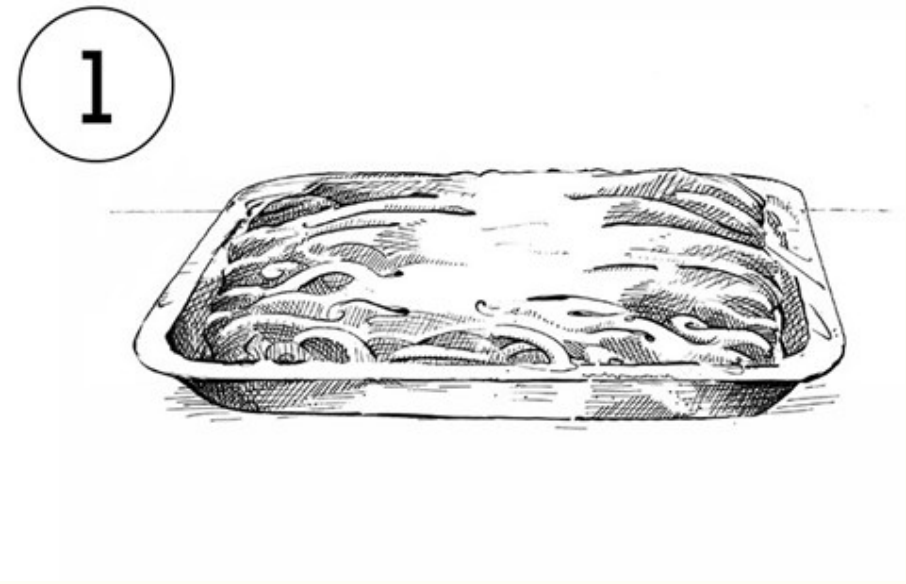
CHUCK ARM ROAST
Economical and flavorful. Best when slow-cooked.

SKILLET COOKING BASICS

With Skillet Cooking, you'll have an affordable, mouth-watering meal on the table the whole family will enjoy in just a matter of minutes.

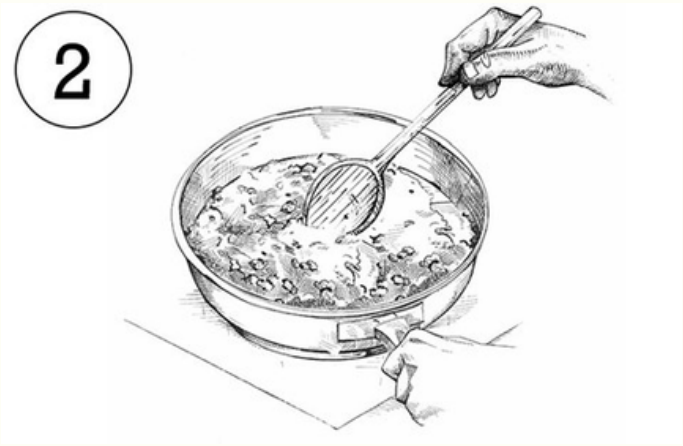
SKILLET COOKING BASICS

This is primarily a preparation technique for recipes that call for browned Ground Beef. But can also apply to cuts you might thinly slice before cooking — think Flank Steaks. Once the beef is cooked, it can go into a variety of recipes. Check out our skillet cooking chart for recommendations and guidelines



PREP & PREHEAT

Pull meat directly from fridge and heat a large, heavy-bottomed skillet over medium heat. It's important to have a large skillet so there's plenty of room for the beef to brown evenly. If your recipe calls for more than a couple pounds of Ground Beef, it's OK to cook in batches.



CRUMBLE & BROWN

Use a wooden spoon or potato masher to break the Ground Beef into crumbles as you're cooking. Stir lightly to ensure even cooking. Depending on your recipe, you may need to brown the meat only lightly, because it will continue to cook later on.

DRAIN

Most recipes call for the Ground Beef to be drained after browning. In extra-lean Ground Beef, there may not be much to drain at all.

SAVOR YOUR OPTIONS

Now's the time to put that delicious Ground Beef to good use in your favorite recipe. Looking for inspiration? Check out Confetti Beef Tacos, Mediterranean Beef and Salad Pita, Wrangler's Beef Chili and more.

CUTS USED FOR SKILLET COOKING:

STRIP STEAK, BONELESS

Tender, lean and perfect for grilling.

TENDERLOIN STEAK (FILET MIGNON)

This is the most tender steak, lean yet succulent, with a fine buttery texture. Sold boneless. This steak also meets government guidelines for lean.

CUBED STEAK

Pre-tenderized, this thin cut is a great value for everyday meals. Skillet cook for best results.

TOP ROUND STEAK, CAP OFF

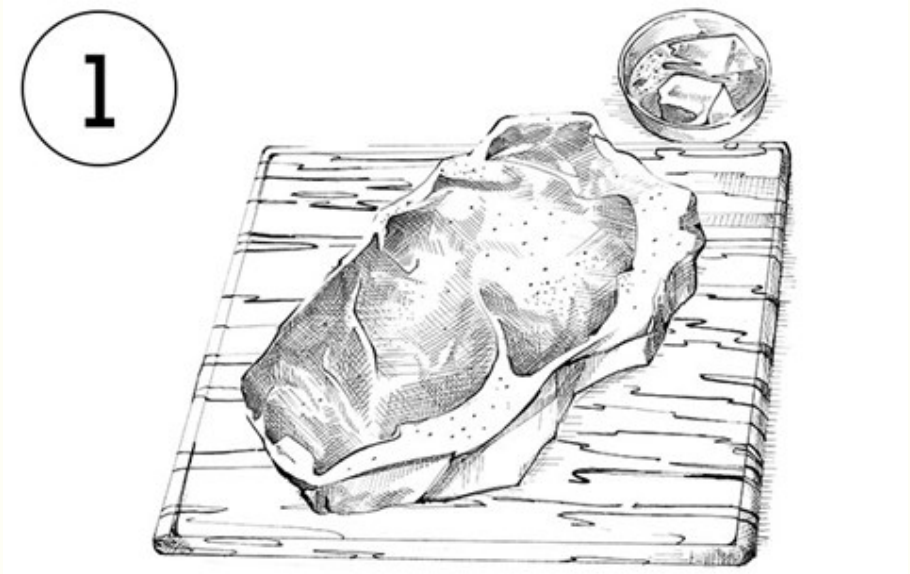
Thick and versatile weekday cut. Typically broiled or slow-cooked to bring out its best.

SKILLET-TO-OVEN BASICS

Skillet-to-oven cooking delivers perfect doneness and sealed in juices, making it worthy of an encore. Take a bow, and dinner is served.

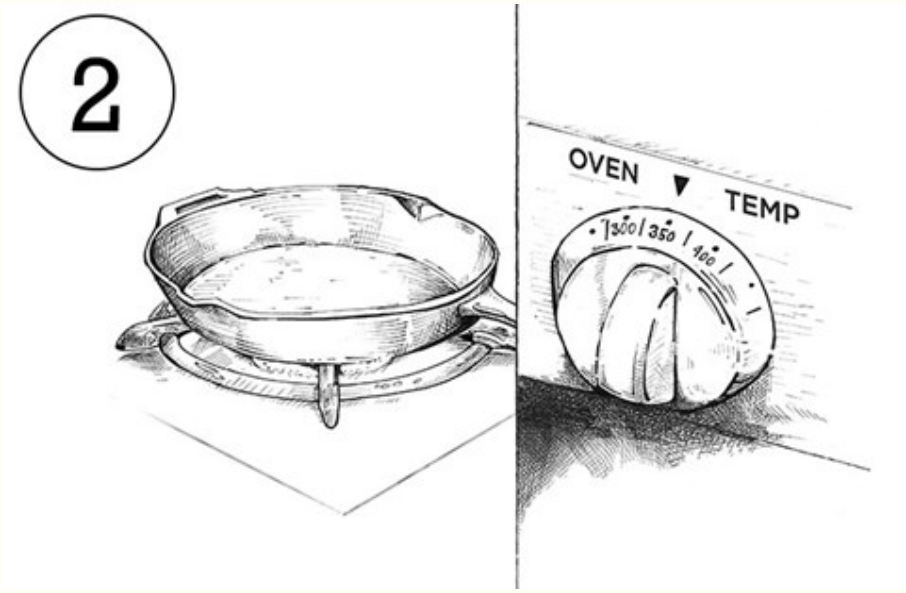
SKILLET-TO-OVEN BASICS

Simply put, this method involves searing beef on the stovetop and finishing it in the oven. It works best for thicker cuts, which need a bit more cooking time to bring up the internal temperature. Well-seasoned cast iron pans work best, but any ovenproof, non-stick skillet will do. See our skillet-to-oven cooking chart for recommendations and guidelines



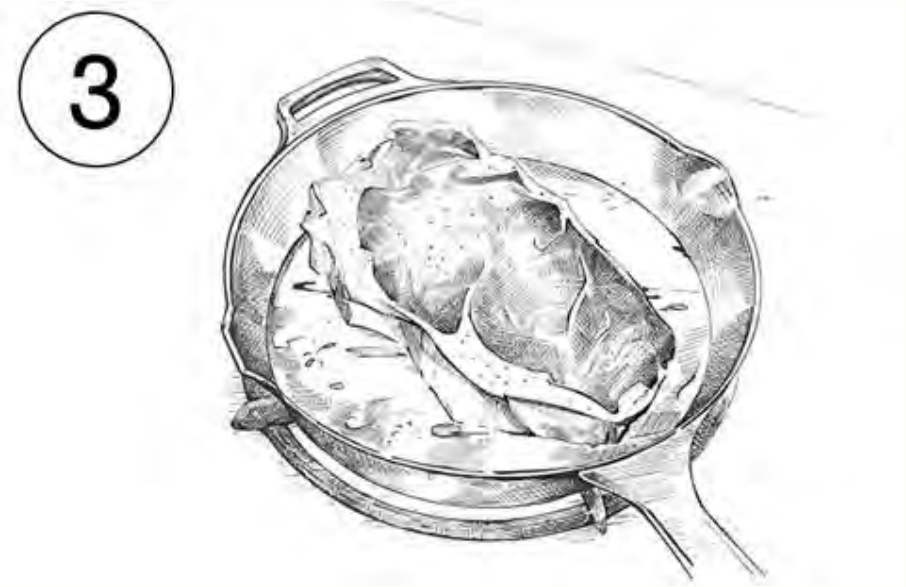
PREP THE BEEF

Some recipes suggest coating each steak lightly with oil (or adding oil to the pan before searing), but we've found the fat content in most steaks is enough to go without. It's healthier and results in less smoke, too. Pat the steaks dry, and if you're using a spice blend, rub it in now, or just hit both sides with a few shakes of salt and pepper.



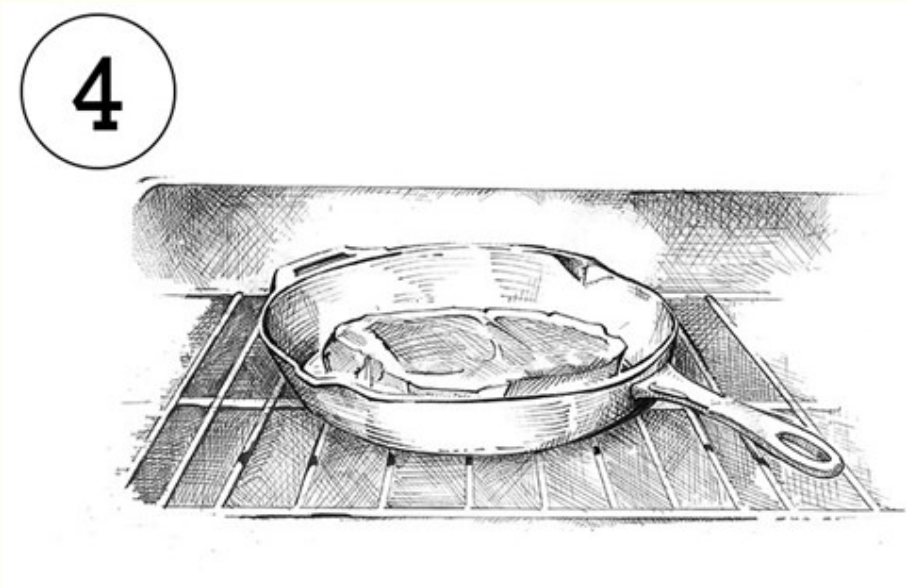
PREHEAT X 2

Preheat an ovenproof skillet over medium heat and the oven to 350ºF, depending on your recipe. It's important to get both ready to go — and have a timer handy — because the next couple of steps will go by quickly.



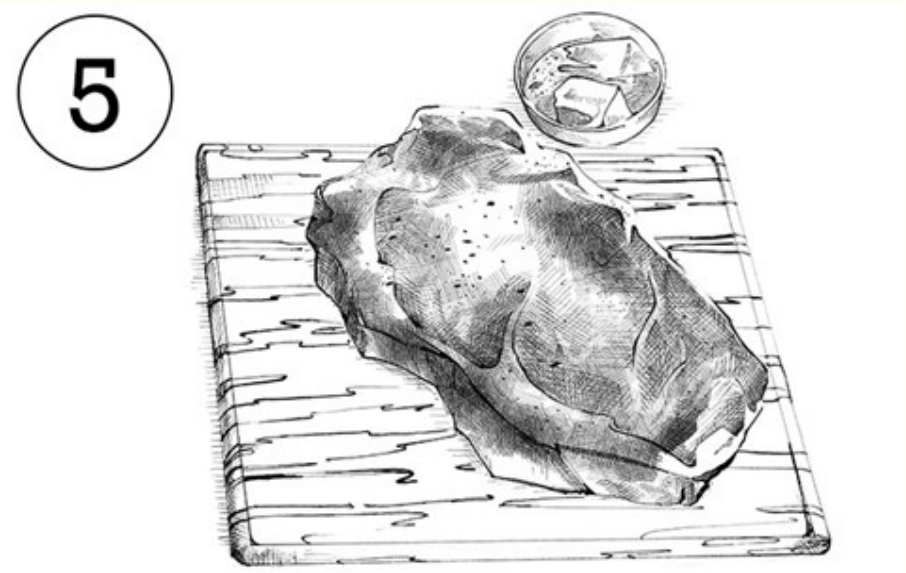
SEAR WITHOUT FEAR

Place your steak into the hot skillet and sear, no more than two minutes per side. The goal is to give it a rich brown color. Trust your timer and flip only once.



MOVE TO OVEN

Now that you have that sweet sear on the outside, it's time to bring up the internal temperature. Quickly flip the steak back over to the first side using tongs and slide the skillet into the preheated oven. Follow the timing guidelines and test for doneness with an instant-read thermometer. Be sure to pull the skillet as soon as the steak reaches your target temperature because it will continue to rise for a few minutes.



REST & ENJOY

Transfer the steak immediately from the skillet to a serving plate or cutting board and cover loosely with aluminum foil (this is called tenting). As always, resting time is essential. Give it at least 5–7 minutes, then top it off with some compound butter.

CUTS USED FOR SKILLET-TO-OVEN COOKING:

COWBOY STEAK
Tender, bone-in steak with a frenched rib presentation that is great for the grill.

TOMAHAWK STEAK
Tender bone-in steak from the Rib with a long bone and marbling that adds flavor. Simply season and grill.

STRIP STEAK, BONELESS
Tender, lean and perfect for grilling.

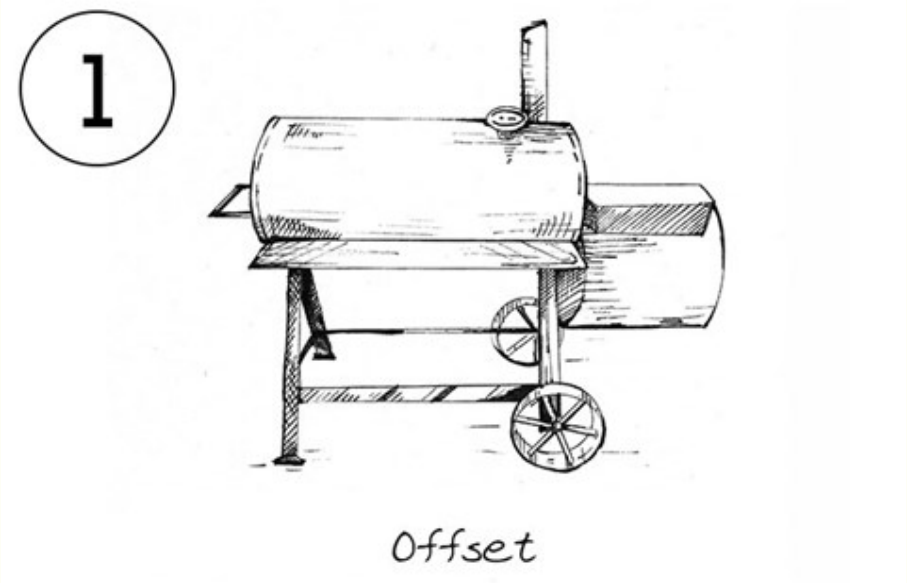
TOP SIRLOIN STEAK, CENTER CUT
This steak is cut from the cap off Top Sirloin Butt and is a tender and lean cut that is ideal for several cooking methods and dishes.

SMOKING BASICS

To many who appreciate the art of smoking meat, it's referred to as "barbecue," "bar-b-q," or just simply as "BBQ." But by any name, this timeless technique delivers richly-flavored, luxuriously tender results.

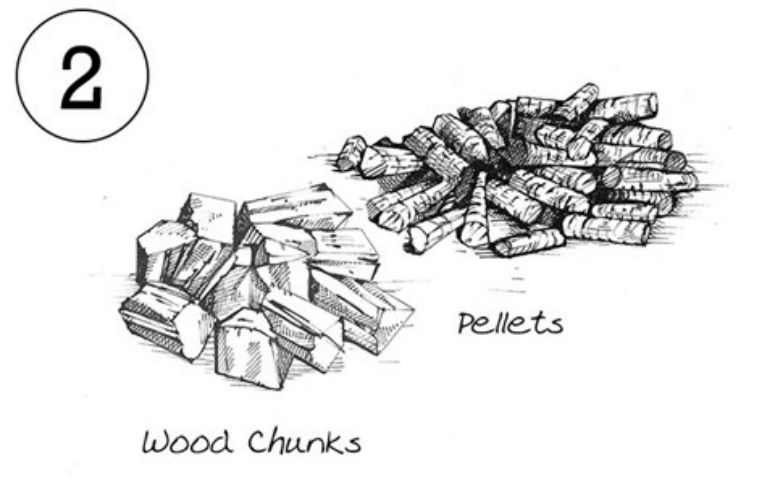
SMOKING BASICS

Large cuts such as Brisket, Roasts and Ribs are prime candidates for smoking, but even a Ground Beef burger can benefit from a hint of smoke. Whichever cuts you choose, always remember that time, patience and practice pay off — don't be afraid to tweak your technique to suit your tools and tastes.



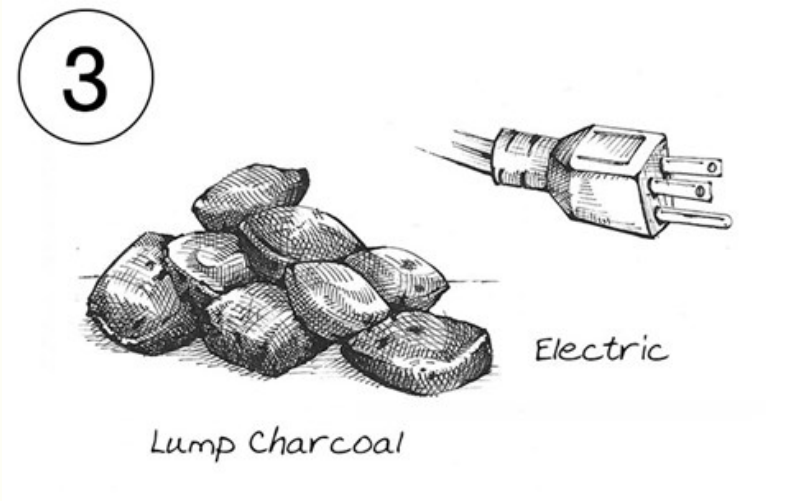
PREP THE SMOKER

Whether you're using a classic smoker, kamado (ceramic, typically egg-shaped) grill, traditional kettle grill or electric smoker, you're still applying the same basic elements: indirect heat, wood smoke and time. Follow the guidelines for your type of smoker, and if your smoker's heat source is directly below the meat, use a drip-pan to prevent flare-ups and avoid producing too much smoke, which can lead to bitter taste. Always work in an open, well-ventilated space.



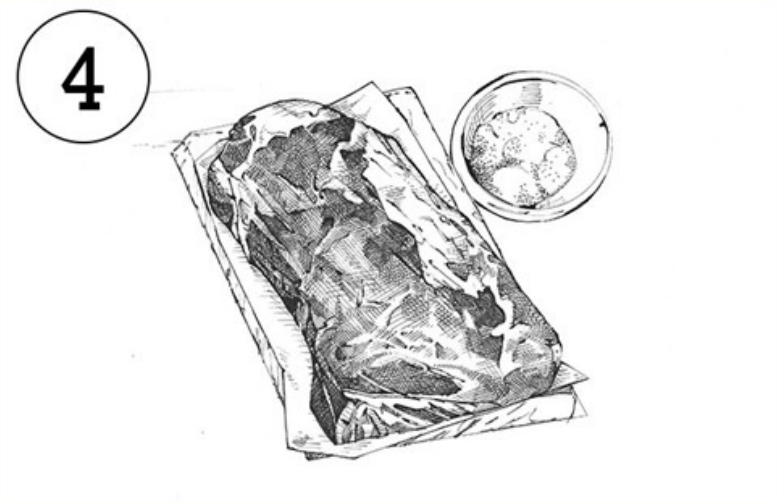
WHAT WOOD YOU DO?

With smoking, the wood itself is an essential part of any recipe. Different hardwoods produce different results, from the deeper smoky flavor of mesquite to the mild sweetness of apple wood to the versatility of hickory. Some aficionados say it's essential to soak hardwoods before smoking so they'll burn longer, while others believe soaked wood won't produce enough clean smoke. Likewise, wood may be smoked in logs, chunks, chips or pellets. Follow the guidelines for your recipe, but feel free to experiment.



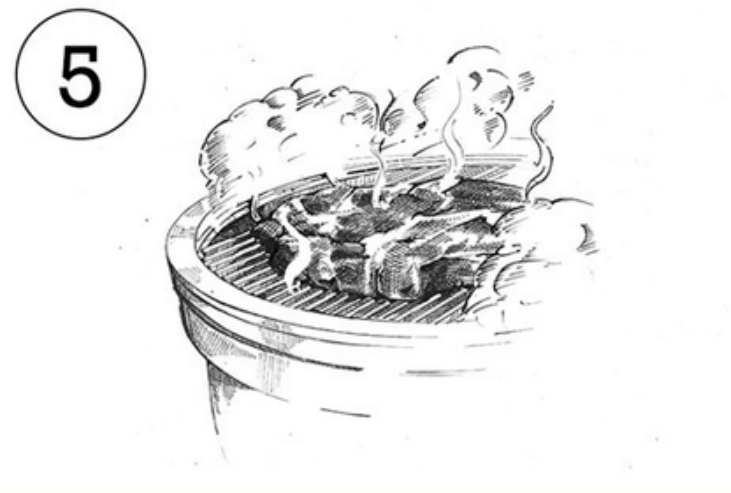
BRING THE HEAT

Just as there are many options to consider with both smokers and hardwoods, the heat source is also an important factor. Serious 'cuers swear by lump charcoal, which contains only burnt wood, burns hotter and longer, and produces a flavorful smoke. Briquettes are commonly used as well, and are particularly effective when employing the "snake" method, similar to a long-burning fuse. Other heat sources include propane gas and a simple flip of the switch, when using an electric smoker.



RUB IT UP

While most of the flavor will come from the smoke and beef, seasoning rubs can blend nicely with the natural flavor of the wood. Rubs can be wet or dry, spicy or sweet, bold or subtle, or just basic salt and pepper. Whichever you choose, keep in mind it's called a rub for a reason: Don't be afraid to get hands-on and work the rub into the surface of the meat to get the most flavor (and prevent it from falling off). Rubs can be applied just before you begin smoking or hours in advance and refrigerated until it's time to get started.



LOW AND (REAL) SLOW

Although a flavorful touch of smoke can be achieved in an hour or less, larger and less tender cuts will generally need to be smoked up to 12 hours or more. Specific times and temps depend on the cut and intended results, so refer to your recipe.

CUTS USED WITH SMOKING:

COULOTTE ROAST

With plenty of marbling, this is a juicy and savory roast. Best roasted in the oven or smoked slowly on the grill.

FLAT IRON STEAK

Extremely tender, well-marbled and flavorful and great for grilling. Cut from the Top Blade.

TRI-TIP ROAST

Boneless and fairly tender with full flavor. Roast or grill then slice across the grain.

CHUCK FLAP/EDGE ROAST

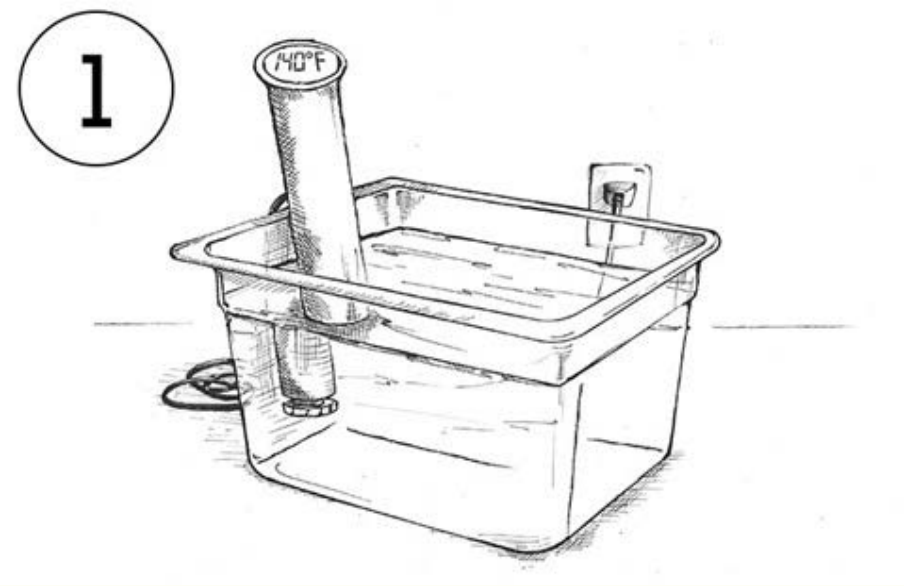
Richly flavored and finely textured. Best for slow-cooking whole or grilling if very thinly sliced across the grain.

SOUS VIDE BASICS

Once a high-end technique limited to professional kitchens, sous vide has grown in popularity among home chefs thanks to the availability of affordable water circulator wands.

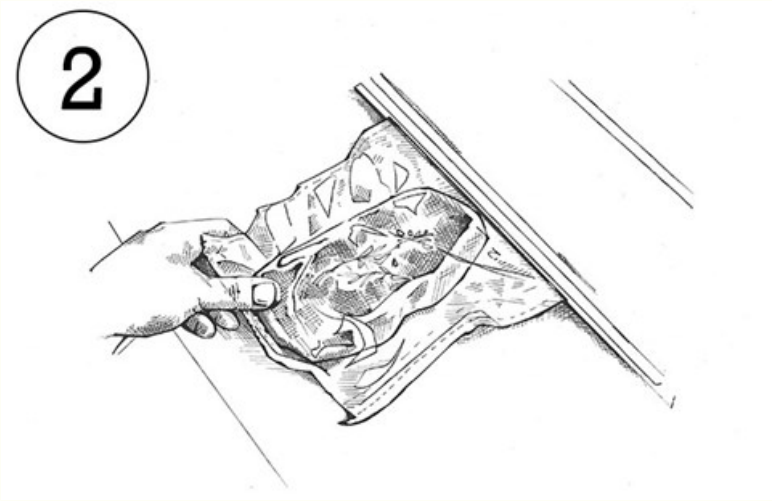
SOUS VIDE BASICS

What makes sous vide so appealing is the ability to cook beef (and most anything else) to a precise temperature over an extended period of time—minimizing the risk of over-cooking and resulting in exceptionally tender, juicy meat. Most beef cuts can be cooked sous vide, including larger, tougher cuts such as Short Ribs or Chuck Roast, but rich, well-marbled cuts such as Strip Steak also really benefit from this preparation.



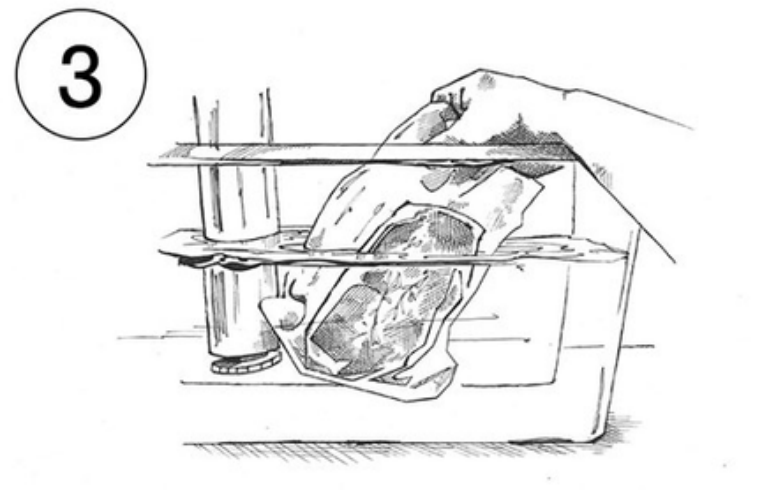
FILL & SET

Attach the wand to a large stock pot or other cooking vessel filled with water, following the manufacturer's instructions. Refer to your recipe for specific temperature settings, but be mindful of recommended minimum internal temps to ensure food safety. Depending on the cut of beef and the desired results, cooking times can range from about an hour up to 48 hours or even longer. Thicker cuts will take longer to cook.



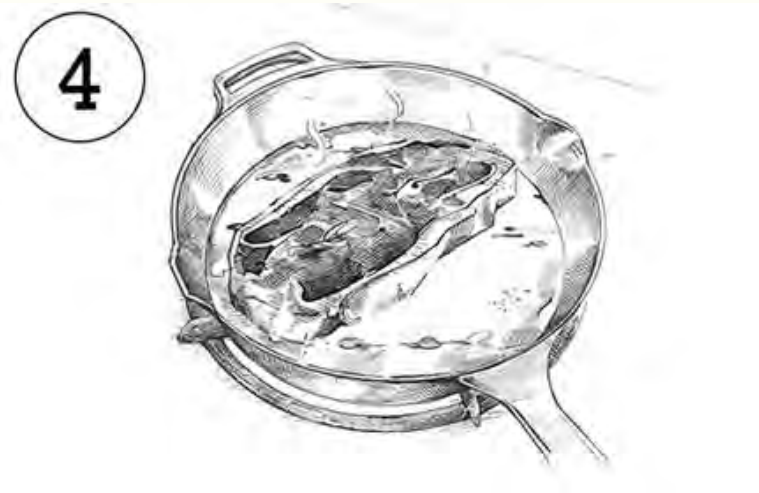
SEASON & SEAL

Season the meat according to your recipe - some call for including herbs, spices or a pat of butter - before sealing. This helps infuse flavors during the cooking process. We recommend using an automatic vacuum sealing unit and food-grade plastic bags designed specifically for sous vide cooking. If you do not have aces to this, you can also use food grade, sealable bags with the air squeezed out of them.



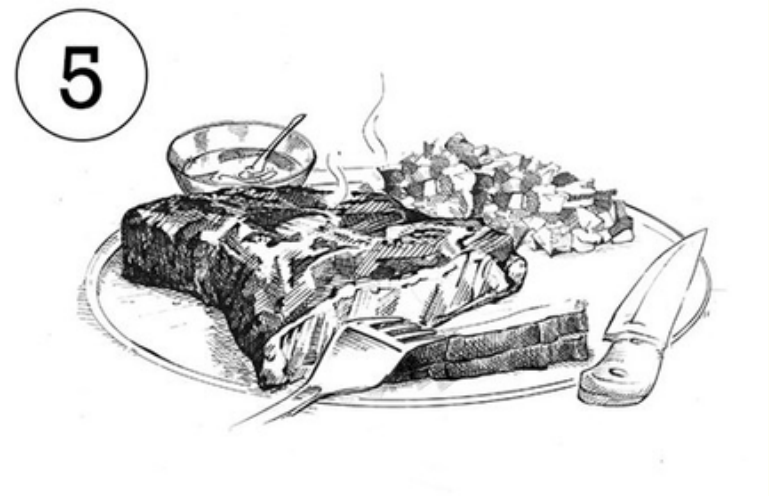
LET IT SOAK

This is where the magic happens. Slip the bag into the preheated water, taking care to avoid splashing. If you're cooking multiple portions in separate bags, it's important to not only avoid overcrowding the container, but also make sure all bags are completely submerged. Once in the bath, the beef will slowly rise to your target temp and stay there until it's time for finishing.



GIVE IT A SEAR

Some preparations can go straight from the bag to the dinner table, but steaks should get a quick sear before plating. Be sure to pat the meat dry with a paper towel to avoid spatters. It's hard to beat a hot cast iron skillet for searing, usually about a minute per side. Larger beef cuts, including roasts, benefit from a few minutes in a hot oven for finishing.



FINISH & SERVE

When cooking steak sous vide, there's no need to rest it before slicing. Be sure to slice across the grain to maximize tenderness. Depending on your recipe, give it another round of seasoning, top it with a compound butter, or serve with your favorite sauce.

CUTS USED WITH SOUS VIDE:

CHATEAUBRIAND TENDERLOIN ROAST

The most tender beef roast that is well known for being lean and succulent. Easy to carve with its fine texture.

TRI-TIP ROAST

Boneless and fairly tender with full flavor. Roast or grill then slice across the grain.

COULOTTE ROAST

With plenty of marbling, this is a juicy and savory roast. Best roasted in the oven or smoked slowly on the grill.

TOP SIRLOIN STEAK, CENTER CUT

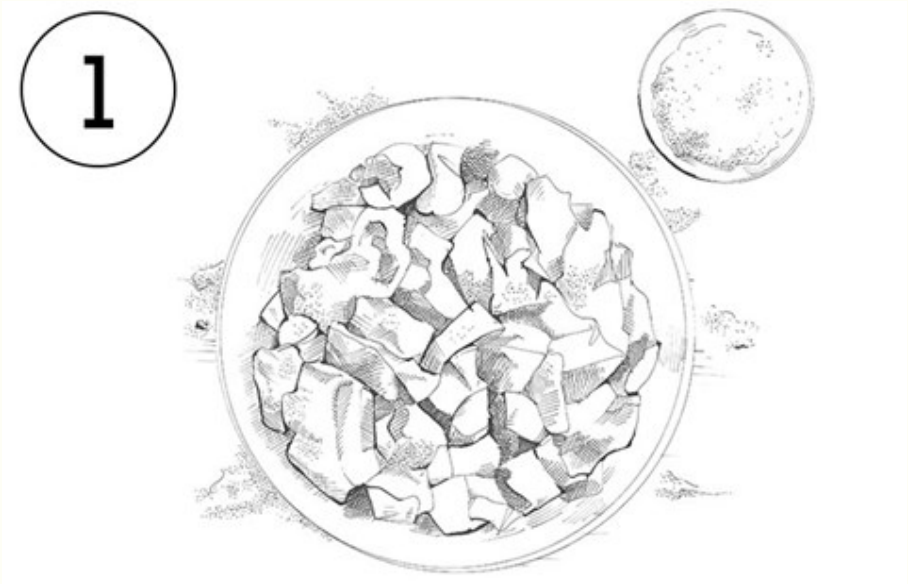
This steak is cut from the cap off Top Sirloin Butt and is a tender and lean cut that is ideal for several cooking methods and dishes.

STEWING BASICS

The best part about stewing is it does all the work for you. This comforting cooking method takes cubes of beef mixed with vegetables and other ingredients in enough liquid to cover them all to create a delicious, hearty meal.

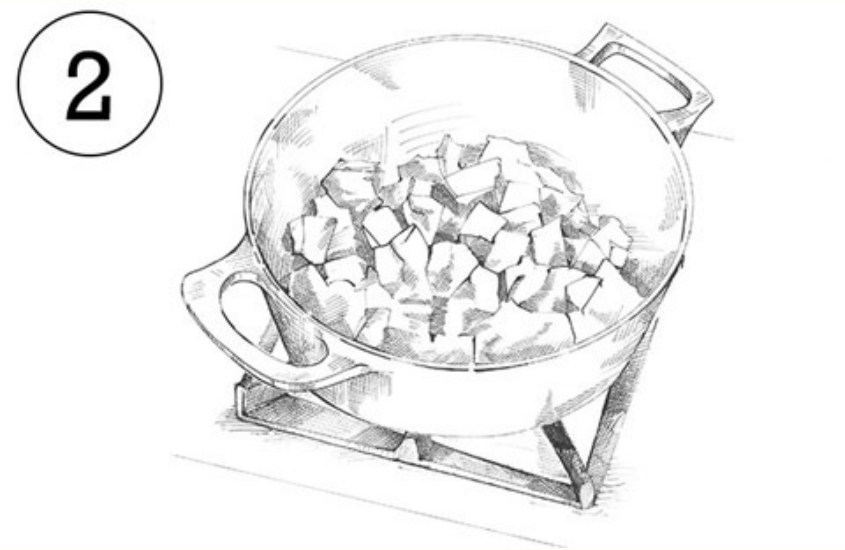
STEWING BASICS

This is a slow-cooking method, similar to braising, with the key difference being the beef is covered in liquid. Stewing is best done in a heavy stockpot or Dutch oven on the stovetop or in the oven, or in a slow-cooker.



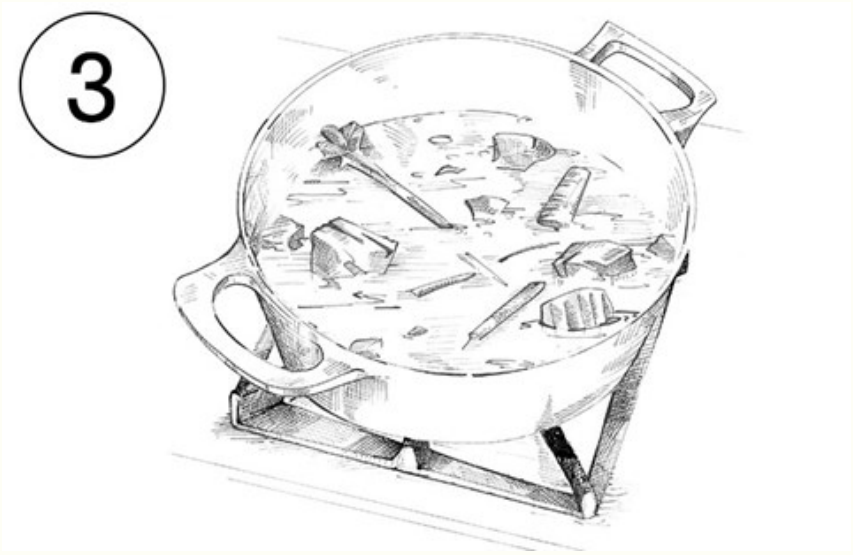
CUT & DREDGE

Whether you're using pre-packaged cubes or cutting your own, aim for cubes about 1-inch square. Many stew recipes call for dredging the beef in seasoned flour before browning.



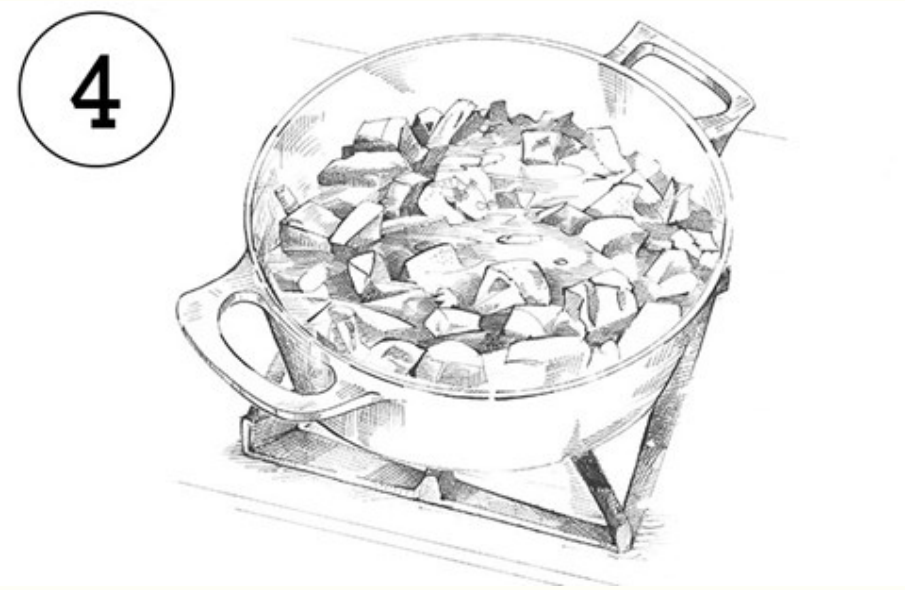
BROWN THE BEEF

Heat a drizzle of oil in the pan over medium heat and brown the meat on all sides, and drain (unless your recipe says to leave the drippings). You may need to work in batches if using a smaller pan. If you're using a slow cooker, transfer it over.



ALL TOGETHER NOW

Depending on your recipe, now's the time to add seasonings, vegetables and liquid — such as beef broth, wine, beer, juice or even water. Bring the liquid to a boil, then reduce heat to low and cover with a tight-fitting lid.



SIMMER & STEW

Follow your recipe for timing guidelines. Don't lift the lid — unless your recipe calls for adding vegetables or other ingredients later on. You'll know it's done when the beef is fork-tender.

CUTS USED FOR STEWING:

STEW MEAT

A full-flavored staple. Great for slow-cooking, chili and stews.

Introduction

A cow's diet directly affects the quality and quantity of the milk she produces. For example, a cow eating only grass can give about 50 glasses of milk per day, whereas a cow feed grass, corn, hay, and mixed feed can produce around 100 glasses of milk per day.

Cows eat around 90 pounds of nutritious food per day, the equivalent of 210 baked potatoes! They also need 25- 50 gallons of water a day- nearly a bathtub full!

While one person could milk 8 cows in an hour by hand, a dairy with 14 machines could milk 60 cows in the same amount of time.

One cow will produce about 200,000 glasses of milk in her lifetime. Cow's milk actually has 2 parts, milk and cream. This cream part of the milk comes during the last part of milking. If you let the milk sit for a time, it will separate. Because the cream is lighter, it will float to the top. This cream is actually used to make butter.

In addition to butter and cream, popular food products like cheese, ice cream, yogurt, whipped cream, and cottage cheese are all made from milk- as are many other delicious food and drink products.

Nutrition

Milk contains 9 nutrients that your body needs to grow and stay healthy.

These include:

- *Niacin-* for healthy metabolism.
- *Protein-* to increase energy; to build and repair muscles.
- *Calcium-* to build strong bones and teeth.
- *Riboflavin-* to increase energy.
- *Vitamin A-* for healthy eyes and skin.
- *Vitamin D-* for strong bones.
- *Vitamin B-12-* to build red blood cells; to strengthen lungs and muscles.
- *Phosphorus-* to increase energy; to build strong bones.
- *Potassium-* for healthy blood pressure and muscles.

Safety & Quality

The milking process happens 2-3 times daily to collect milk and provide the proper milking schedule for the cows' needs. First, the cows' udders are cleaned with iodine (or similar sanitizing product), then the udders are inserted into a milking machine. This machine uses pulsations to collect the cow's milk.

This process is done for about 15 minutes and reaches temperatures of about 100F. Milk then flows through refrigerated pipes and into a bulk tank which is sanitized for proper health standards and quality assurance. The milk is cooled in this tank to 36-38F and then taken to the processing plant to be pasteurized and homogenized. The process of pasteurization kills harmful bacteria by heating raw milk to 161.5F for 15 seconds then cooling it immediately.

Homogenization then breaks down the fat molecules so that they stay integrated instead of separating as cream. The entire process from milking to store delivery typically takes 2 days.

Economics

Texas Dairy industry boosts local, state, and national economies. The purchasing of machinery, trucks, fuel, and other equipment; feed and healthcare for animals; and the use of services like banking and insurance generate jobs and income. Even after the milk leaves the farm, it continues creating jobs and revenue in transportation, distribution, processing, and retail markets.

How does dairy "feed" the economy?

- *253,000 jobs* (direct and indirect) with *$12.7 billion* in wages.
- *351 Grade A dairies* with an estimated *586,395 cows* produce over *15.6 billion pounds of milk* (over 1.7 billion gallons) in 2020.
- The average herd has about *1,500 cows*, each producing on average about *2,900 gallons* of milk per year.
- Texas milk production and milk output both rank *fifth nationally*.
- Dairy delivers a *$50.3 billion* total state economic impact (direct and indirect).
- Dairy contributes *$1.6 billion* in state taxes in Texas.

Economics (cont.)

- In 2019, dairy brought in more than *$2.4 billion* in total cash receipts, with *$1.8 billion* in total contribution to Texas's gross product (*2.8%* of GDP).
- In 2018, milk produced valued almost *$2 billion,* almost *7.9%* of total Texas agriculture commodity production.
- Texas dairy exports total *$486.2 million.*

BREEDS OF COWS

There are over nine million cows in the United States today and about 90 percent of these are Holsteins.There are seven major breeds.

VITAL STATISTICS
OF A HOLSTEIN MILK COW

GENDER: Female

HEIGHT: 5 TO 5½ Feet

WEIGHT: 1,500 TO 1,800 lbs.

BODY TEMPERATURE: 101° F

AMOUNT OF MILK HELD IN UDDER: 25 to 50 lbs.

HOLSTEINS (BLACK & WHITE)

- Originated in Europe and brought to U.S. by Dutch settlers
- Know for highest milk production of all breeds
- The Holstein is the dominant dairy breed in U.S.

RED & WHITE HOLSTEIN

- Originated in U.S. and Canada when farmers started selecting for recessive red hair color trait
- Most recently recognized into breed family in 1964

JERSEYS (YELLOWISH-BROWN)

- Originated on the island of Jersey, 15 miles off the coast of France
- Produce more butterfat in their milk than any other breed

GUERNSEY (GOLDEN TAN & WHITE)

- Originated on an island in the English Channel, 30 miles off the coast of France
- Known to be hearty and adaptable

BROWN SWISS (BROWNISH GRAY)

- Originated in the Alps Mountains
- They are hearty and rugged, with superior feet and legs
- Known to be quiet and docile

AYRSHIRE (WHITE WITH RED SPOTS)

- Originated in Scotland
- Known for their vigor and efficiency of milk production

MILKING SHORTHORN (ROAN)

- Originated in England
- Known to be very versatile

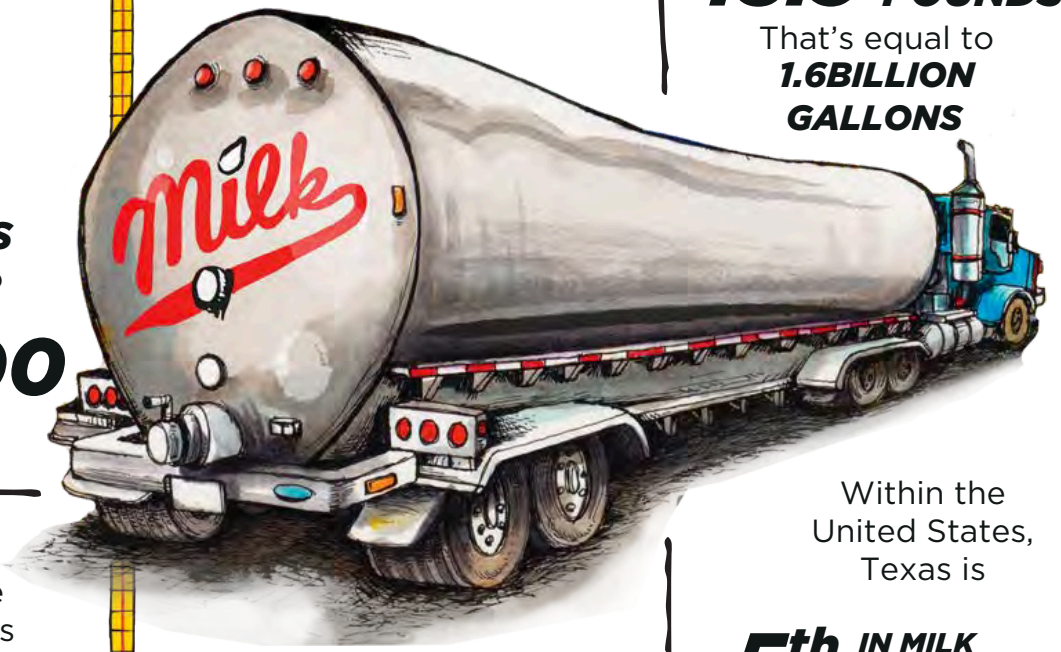
TEXAS DAIRY FACTS

Texas has approximately **380 DAIRY FARMS** that are home to approximately **565 ,000 MILK COWS**

The average herd size of those Texas dairy farms is approximately **1,487 MILKING COWS**

Which places Texas **5TH IN NUMBER OF MILK COWS**

There are **56DAIRY PROCESSING PLANTS** throughout the state of Texas



Each dairy cow in Texas provides an average of **2,861 GALLONS OFMILKPER YEAR**

That's equal to **7.84GALLONSPERDAY**

The total amountof milk producedin Texas is about **13.9 BILLION POUNDS**

That's equal to **1.6BILLION GALLONS**

Within the United States, Texas is

5th IN MILK PRODUCTION

5th INMILK OUTPUT PER COW

In 2019, the cost of a Texas dairy cow was about **$1,325**

The average value of the milk a Texas dairy cow produces in one day is about **$11.95**

Cash receipts for the sale of milk by dairy farmers amounted to **$2.2 BILLION**

In 2019, Texas dairy exports totaled **$321 MILLION**

All facts are based on 2019 USDA data.

Brought to you by the **dairy farm families of Texas.**

LEARN MORE AT DAIRYMAX.ORG

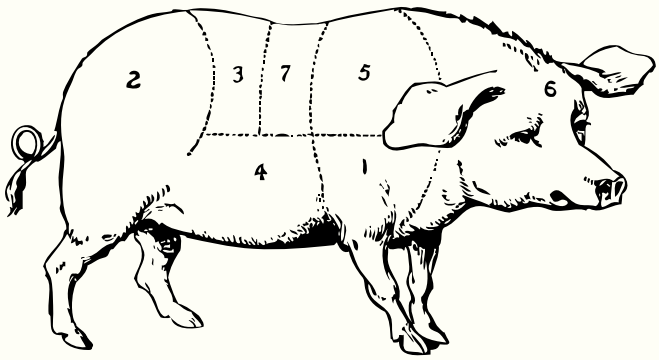
Dairy MAX YOUR Local Dairy Council

Pork

Nutrition

Pork has many beneficial qualities that make it easy to incorporate into a balanced menu. The variety of options range from decadent and flavorful to lean and nutrient rich cuts that are affordable, easy to make, and enjoyable to people of all ages.

Both pork tenderloin and pork sirloin roast meet the critetia for the American Heart Association's Heart Checkmark, which means they contain less than 5 grams of fat, less than 2 grams of unsaturated fats, and 480 milligrams or less of sodium per label serving. Pork is packed full of protein, making it easy to include in a health-forward, balanced diet.



Following are the key nutrients in pork with the percent of daily value (DV) provided by pork of a 3-ounce serving, followed by cuts and cooking methods.

6% Iron

Iron is a mineral we need for growth and development. Our body uses it to make hemoglobin, which is a protein in red blood cells that carries oxygen from the lungs throughout the body, and myoglobin, a protein that provides oxygen to muscles. Your body also uses iron in hormone production. Iron in food comes in two forms: heme iron and nonheme iron. Meat like pork, seafood, and poultry have both heme and nonheme iron.

34% Niacin

Important for the normal function of many enzymes in the body and involved in the metabolism of sugars and fatty acids.

6% Potassium

This mineral, also known as an electrolyte, plays a major role in water balance and helps maintain normal blood pressure. This is considered a nutrient of public health concern.

50% Thiamin

Without this key vitamin, metabolism of carbohydrates, protein, and fat would be significantly compromised. Animal protein is one of the best sources of this nutrient, and among the choices, pork is tops.

25% Vitamin B12

Helps build red blood cells and metabolize carbohydrates and fats.

6% Magnesium

Important for the normal function of many enzymes (catalysts for the body's chemical reactors), glucose and muscle action.

15% Phosphorus

Strengthens bones and generates energy in cells.

20% Riboflavin

Next to milk, few foods have as much riboflavin per serving as pork. Riboflavin has an important role in the release of energy from foods.

25% Zinc

A component of more than 70 enzymes, zinc is a key player in energy metabolism and the immune system.

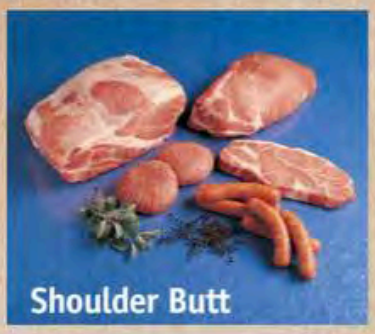
30% Vitamin B6

Important for the normal function of enzymes and co-enzymes, which are needed to metabolize protein, carbohydrates, and fats. Plus, it plays a critical role in the regulation of glycogen (stored carbohydrates) metabolism.

46% Protein

Pork Basics

pork Be inspired



Upper row (l-r):
Bone-in Blade Roast,
Boneless Blade Roast

Lower row (l-r):
Ground Pork,
Sausage, Blade Steak

Upper row (l-r):
Smoked Picnic,
Arm Picnic Roast

Lower row:
Smoked Hocks

Top:
Spareribs

Bottom:
Slab Bacon, Sliced Bacon

Upper row (l-r):
Bone-in Fresh Ham,
Smoked Ham

Lower row (l-r):
Leg Cutlets, Fresh
Boneless Ham Roast

Loin

Left: Tenderloin
Right: Canadian-Style Bacon

Left: Country-Style Ribs
Right: Back Ribs

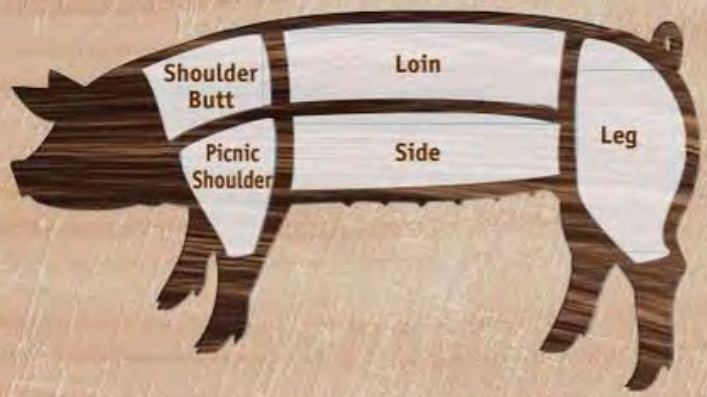
Upper row (l-r):
Center Rib Roast (Rack of Pork),
Bone-in Sirloin Roast

Middle:
Boneless Center Loin Roast

Lower row (l-r):
Boneless Rib End Roast,
Boneless Sirloin Roast

Upper row (l-r):
Sirloin Chop, Rib Chop,
Loin Chop

Lower row (l-r):
Boneless Rib End Chop,
Boneless Center Loin Chop,
Butterfly Chop



THE MANY SHAPES OF PORK ROASTS

Cut Loose!

When shopping for pork, consider cutting traditional roasts into a variety of different shapes

CHOPS: Dinner, backyard barbecue or gourmet entree

CUBES: Great for kabobs, stew & chili

STRIPS: Super stir fry, fajitas & salads

CUTLETS: Delicious breakfast chops & quick sandwiches

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Pork

Braising

Braising Basics

1. Season meat, if desired.
2. In a large, heavy skillet with a lid, brown meat on all sides in a small amount of oil; remove excess drippings from pan.
3. Add a small amount of liquid and cover pan tightly.
4. Simmer over low heat on the stove or in a low to moderate (275°F to 300°F) oven.

Recommended Cuts

Blade Steak / Pork Steak	¾ inch thick	11-12 minutes
Cutlets	½ inch thick	3-4 minutes
Shoulder / Boston Butt	3-6 lbs.	2-2 ½ hours
Chops, boneless	¾ inch thick	6-10 minutes
Chops, bone-in	¾ inch thick	8-12 minutes
Tenderloin Medallions	½ inch thick	8-10 minutes

Cooking Tips

Not crowding your pan will allow moisture to escape during the browning process and give you a properly browned item. For successful browning, foods must be dry and free of moisture or steaming not browning will result.

Broiling

Broiling Basics

1. Place pork on preheated broiler pan so it is three to five inches from the heat source.
2. Broil until the pork is brown on one side; turn and broil the other side until brown.
3. Season as desired.

Recommended Cuts

Chops	Approx. ¾ - 1 ½ inches thick	8-12 minutes
Kabobs	Approx. 1 inch cubes	8-10 minutes
Ground Pork Patties	Approx. ½ inch thick	8-12 minutes
Tenderloin	Approx. 1 - 1 ½ lbs.	20-30 minutes

Cooking Tips

For cuts of pork 1 ½ inches thick, broil three to four inches from the heat. For cuts more than 1 ½ inches thick, broil four to five inches from the heat.

Pork

Grilling/Barbecueing

Grilling / Barbecuing Basics

Grilling is the method of cooking pork over direct or indirect heat on an electric, gas or charcoal grill.

Barbecuing is a method of slowly cooking pork in an open pit or on a pit using coals, hardwoods, gas or electricity as a heat source. The same effect can also be achieved using a grill by placing the pork on the rack away from the heat source. The food is frequently based with a tangy tomato- or vinegar- based sauce.

Recommended Cuts

New York (Top Loin) Pork Roast	3-5 lbs.	12 - 15 minutes per lbs.
Ribeye (Center Rib) Pork Roast	3-5 lbs.	14-17 minutes per lbs.
Ground Pork Patties	Approx. ½ inch thick	8-12 minutes
Pork Back Ribs	1 ½ - 2 lbs. per rack	1 ½ -2 hours
Shoulder / Boston Butt	Approx. 3-5 lbs.	2 ½ - 4 hours
Spareribs	3 ½ - 4 lbs. per rack	1 ½ - 2 hours
Country Style Ribs	3-4 lbs.	45 minutes - 1 hr.

Cooking Tips

To prevent the meat from sticking, use clean racks and coat them with vegetable oil or a nonstick vegetable oil spray.

Do not use sharp utensils that may pierce the meat when trying to turn it because piercing allows valuable juices to escape. Use other utensils, such as wooden spoons and spatulas for turning the meat.

Roast

Roast Basics

Roasting, very similar to baking, is a method of cooking pork in the oven in a shallow, uncovered pan, and without adding liquid to the pan.

Any cut of pork can be roasted, and should be roasted at 350°F unless otherwise noted.

Recommended Cuts

Ham	Approx. 5-6 lbs.	20 minutes per lbs.
Loin Roast, Bone-In or Boneless	Approx. 2-5 lbs.	20 minutes per lbs.
Shoulder	Approx. 3-6 lbs.	45 minutes per lbs.

Cooking Tips

Using the drippings from the roasted meat will provide great flavor when making a stock, gravy or sauce.

When placing a thermometer in the meat to check for doneness, be sure that the stem of it is not touching a bone because this can result in a false reading.

Do not use sharp utensils that may pierce the meat when trying to turn it because piercing allows valuable juices to escape. Use other utensils, such as wooden spoons and spatulas for turning the meat.

A roast with a bone in it will cook faster than a boneless roast because the bone will conduct heat faster than the meat.

Pork

Sauteing

Sauteing Basics

1. Heat a small amount of oil in a large heavy skillet over a medium-high heat.
2. Place pork in skillet; do not cover.
3. Cook pork uncovered, turning occasionally. For stir-frying, cook over high heat, stirring constantly.

Recommended Cuts

Ribeye (Rib) Pork Chop	¾ inch thick	8-12 minutes
Blade Pork Steak	¾ inch thick	10-16 minutes
Cutlets	½ inch thick	3-4 minutes
Ground Pork Patties	½ inch thick	8-11 minutes
Tenderloin Medallions	¼ - ½ inch thick	4-8 minutes

Cooking Tips

Use tongs or a spatula instead of a fork when placing pieces in the pan or when turning. Piercing meat with a fork allows juices to escape.

Stewing

Stewing Basics

1. Coat meat lightly with seasoned flour, if desired.
2. In a large, heavy pan with a lid, brown meat on all sides in a small amount of oil; remove excess drippings from the pan.
3. Cover meat with desired liquid(s).
4. Cover pan and simmer over low heat on stove or in a low to moderate (275°F to 300°F) oven for 1-3 hours, until tender.
5. If adding vegetables, add towards the end of cooking time, during the last 20 to 45 minutes.

Recommended Cuts

Cubed and Sliced Loin or Shoulder	1 inch thick	45 minutes - 1 hour

Cooking Tips

Leftovers? They're even better reheated tomorrow.
Prepare dinner in the slow cooker and it's ready when you are!

Pork

The safe internal pork cooking temperature is 145˚F followed by a 3 minute rest.

Cooking Temperature of Pork

Finding the correct pork cooking temperature is the final step in plating a perfectly juicy, tender cut of meat. Pork today is very lean, making it important to not overcook and follow the recommended pork cooking temperature. The safe internal pork cooking temperature for fresh cuts is 145° F. To check doneness properly, use a digital cooking thermometer.

Fresh cut muscle meats such as pork chops, pork roasts, pork loin, and tenderloin should measure 145° F, ensuring the maximum amount of flavor. Ground pork should always be cooked to 160° F. Doneness for some pork cuts, such as small cuts that are difficult to test with a thermometer or large cuts that cook slowly at low temperatures, is designated as “tender.” Fully cooked ham can be reheated to 140° F or even enjoyed cold, while fresh ham should be cooked to 145° F followed by a 3-minute rest.

Following these pork cooking temperature guidelines will not only result in a safe eating experience but also preserve the quality of your meat for a juicy, tender, delicious meal.

National Pork Board

Medium-Rare 145-150°F | **Medium** 150-155°F | **Medium-Well** 155-160°F | **Well** 160°F

Pork

Using a meat thermometer is the best way to test for doneness, ensuring both a safe and delicious eating experience.

What is the final cooking temperature of pork?

Cut	Temperature
Pork Loin Pork Tenderloin Pork Chop	145°F - 160°F
Precooked Ham	140°F
Ribs Pork Shoulder Cutlets	Tender
Ground Pork	160°F

How to Temp Pork

There are two types of meat thermometers: digital and analog. Either one will work, however the digital meat thermometer will give you the most accurate results.

When you measure the internal temperature, measure at the thickest part of the meat and away from the bone. If the cut is thinner than ¾ test through the side.

Check the temperature while still in or on the heat source or immediately after removing.

After temping meat, let it rest at least 3 minutes for juices to properly distribute for maximum flavor.

Buying, Handling, and Storing Pork

Properly storing pork will cut down on waste, help ensure safety, and make food prep easier!

Buying Pork

Finding the right cut, amount, and quality of pork depends on your meal needs.

- Pork that is a pinkish-red color will provide a better eating experience.
- Avoid choosing meat that is pale in color and has liquid in the package.
- Look for pork that has marbling, or small flecks of fat. Marbling is what adds flavor.
- Avoid choosing any meat that has a dark-colored bone.
- The fat of the pork should be white with no dark spots.
- The average serving size for pork is 3 ounces of cooked meat. Start with 4 ounces of boneless, raw pork to yield 3 ounces of cooked pork. A 3-ounce serving is about the same thickness as a deck of cards.

Handling Pork

Never taste a food to see if it is spoiled. It is always best to use the rule of “When in doubt, throw it out.”

Safe Pork Handling

Before and after handling raw pork, wash your hands thoroughly with soapy, hot water. Do not cross-contaminate and be sure to keep your raw pork juices away from other foods. Always remember to wash all utensils that came in contact with the raw pork before using them on other foods.

It is important to keep your raw meats refrigerated to ensure safety. If food has been left in the “danger zone” – between 40 and 140° F – pathogenic bacteria can grow.
Because of modern feeding practices, trichinosis is no longer a concern. Although trichina is virtually nonexistent in pork, if it were present, it would be killed at 137° F.

That’s well below the recommended end cooking temperature for pork, which is 145° F, followed by a 3-minute rest time.

Storing Pork

How long can I keep my pork in the refrigerator?

Cut	Time
Ground Pork	1-2 days
Pork chops, tenderloin or roasts	2-4 days
Smoked ham (whole and sliced)	3-4 days opened
Bacon	5-7 days
Sausage, hot dogs, deli meat	7 days opened

How long can I keep my fresh pork in the freezer?

Cut	Time
Ground Pork	1-3 months
Pork chops, tenderloin or roasts	3-6 months
Whole, cooked ham	freezing not recommended
Leftover ham	2-3 months
Bacon	1 month
Sausage, hot dogs, deli meat	freezing not recommended

Pork Storage & Handling

How do I properly wrap my fresh pork to keep it in the freezer?

- Use one of these freezer wrap materials: specially-coated freezer paper (place the waxed side against the meat); heavy-duty aluminum foil; heavy-duty polyethylene film; heavy-duty plastic bags.
- Re-wrap pork in convenient portions: leave roasts whole, place chops in a meal-size packages, shape ground pork into patties. Put double layer of waxed paper between chops and patties.
- Cover sharp bones with extra paper so the bones do not pierce the wrapping.
- Wrap the meat tightly, pressing as much air out of the package as possible.
- Label with the name of the pork cut and date.
- Freeze at 0°F or lower.

Defrosting & Thawing Pork

The best way to defrost pork is in the refrigerator in its wrapping.

Small Roast	3-5 hours per pound
Large roast	4-7 hours
One-inch thick chop	12-14 hours
Ground pork	estimated by package thickness

Can I use my microwave to defrost pork?

Follow the microwave manufacturer's guidelines for defrosting meat. Cook meat immediately after microwave-thawing.

Can I cook partially thawed pork?

It is safe to cook frozen or partially-frozen pork in the oven, on the stove, or on the grill without defrosting it first; the cooking time may be about 50% longer. Use a meat thermometer to check for doneness. Do not cook frozen pork in a slow cooker.

Can pork be refrozen if it has thawed?

Once the food is thawed in the refrigerator, it is safe to refreeze it without cooking, although there may be a loss of quality due to the moisture lost through defrosting.

Pork's Most Popular Cuts

SHOULDER

Shoulder Steak; bone-in

Shoulder Roast; bone-in

Shoulder Country-Style Ribs; bone-in

LOIN

New York Chop

Porterhouse Chop

Ribeye Chop

Sirloin Chop; boneless

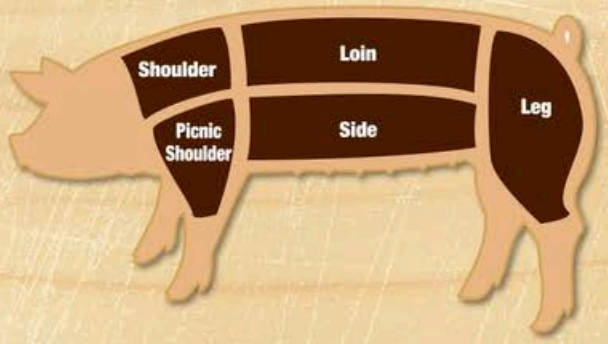
Loin Back Ribs

Loin Country-Style Ribs; bone-in

Loin Country Style Ribs; boneless

New York Roast

Tenderloin



SIDE

Spareribs

St. Louis-Style Ribs

For recipe ideas visit:
www.PorkBeInspired.com

pork
Be inspired

Purchasing Pork: Identifying Fresh Pork Cuts

CHOPS

New York Pork Chop
Formerly: Top Loin Chop

Porterhouse Pork Chop
Formerly: Loin Chop, bone-in

Ribeye Pork Chop
Formerly: Rib Chop, bone-in

Ribeye Pork Chop, boneless
Formerly: Rib Chop, boneless

Sirloin Pork Chop, boneless

ROASTS

New York Pork Roast
Formerly: Top Loin Roast

Pork Ribeye Roast
Formerly: Center Rib Roast

Sirloin Pork Roast

Pork Tenderloin

Arm Pork Roast
Formerly: Arm Picnic

Blade Pork Roast
Formerly: Shoulder Blade Boston Roast

RIBS

Pork Back Ribs

Pork Spareribs

Pork St. Louis-Style Ribs

Pork Country-Style Ribs, bone-in

Pork Country-Style Ribs, boneless

Cut Loose!

When shopping for pork, consider these convenient options:

CUBES: Great for kabobs, stew & chili

GROUND: Quick patties and bulk for casseroles

CUTLETS: Delicious breakfast chops & quick sandwiches

pork
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Pork Cooking Methods, Times and Temperatures:

pork
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Roast/Bake: Roast at 350° F. unless otherwise noted. Roast in a shallow pan, uncovered.

Broil: 4-5 inches from heat. Turn halfway through cooking time.

Grill: Over direct, medium heat; turn once halfway through grilling.

Barbecue: Barbecue over indirect medium heat (about 325° F.) unless otherwise noted.

Sauté: Add a little cooking oil to pan; saute over medium-high heat and turn once halfway through cooking time.

Braise: Cook over medium-high heat in 1 tablespoon vegetable oil until browned evenly on both sides. Add enough liquid to come ¼ to ½ inch up sides of pork. Return just to boiling. Cover and simmer until tender.

Stew: Cook, covered, with liquid at a slow simmer. This method best used with 1-inch loin or shoulder cubes for 45 min.-1hr.

PORK CHOPS, 3/4 inch thick		Broil/Grill	Sauté	Braise	Cook to
Boneless	New York (Top Loin) Pork Chop Ribeye (Rib) Pork Chop Sirloin Pork Chop	8-12 min.	8-12 min.	6-10 min.	145°-160°F
Bone-in	Porterhouse (Loin) Pork Chop Ribeye (Rib) Pork Chop Sirloin Pork Chop	8-12 min.	10-16 min.	8-12 min.	

ROASTS		Roast/Bake	Barbecue	Braise	Cook to
Fresh Leg/Uncured Ham, bone-in (16-17 lb.)		15 min. per lb.			145°-160°F
Blade (Shoulder) Pork Roast	3-4 lbs.	55-85 min. per lb. roast at 275° F.	45-75 min. per lb.	2-2½ hrs.	Tender
	5-6 lbs.		30-45 min. per lb.		
New York (Top Loin) Pork Roast Sirloin Pork Roast Pork Loin Center Roast	2 lbs.	26-28 min. per lb.	20-26 min. per lb.		145°-160°F
	3-5 lbs.	20-25 min. per lb	12-15 min. per lb.		
Pork Crown Roast (10 lbs.)		12-15 min. per lb.			
Rack of Pork (4-5 lbs.)		25-40 min. per lb.			

RIBS	Roast/Bake	Barbecue	Braise	Cook to
Pork Back Ribs (1½-2 lbs. per rack)	1½-2 hrs.	1½-2 hrs.	1¼-1½ hrs.	Tender
Country-Style Ribs (3-4 lbs.)	1-1¼ hrs.	45 min. - 1 hr.	30-35 min.	
Spareribs (St. Louis Style) (3½- 4 lbs. per rack)	1½-2 hrs.	1½-2 hrs.	1¼-1½ hrs.	

TENDERLOINS	Roast/Bake	Broil/Grill	Braise	Cook to
Loin Cubes/Kabobs (1 inch)		8-10 min.	8-10 min.	Tender
Tenderloin (1-1½ lbs.) roast at 425° F.	20-35 min.	20-30 min.		145°-160°F

OTHER CUTS	Roast/Bake	Broil/Grill	Sauté	Braise	Cook to
Blade Pork Steak (¾-inch)		10-12 min.	10-16 min.	11-12 min.	Tender
Cutlets (½ inch)			3-4 min.	3-4 min.	
Ground Pork Patties (½ inch)		8-12 min.	8-11 min.		160° F.
Ham, fully cooked (5-6 lbs.)	20 min. per lb.				140° F.

Pork today is very lean and shouldn't be overcooked. To check doneness, use a digital cooking thermometer.

The National Pork Board follows the guidance of the U.S. Department of Agriculture.

The National Pork Board recommends cooking pork chops, roasts, and tenderloin to an internal temperature between 145° F. (medium rare) and 160° F. (medium), followed by a 3 minute rest. Since large cuts increase approximately 10° F. while resting, remove them from the heat at 150° F. followed by a 10 minute rest. Doneness for some pork cuts is designated as "tender". This includes small cuts that are difficult to test with a thermometer and large cuts that cook slowly at low temperatures. Ground pork, like all ground meat, should be cooked to 160° F. Pre-cooked ham can be reheated to 140° F. or enjoyed cold.

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Poultry

Introduction

Poultry is more than just chickens! There are different types of poultry raised in Texas Including turkeys, geese, ducks, guineas, peafowl, pigeons, quail, and chickens. Poultry is vital to the Texas economy... and your plate! It is estimated that the Texas poultry industry contributes more than $2. 1 billion to the state's economy. This publication will teach you about the details about industry income, employees, and economic impact.

Production

In Texas, broiler chickens and turkeys are the primary poultry grown for meat production. Broiler is the name given to chickens raised for meat.

There are approximately 625 million broiler chickens and 6.5 million turkeys raised in Texas. These types of poultry are primarily grown on family farms by farmers who have contracts with processing companies. There are approximately 800 contract farms in Texas that grow broilers and turkeys.

Poultry farms are primarily located in East and South Central Texas. Shelby County in East Texas ranks seventh in the United States for poultry and egg production at $448.6 million. Gonzales County ranks ninth in the U.S. at $402 million.

Modern poultry facilities provide optimum conditions for the birds to grow. Broilers and turkeys are grown in poultry barns where temperature, humidity, lighting, ventilation, air quality, litter, feed, and water are constantly monitored.
Eggs from laying hens are also a top commodity produced in Texas.

Production Cycle

- Broiler Breeders – This is the first segment of the broiler industry. These farms produce fertile eggs that develop to produce broilers.
- Hatchery – The hatchery is responsible for the incubation and hatching of the chicks from fertile eggs obtained from the broiler breeders.
- Grow-out Farms – Chicks are transported in climate-controlled trucks to the third

- segment of the broiler industry, called the grow-out farm. This is where the broilers are raised.
- Processing – Once the birds reach market weight, they are transported to processing facilities where they are processed for meat and by-products.

Turkeys are processed similarly to broilers, however, they are raised a bit differently. Male turkeys, called toms, are raised separately from the females, called hens.

Processing Poultry

On average, the farms where these birds are raised are less than 1 hour away from the processing plant. This is important so that transport time, bird weight loss, and death loss is minimized. These birds are transported in coops that are large enough for the birds to sit comfortably, but small enough to keep them from flapping around which could cause injuries.

Whole broilers, wings, filets or tenders, thighs, and drumsticks are some of the products that are prepared for delivery to the grocery store. Further processing of poultry meat creates products that are cut up, de-boned and skinned, ground, marinated, chopped and formed, breaded, glazed, panfried, oven roasted, fried, chargrilled, and individually quick frozen. This also creates different product forms such as patties, nuggets, tenders, filets, wings, drums, and thighs.

Once the products are processed, they are shipped from the processing plant fresh or frozen, raw or further processed. Products may be shipped in temperature controlled trucks or by train. Some products may be exported to other countries on ships.

Nutrition

The USDA MyPlate recommends that we consume 5-6 ounces per day of lean protein and poultry, such as chicken or turkey, is a great option! Americans consume more chicken than anyone else in the world.

One 3 ounce skinless, boneless chicken breast provides:

- 120 calories
- 3 grams of fat

Poultry

Chicken is also naturally low in sodium and a good source of protein and Vitamin B6. Turkey has the lowest number of calories and the least amount of fat per ounce compared to the top eleven proteins consumed in the U.S.

Poultry By-products

In addition to many edible products that come from poultry, they also provide a number of inedible by-products. These include:

- Fertilizer
- Pet food
- Feather boas
- Cosmetics
- Upholstery foam
- Diapers

Poultry Cuts

All segments of small, young poultry can be prepared using dry heat cooking methods. Older birds, once they stop laying eggs, are butchered and marketed as stewing hens or boiling fowl. These birds need moist heat preparation and are ideal for pot pies, stews, and soups.

All poultry should be fully cooked to at least 74°C (165°F) to eliminate the presence of salmonella. A bird can be split in half lengthwise through the backbones and keel bone, or it can be split into a front quarter and a hind quarter. The front quarter of the bird contains the breast and wing meats, while the hindquarter contains the legs. It is common to further break the poultry into segments. For maximum yield and precise processing, poultry can be segmented by cutting through the soft natural joints of the bird. The term 8-cut chicken is used to describe a chicken segmented into two drumsticks, two thighs, and both breasts split in half across the rib bone (one half may contain the wing). This procedure is always done with the bone in. These segments can be processed further to boneless skinless cuts if desired.

Whole Breast

The intact breast separated from the remainder of the chicken at the junction of the vertebral and sternal ribs. The sternal ribs remain attached to the breast bone and the vertebral ribs are attached to the back. May be displayed with skin-side up or skin-side down.

Breast with Ribs:

The intact breast separated from the backbone at the juncture with the back. The entire rib cage is attached to the breast. It may be displayed with the skin side up or skin side down.

Breast Quarter

Half of the breast with the wing and back portion attached.

Breast Quarter without Wing:

The breast quarter with the back portion attached, but without the wing.

Split Breast

The whole breast cut in half parallel to breast bone to create approximately two equal halves. One or both halves may be displayed with or without ribs.

Boneless Breast

The whole breast with the bones removed. The skin can be attached or removed.

Boneless Split Breast

A half breast with the bones removed. The skin can be attached or removed.

Tenderloin

The inner pectoral muscle that lies up against the keel bone. It is the long slender muscle that is removed from the inner portion of the breast meat.

Leg Quarter

The thigh and drumstick with a portion of the back attached. The tail may or may not be removed

Whole Leg

The thigh and drumstick with the back portion removed. The ribeye muscle or ‘oyster’ may be attached. The oyster is the piece of meat on the back that lies just in front of the hip joint.

Thigh with Back

The upper portion of the leg quarter that is separated at the knee and includes part of the back beyond the hip joint.

Thigh

The upper portion of the whole leg that is separated at the knee and hip joints. The back portion is not attached.

Boneless Thigh

The whole thigh with the bone removed. The skin may or may not be attached.

Drumstick

The lower portion of the leg that is separated at the hock and knee joints.

Boneless Drumstick

The lower portion of the leg that is separated at the hock and knee joints with the bone removed. The skin may or may not be attached.

Whole Wing

The entire wing with all muscle, bone, and skin attached except that the wingtip may be removed.

Wing Drumette

The part of the wing between the second and third joint (shoulder).

Wing Flat

The part of the wing between the first and second joints of the wing. This is the part of the wing with two bones between the wingtips and the drumette.

Back

Is the back of the carcass beginning at the base of the neck and extending back to the tail. It includes the vertebral ribs, hip bones, and attached flesh. All or portions of the oyster may also be attached. The oyster is the piece of meat on the back that lies just in front of the hip joint. The tail may or may not be removed.

Neck

The neck bones with flesh attached. The skin may or may not be present.

Paws

The whole foot with the cuticle removed and cut midway to the hock joint.

Gizzard

The thick-walled muscular organ that has been cross-sectioned into two halves

Liver

The reddish-brown, wedge-shaped organ with four lobes of unequal size and shape.

Heart

The triangular-shaped, four-chambered muscular organ.

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POULTRY Q&A

J. B. Carey, A. L. Cartwright, M. B. Farnell and M. Davis*

Biology/Behavior/Anatomy

Q: Why do chickens bob their heads back and forth?

A: Chicken's eyes are located on the sides of the head, not facing the front like our eyes. This allows the chicken to see much more of the world at one time than we can see. They can almost see behind themselves. This helps them see predators and alerts them to danger. But their forward vision is incomplete; they have a blind spot in front of them. They also can't see an object with both eyes at once. They have trouble getting a three-dimensional view of objects so they reposition their heads to get the 3-D picture. That is why they bob their heads.

Q: At what age do chickens begin to lay eggs?

A: If all necessary conditions (day length, nutrition, etc.) are met, chickens should begin egg production at about 20 weeks of age.

Q: What is the average life span of a chicken?

A: Many commercial laying hens are kept for up to 3 years. There are undocumented accounts of "yard chickens" living for more than 10 years.

Q: From where do chickens originate?

A: Chickens were domesticated from jungle fowl in Southeast Asia many centuries ago.

Q: What is the scientific name for chickens?

A: The scientific name of the domestic chicken isGallus domesticus. The scientific name for its predecessor, the jungle fowl, is Gallus gallus.

Q: How can you tell the sex of baby chicks?

A: Sexing most chickens is difficult. In some lines there are genetic differences in color between the sexes. In some lines there are differences in feathers, with the primary feathers of the male being shorter than those of the female. But these genetic differences are rare and in most lines of chickens sex can not be determined in this manner.

Most chicks are sexed by examining the complex folding of the vent area (which

*Extension Poultry Specialists, The Texas A&M University System.

roughly corresponds to the anal area). This method is extremely difficult and it takes lots of time and practice to acquire this skill.

Q: How can baby chicks survive without a mother hen?

A: Newly hatched chicks have certain inborn behaviors. They are curious and they peck and scratch. In this way, newly hatched chicks learn what to eat.

Q: Why do hens stop laying eggs?

A: Healthy hens stop laying for either of two reasons:

1) They have been in production for a while and are entering a molt; or
2) They are not stimulated appropriately by light. Hens lay when they receive the required hours of light (day length) each day.

Q: How do chickens reproduce?

A: The male mounts the hen from behind and stands on her back. The penis transfers semen into the cloaca of the hen. The cloaca is a common receptacle for the intestinal tract, the reproductive system and the urinary system. Spermatozoa are stored in accessory sex organs in the female. There, the spermatozoa are nourished and released over several weeks. So, the rooster does not have to mate with the hen each time she is to lay an egg to produce fertile eggs. Hens remain highly fertile for about 10 days to 2 weeks after mating. Then they need to mate again to increase the fertility of the eggs laid.

Hens ovulate about every 24 to 26 hours.

The egg yolk has a germ cell on its surface. The spermatozoa fertilize this germ cell. Then the albumen, or white of the egg, is secreted around the yolk by the reproductive tract. Finally, the shell membranes and the shell are secreted and deposited as the egg travels down the reproductive tract. The egg is laid through the cloaca. This is the way fertile eggs are laid by the hen. The hen would still lay eggs if a rooster were not around, but the eggs would not be fertile.

Q: In random chicken matings, what percent of eggs produced result in male offspring?

A: The sex ratio in chickens is 50:50.

Q: Are poultry comfortable in a modern poultry barn?

A: Yes, modern poultry facilities provide optimum conditions for birds to grow. Temperature, humidity, lighting, ventilation, ammonia concentration, litter condition, feed rations and water quality are constantly monitored to provide the birds with a healthy environment. Chickens reared in a poor environment are not productive, so growers have an economic incentive to raise their animals in a comfortable setting.

Q: Do domesticated chickens and turkeys prefer to live outdoors?

A: A properly maintained poultry barn is a comfortable environment for birds where they are protected from predators and have a readily available food supply. When doors to poultry barns have been left open accidently, only a few birds have actually left the safety of the poultry facility.

Q: Would domesticated poultry be better off if released in the wild?

A: No, the natural world is a cruel and inhospitable environment. Feral poultry would immediately face temperature extremes, predators, disease and starvation. Experts estimate that more than 60 percent of Bobwhite Quail die each year because of these natural factors. Today's poultry industry raises birds according to strict animal welfare guidelines, with the aim of providing a humane environment.

Q: Are U.S. poultry producers responsible for causing avian influenza?

A: No. U.S. poultry producers constantly monitor their birds for diseases and have preparedness plans and biosecurity procedures in place to prevent disease. Commercial poultry in the U.S. have the best possible veterinary care. Also, poultry in modern rearing facilities are isolated from migratory birds, which may transmit avian influenza.

Incubation/Embryology

Q: Which part of the egg develops into a baby chicken, the yolk or the white?

A: Neither. In a fertilized egg there is a group of cells on the surface of the yolk in an area called the germinal disc. By the time the egg is laid by the hen, there are several hundred thousand cells in this disc. These cells develop into the embryo, which eventually surrounds the yolk and uses it for food.

Q: Should fertile eggs with dirty shells be incubated?

A: Dirt on an egg can restrict oxygen and gas exchange in the egg. A very fine sand paper can be used to remove soiled areas. The main problem is that the soiled area can cause bacterial infection. It is best to incubate only clean eggs.

Q: Does incubation temperature influence the sex of hatching eggs?

A: Incubation temperature has nothing to do with determining the sex of the bird. Altering the incubation temperature will only reduce the number of eggs that hatch and threaten the health of the birds.

Q: What is candling eggs and how is it done?

A: Egg candling is the process of shining a bright light through the egg to examine its internal contents. One easy way to candle an egg is to use a small, bright flashlight.

Q: Will incubation of double-yolked eggs result in "twin chickens"?

A: Double-yolked eggs almost never hatch. Even though a double-yolked egg is larger, itcannot support the development of two chicks.

Q: What is the purpose of turning eggs during incubation?

A: The yolk is less dense than the white, so the yolk floats to the top of the egg. Turning repositions the yolk and white, keeping the yolk and the embryo from pressing against and possibly sticking to the inside of the eggshell.

Q: What is the recommended environmental temperature for newly hatched, or brooding, chicks?

A: The brooding box should contain a range of temperatures at all times. The area close to heat lamps should be 95 degrees F, but other areas away from the light should be cooler so the chicks can cool themselves if they get too hot. If the chicks huddle together by the light, they are too cold. If they huddle around the edges of the brooder away from the light, they are too hot. The temperature in the brooding box can be decreased 5 degrees each week as the chicks get older.

Products/Food Safety

Q: Are hormones used to produce poultry meat?

A: No, hormones are not fed or administered to commercial poultry. The rapid growth rates and feed efficiencies in commercial poultry are the result of traditional genetic selection, good nutrition, and improved animal husbandry practices to maintain the health and productivity of poultry.

Q: Are antibiotics indiscriminately used in poultry production?

A: No, antibiotic treatment is costly and is used only under the strict supervision of a poultry veterinarian to treat sick birds or to prevent diseases that are likely to occur. When antibiotics are administered, withdrawal periods are strictly adhered to. This ensures that no antibiotic residues remain in the meat we eat. Alternatives to antibiotics are frequently used, including vaccinations and probiotics (such as the beneficial bacteria commonly found in yogurt).

Q: Are supermarket poultry injected with artificial additives and artificial flavors?

A: Poultry is sometimes injected with salt solutions and chicken broth to improve meat tenderness, taste and shelf life. These are natural solutions that enhance product quality and can reduce bacterial spoilage.

Q: Why are some of the processed chickens purchased in stores yellow?

A: The yellow color of chicken skin is the result of natural pigments found in corn or other feed ingredients in the diet of chickens.

Q: What are "free range" chickens?

A: Free range refers to chickens that have access to an environment outside a chicken house or sheltered area.

Q: Are "free range" and "organic" poultry more wholesome than conventionally raised poultry?

A: All poultry—whether free range, organic or conventionally raised—are fed diets that meet or exceed the National Research Council's recommendations for Poultry Nutrition. While the feed formulations used by different growers may vary, the actual nutrient content and wholesomeness of all poultry products is comparable.

Q: Why do chickens and turkeys have white and dark meat?

A: Different muscles do different jobs for the bird. Muscles that are used almost constantly, such as leg and thigh muscles, are dark. Muscles that are used to move quickly for short periods of time, such as the wing muscles, are white. Because they work differently, white and dark muscles have different fuel demands and oxygen usage. The ability to store and use oxygen for energy metabolism determines whether a muscle will appear white or dark.

Q: Do eggs from Araucana chickens really have no cholesterol?

A: No, they have cholesterol just like all other eggs.

Q: Is it safe to eat raw eggs?

A: The risk of food poisoning from bacterial contamination is highest with raw eggs. To reduce the risk of food poisoning, people should not consume raw or lightly cooked eggs.

Q: How long will table eggs stay fresh?

A: Fresh eggs can be stored in a refrigerator (at 40 to 45 degrees F) for 4 to 5 weeks after the packaging date on the carton. Hard-boiled (cooked) eggs should be kept in the refrigerator for no more than 1 week.

Q: What are blood spots? Although rare in packaged eggs, blood spots can sometimes be found when an egg is cracked. These spots are caused by the rupture of a blood vessel during the formation of the egg. Blood spots are most often found on the outer surface of the yolk. They do not indicate that an egg is fertile. After a period of time a blood spot will dissipate, so if you see a blood spot it means the egg is fresh. Eggs with blood spots are fine to consume. The blood spot can be removed with the tine of a fork or the tip of a knife.

A:

Another imperfection that can be found in an egg is a meat spot. Meat spots are usually found in the albumen (white) of the egg. Meat spots are pieces of the oviduct of the chicken that have become dislodged during the formation of the egg and have been deposited in the albumen. Eggs with meat spots are also safe to consume. The meat spots can be removed with the tine of a fork or the tip of a knife.

Q: Is there a difference in the nutritional quality of brown-shelled and white-shelled eggs?

A: No, there is no difference. The color of the eggshell is determined by the breed of hen that lays the egg. White egg layers have white feathers and ear lobes, while brown egg layers usually have darker feathers and always have red ear lobes. Hens that lay brown-shelled eggs are usually larger than hens that lay white-shelled eggs, and thus require more food. This is why brown eggs are typically more expensive than white eggs.

Q: Are fertile eggs more nutritious than non-fertile eggs?

A: No. Most table eggs that are bought at the grocery have no chance to be fertile anyway, because the hens are not housed with roosters.

Q: How should I store my eggs at home?

A: Even though most refrigerators have a place to store eggs, eggs should be stored in the carton in which they are purchased. This is because eggshells have thousands of tiny pores to allow gases to move in and out of the egg. Eggs not stored in the carton can pick up odors from other items in the refrigerator.

Q: Why is there a greenish ring around the yolk of hard-boiled eggs?

A: The greenish ring is caused by a combination of iron and sulfur when the egg is cooked too long or not cooled quickly after cooking. Such eggs are safe to eat.

Q: What are the stringy pieces of white around the yolk?

A: These strands are called chalazae. They are thickened pieces of the albumen (white) that help keep the yolk centered in the egg. They do not indicate fertility and are a natural part of the egg.

Q: Why is the albumen (white) sometimes cloudy or greenish or yellowish in color?

A: Cloudiness is caused by carbon dioxide in the albumen that has not had time to escape through the pores in the eggshell. There is nothing wrong with these eggs, and the cloudiness indicates that the egg is very fresh. A slight green or yellow color to the albumen of fresh eggs indicates the presence of riboflavin (Vitamin B2). These eggs are safe to consume.

Q: How long can I keep fresh poultry meat?

A: All fresh meats should be cooked or frozen within 1 to 2 days after purchase.

Q: How long can I keep frozen poultry meat?

A: Frozen poultry meats will retain their quality in the freezer for 3 to 6 months.

Q: What do the terms "Fresh," "Frozen" and "Hard Chilled" mean?

A: The term "Fresh" is allowed for poultry that has never had an internal temperature below 26 degrees F. "Hard Chilled" or "Previously Hard Chilled" is used for products whose internal temperature has been below 26 degrees F but not below 0 degrees F. "Frozen" or "Previously Frozen" refers to poultry that has had an internal temperature below 0 degrees F.

Q: How is the term "Organic" used on poultry products?

A: The term "Organic" cannot be used by itself. However, the U.S. Department of Agriculture does allow the use of the phrase "certified organic by (a certifying entity)."

Q: Can avian influenza be transmitted to humans by eating properly cooked poultry?

A: No,avian influenza is caused by a heat-sensitive virus that is easily killed by proper cooking (heating to an internal temperature of 180 degrees F). Commercially reared poultry are constantly monitored for avian influenza and infected birds would never enter the food supply.

Conclusion–Fifty years ago, poultry was expensive and eaten only on special occasions. Today's poultry industry is able to produce wholesome, inexpensive products that are a great source of protein. As a result, most people eat poultry quite often. These advances are the result of improved nutrition, better animal husbandry, selective breeding and enhanced disease control. Industry personnel, researchers and government officials are continually monitoring and making improvements in poultry production so that consumers will continue to have high quality products at a low cost.

For more information visit the Extension poultry web site at: http://gallus.tamu.edu

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Sheep

Introduction

Texas ranchers care for over 600,000 sheep. In the U.S., there are 3.8 million sheep. They are raised primarily to produce lamb and most are shorn to produce wool for clothing and other uses. A small number of farms milk sheep for cheese, yogurt, and other diary products. In Texas, there are more hair sheep than wool sheep. Hair sheep tend to require less labor and the lambs are well suited for the non-traditional market.

Production

Sheep contribute roughly $140 million to the state of Texas. Most Texas lambs are marketed around 70 pounds and sell for $2.00 per pound. The majority of sheep are sold direct into the non-traditional market; however, some lambs will be sent to feeders to be grown out to heavier weights prior to harvest.

In 2018, U.S. farmers and ranchers produced 150 million pounds of lamb. In addition, we imported 250 million pounds of lamb to meet the domestic demand, primarily from Australia and New Zealand

The average American only eats 0.8 pounds of lamb annually. However, this demand has been steadily increasing. Ethnic consumers and millennials are growing the demand for lamb and mutton.

Like cattle, sheep are ruminant animals. They have four different compartments to their stomachs. The rumen, the largest compartment of the stomach, is the main site of fermentation. Rumen microbes digest plants eaten by the sheep into components that the sheep can use. Sheep eat a wider variety of plants than cattle. Sheep prefer to eat forbs, commonly called weeds. Ranchers can better manage rangelands with sheep than cattle alone.

Due to their size, sheep are the preferred livestock species for small acreage landowners. A small flock or herd is suitable to the land base. Also, sheep don't require as many facilities and equipment as cattle.

Sheep

Sheep are more susceptible to internal parasites than cattle, specifically the barber pole worm. For this reason, most sheep are raised in arid regions of Texas where parasites are not as much of an issue.

Processing

Wool is protein based; therefore it is:

- durable
- fire retardant
- biodegradable

It can also hold 30% of its weight in water without feeling wet, which allows it to wick moisture away from the body and reduce body odor. Wool has natural felting properties. This is why wool sweaters shrink when washed. However, super-wash technology has been developed to treat wool so that it won't shrink. And felting isn't always a bad thing. After wool has been woven into fabrics it is purposely felted. This gives the garments durability and wrinkle resistance. We commonly think of wool garments as cold weather attire, such as sweaters and socks.

But this is only true of one type of wool manufacturing. Advancements in our understanding of how to work with wool fibers of varying quality have unlocked lots of new and different uses for wool. For instance, wool shoes have been recently developed that created an entirely new market for wool.

We commonly think of wool as itchy and cannot be worn next to the skin. However, wool from sheep specifically bred to grow extra fine wool can be made into next-to-skin garments, such as t-shirts or underwear. These garments are naturally better at controlling temperature and odor than synthetic fibers.

Preparing the Commodity

People are commonly intimidated by lamb and believe that it takes a skilled chef to properly prepare lamb. Lamb does have unique flavors compared to other red meats but most lamb cuts can be prepared very similar to beef.

Sheep

- Lamb chops, ground lamb, and lamb kabobs are excellent on the grill. NOTE: Lamb fat is more volatile and flares easily over an open flame, so be careful not to overcook it.
- Leg of lamb and shoulder roasts are excellent for slow cooking or smoking.
- Ground lamb, lamb stew meat, and lamb shanks are great for soups and stews.
- Sheep meat from animals yearlings or older is called mutton. Mutton has stronger bolder flavors. Some people are turned off by the aroma and flavor. Yet, some people prefer this bolder flavor, especially if they commonly ate lamb during their lifetime.
- Grass-fed lamb tends to have stronger and bolder flavors then grain-fed lamb.

Nutrition

Did you know that a single 3 ounce serving of lamb is considered nutrient dense because it provides many nutrients and is relatively low in calories?

- A single serving can provide almost half of the daily protein requirement for an average adult over the age of 19. Lamb is an excellent source of B12 and Selenium.
- It is also considered a good source of 10 essential nutrients.
- Lamb is considered a high-quality protein because it includes all the indispensable amino acids, which are not synthesized in the human body and must come from food.

Bone-In Leg

Because of its impressive presentation, the bone-in-leg is perfect for any holiday celebration or special occasion. The bone adds both flavor and richness to the meat.

BRT Leg

The BRT or boneless leg is the most versatile cuts of lamb from roasting whole to trimming into kabob meat or individual chops or smaller roasts, to butterflying and grilling. Leg is the leanest lamb cut. A whole boneless leg of American Lamb typically weighs 7-8 pounds so there will be plenty of leftovers.

GROUND

Mellow and mildly flavored, ground lamb contains lean meat and trimmings from the leg, loin, rib, shoulder, flank, neck, breast or shanks. Readily available and the perfect substitute for ground beef in many recipes, ground lamb offers a long list of possibilities for quick and easy weeknight dinners: meatballs, burgers and sliders, shepherd's pie, kabobs, and meatloaf. Add aromatic seasonings to impart delicious flavor and variety to any meal made with ground lamb.

Loin Chop

One of the most readily available cuts in the case at the grocery store and butcher shop, loin chops are lean, tender and delicious! With their perfect 3- to 4-ounce serving size and attractive “T” shaped bone that runs through the meat, loin chops (sometimes called T-bone chops) are simple to prepare. Season with a dry rub, or marinate 4 to 6 hours, then grill, broil or panfry the chops for a delicious meal.

Rack

An impressive presentation that is surprisingly easy to prepare at home, the rack offers versatility for entertaining. The rack of lamb is an icon of fine dining menus across the country. Serving a rack of lamb makes it easy to have an effortless, restaurant quality meal at home. There are 8 chops per rack and an American Rack weighs about 2 pounds.

Frenched Rack: a few inches of meat is removed from the end of the bones **Crown Roast**: two frenched racks tied together to resemble a crown.

Shank

Lamb shanks come in both foreshanks and hindshanks. Lamb shanks practically melt off the bone when they are slow cooked, and are a popular menu item across the country. Lean on fat but big on flavor, the meaty shank is perfect for braising in a slow, simmering broth.

Rib

One of the most cost-conscious cuts of lamb, the lamb spareribs or Denver ribs are perfect for braising and grilling and are a great substitute for baby back pork ribs in your favorite BBQ recipe.

Sirloin Chop

Lamb chops come in many shapes and sizes, depending on the part of the animal they come from. Large and meaty, sirloin chops are cut from the leg and can be identified by the crosscut section of round leg bone within the meat. More value-oriented than the prized rib and loin chops, sirloin chops can be just as tender and tasty.

Shoulder Roast

Lamb shoulder comes from the upper front shoulder of the lamb. The shoulder of any animal bears a lot of weight and will be a tough cut that needs to be cooked low and slow in order to break down the connective tissue and make it tender. It is different from the "leg of lamb," which comes from the rear leg, and is leaner and more tender. The shoulder has a higher fat content, is richer in flavor and is less expensive than the lamb leg. Because of the higher fat content, it is also more forgiving and stays juicier.

Lamb from Farm to Table

Sheep is the oldest domesticated meat species. Sheep have been raised by humans beginning about 9,000 years ago in the Middle East. In many countries, lamb (a young sheep) is the major source of protein. Many Americans think of lamb as a springtime food, but it can be enjoyed year-round. The following information answers many questions callers have asked the U.S. Department of Agriculture (USDA) Meat and Poultry Hotline about lamb.

What is the Difference Between Lamb and Mutton?

Sheep (Ovine) carcasses are classified as lamb, yearling mutton, or mutton depending on their age as evidenced by their muscles and bones. For the purpose of this fact sheet we will be discussing lamb. The flavor of lamb is milder than mutton. Lamb is produced from younger animals, typically less than a year old, and mutton is produced from older animals. Most lambs are brought to market at about 6 to 8 months old. A lamb weighs about 140 pounds and yields approximately 46 to 49 pounds of edible lean retail lamb cuts, semi-boneless.

If the phrase “Spring Lamb” is on a meat label, it means the lamb was slaughtered between March and October. The term comes from olden times, when lambs born in harsh winter weather would have little chance to survive until the next year. Today, with more protected animal husbandry conditions, enjoying “lamb” is not confined to a particular season of the year.

How Are Lambs Raised?

Lambs are nursed by their mothers and when they are weaned, gradually begin feeding on pasture or coarsely ground grain. They are fed hay and feed consisting of corn, barley, milo (a type of sorghum), and/or wheat supplemented with vitamins and minerals. Lambs are usually “finished” (grown to maturity) in feedlots where they are fed specially formulated feed. While most lambs are finished on grains, some lambs are raised on pasture and are finished on grass. Grass-finished lamb is usually distinguished on the label.

How is Lamb Inspected?

All lamb found in retail stores is either USDA inspected for wholesomeness or inspected by state systems which have standards equal to the federal government. Each lamb and its internal organs are inspected for signs of disease. The “Passed and Inspected by USDA” seal ensures the lamb is wholesome and free from disease.

What Does the Grade Mean?

Grading for quality is voluntary. A processing plant may request to have its lamb graded for quality based on traits such as tenderness, juiciness and flavor. USDA-graded lamb sold at the retail level is Prime, Choice and Good. Lower grades (Utility and Cull) are mainly ground or used in processed meat products.
Lamb quality grades take into consideration maturity (lamb, yearling mutton and mutton), conformation, and the palatability-indicating characteristics, such as fat streaking within the flank and firmness of the lean. Most of the graded lamb sold in supermarkets is USDA Choice; 80% of the American lamb supply is USDA Prime or USDA Choice. The protein, vitamin and mineral content of lamb are similar in all grades.

How is ungraded lamb different?

All lamb is inspected for wholesomeness; however, since grading is not mandatory, the overall quality of ungraded lamb is unknown - it may be higher or lower than USDA-graded lamb found at retail. Since the quality of lamb varies according to the age of the animal, it is advisable to buy lamb that has been USDA graded since age is taken into consideration.

Can hormones and antibiotics be used in lamb raising?

Yes. Hormones and antibiotics approved by the U.S. Food and Drug Administration (FDA) are permitted to be used in lambs slaughtered for meat. Antibiotics may be given to prevent or treat disease in lambs and hormones may be given to promote efficient growth. A recommended withholding period is required from the time antibiotics are administered until it is legal to slaughter the animal. This is so drug residues can exit the animal's system. The Food Safety and Inspection Service (FSIS) samples lamb carcasses at slaughter and tests for residues. FSIS laboratory results above the tolerance limit set by FDA are considered a residue violation and are investigated by FDA or the state.

What to Look for When Selecting Lamb

When shopping for lamb, look for meat that is fine textured and firm that has red coloring and white marbling (white flecks of fat within the meat muscle). The fat trim should be firm, white and not too thick. The USDA quality grades are reliable guides.

Retail Cuts of Fresh Lamb

There are five basic major (primal) cuts into which the lamb carcass is separated: shoulder, rack, shank/breast, loin and leg. It is recommended that packages of fresh lamb purchased in the supermarket be labeled with the primal cut as well as the product, such as “shoulder roast” or “loin chop.”

What is a rack of lamb?

The “rack” is the primal cut, more commonly known as the rib. The rack contains 9 full ribs and can be split (along the backbone) into two lamb rib roasts. A "lamb crown roast" is made by sewing two rib roasts together to form a circle or crown.

What is a lamb chop?

Chops can come from various primal cuts. "Loin" chops come from the loin and "rib" chops come from the rack (or rib); these are the most tender and most expensive chops. "Blade" and "arm" chops (from the shoulder) and "sirloin" chops (from the leg) are less expensive but may be just as tender.

How much lamb is consumed?

According to USDA’s Economic Research Service, each American eats about .7 pound of lamb yearly.

What does “natural” mean?

All fresh meat qualifies as “natural.” Products labeled “natural” cannot contain any artificial flavor or flavoring, coloring ingredient, chemical preservative, or any other artificial or synthetic ingredient; and the product and its ingredients are not more than minimally processed (ground, for example). All products claiming to be natural should be accompanied by a brief statement which explains what is meant by the term “natural.”

How and why is some lamb aged?

Lamb is aged to develop additional tenderness and flavor. Usually only the higher quality, more expensive primals, such as racks, ribs, and loins are aged, and these are mainly sold to restaurants. Aging is done commercially under controlled temperatures and humidity. Since aging can take from 10 days to 6 weeks under controlled conditions, the USDA does not recommend aging lamb in a home refrigerator.

Why is lamb called a "red" meat?

Oxygen is delivered to muscles by the red cells in the blood. One of the proteins in meat, myoglobin, holds the oxygen in the muscle. The amount of myoglobin in animal muscles determines the color of meat. Lamb is called a "red" meat because it contains more myoglobin than chicken or fish. Other "red" meats are beef, veal, and pork.

Additives

Additives are not allowed on fresh lamb. If it is processed, additives such as MSG, salt, or sodium erythorbate must be listed on the label.

Dating of Lamb Products

Product dating is not required by Federal regulations. However, many stores and processors may voluntarily date packages of raw lamb or processed lamb products. If a calendar date is shown, immediately adjacent to the date must be a phrase explaining the meaning of that date such as "sell-by" or "use before."

Except for "use-by" dates, product dates don't always refer to home storage and use after purchase. "Use-by" dates usually refer to best quality and are not safety dates. But even if the date expires during home storage, a product should be safe, wholesome and of good quality if handled properly and kept at 40° F or below. If the product has a "useby date," follow that date. If the product has a "sell-by" date or no date, cook or freeze the product according to the recommendations in the "Storage Times" section of this publication.

Rinsing Lamb

There is no need to rinse raw lamb before cooking because this creates a cross-contamination hazard and is not necessary. Any bacteria which might be present would be destroyed by cooking.

How to Handle Lamb Safely

Raw Lamb. Select lamb just before checking out at the register. Put packages of raw lamb in disposable plastic bags (if available) to contain any leakage which could cross-contaminate cooked foods or produce that will be eaten raw such as salad.

Take lamb home immediately and refrigerate it at 40 °F or below. Use ground lamb or stew meat within 1 to 2 days; lamb chops, roasts, and steaks within 3 to 5 days or freeze at 0 °F or below. If kept frozen continuously, it will be safe indefinitely.

It is safe to freeze lamb in its original packaging or repackage it. However, for long-term freezing, overwrap the porous store plastic with storage wraps or bags to prevent "freezer burn," which appears as grayish-brown leathery spots and is caused by air reaching the surface of food. Cut freezer-burned portions away either before or after cooking the lamb. Heavily freezer-burned products may have to be discarded for quality reasons. For best quality, use frozen lamb roasts, steaks, and chops within 6 to 9 months; ground lamb, 3 to 4 months.

Ready-Prepared Lamb. For fully-cooked, take-out lamb dishes such as Kabobs, Gyros, or Chinese food, be sure they are hot at pickup. Use cooked lamb within 2 hours (1 hour if the air temperature is above 90 °F) or refrigerate it at 40 °F or below in shallow, covered containers. Eat it within 3 to 4 days, either cold or reheated to 165 °F. It is safe to freeze ready-prepared lamb dishes. For best quality, use within 2 to 3 months.

Safe Thawing

There are three safe ways to thaw lamb: in the refrigerator, in cold water, and in the microwave. It's best to plan ahead for slow, safe thawing in the refrigerator. Ground lamb, stew meat, and steaks may defrost within a day. Bone-in parts and whole roasts may take 2 days or longer.

Once the raw product thaws, it will be safe in the refrigerator before cooking 3 to 5 days (for roasts, steaks, and chops) and 1 to 2 days for ground lamb. During this time, if you decide not to use the lamb, you can safely refreeze it without cooking it first.

To thaw lamb in cold water, do not remove the packaging. Be sure the package is airtight or put it into a leakproof bag. Submerge the lamb in cold water, changing the water every 30 minutes so that it continues to thaw. Small packages of lamb may defrost in an hour or less; a 3- to 4pound roast may take 2 to 3 hours.

When thawing lamb in cold water or in the microwave, plan to cook it immediately after thawing. Never thaw on the counter or any other location at room temperature. Leaving food out too long at room temperature can cause bacteria (such as Staphylococcus aureus, Salmonella Enteritidis, Escherichia coli O157:H7, and Campylobacter) to grow to dangerous levels that can cause illness.

Foods defrosted in the microwave or by the cold water method should be cooked before refreezing because they may potentially have been held at temperatures above 40 °F, where bacteria multiply rapidly.

It is safe to cook frozen lamb in the oven, on the stove, or grill without defrosting it first; the cooking time may be about 50% longer. Do not cook frozen lamb in a slow cooker.

Marinating

Marinate lamb roasts, steaks, or chops in the refrigerator up to 5 days. Lamb cubes or stew meat can be marinated up to 2 days. Boil used marinade before brushing on cooked lamb. Discard any uncooked leftover marinade.

Storage Times

Since product dates aren't a guide for safe use of a product, how long can the consumer store the food and still use it at top quality? Follow these tips:

- Purchase the product before the date expires.
- Follow handling recommendations on product.
- Keep lamb in its package until ready to use.
- Refrigerate lamb roasts, steaks, and chops 3 to 5 days (ground lamb or stew meat, 1 to 2 days); and 3 to 4 days after cooking.
- If product has a "use-by" date, follow that date.
- If product has a "sell-by" date or no date, cook or freeze the product by the times recommended above.
- Once a perishable product is frozen, it doesn't matter if the date expires because foods kept frozen continuously are safe indefinitely.
- For best quality, use frozen lamb roasts, steaks, and chops within 6 to 9 months; ground lamb, 3 to 4 months.

APPROXIMATE LAMB COOKING TIMES

Safe Cooking: For safety, the USDA recommends cooking lamb patties and ground lamb mixtures such as meat loaf to a safe minimum internal temperature of 160 °F as measured by a food thermometer. Cook all raw lamb steaks, chops, and roasts to a minimum internal temperature of 145 °F as measured with a food thermometer before removing meat from the heat source. For safety and quality, allow meat to rest for at least three minutes before carving or consuming. For reasons of personal preference, consumers may choose to cook meat to higher temperatures. For approximate cooking times for use in meal planning, see the following chart.

Times are based on lamb held at refrigerator temperature (40 °F). Remember that appliances and outdoor grills can vary in heat. Use a food thermometer to check for safe cooking and doneness of lamb.

Cut of Lamb	Size	Cooking Method	Cooking Time	Minimum Internal Temperature & Rest Time
Lamb Leg, bone in	5 to 7 lbs.	Roast 325°	20 to 25 min./lb	145°F and allow to rest for at least 3 minutes
	7 to 9 lbs.	Roast 325°	15 to 20 min./lb.	
Lamb Leg, boneless, rolled	4 to 7 lbs.	Roast 325°	25 to 30 min./lb.	
Shoulder Roast or Shank Leg Half	3 to 4 lbs.	Roast 325°	30 to 35 min./lb.	
Cubes, for Kabobs	1 to 1 ½"	Broil / Grill	8 to 12 minutes	
Ground Lamb Patties	2" thick	Broil / Grill	5 to 8 minutes	160°F
Chops, Rib, or Loin	1 to 1 1/2" thick	Broil / Grill	7 to 11 minutes	145°F and allow to rest for at least 3 minutes
Leg Steaks	3/4 " thick	Broil / Grill 4" from heat	14 to 18 minutes	
Stew Meat, pieces	1 to 1 ½"	Cover with liquid; simmer	1 ½ to 2 hours	145°F and allow to rest for at least 3 minutes
Shanks	¾ to 1 lb.			
Breast, Rolled	1 ½ to 2 lb.	*Braise 325°F	1 ½ to 2 hours	

*Braising is roasting or simmering less-tender meats with a small amount of liquid in a tightly covered pan.

Microwaving

Refer to the microwave's oven manual for microwaving lamb, and check it with a food thermometer.

Partial Cooking

NEVER brown or partially cook lamb to refrigerate and finish cooking later because any bacteria present wouldn't have been destroyed. It is safe to partially cook or microwave lamb immediately before transferring it to a hot grill or conventional oven to finish cooking.

What is the Yield of Cooked Lamb?

After cooking bone-in lamb leg or roast, one pound of raw weight will yield 8 to 9 ounces of edible meat. Ground lamb or boneless cuts will yield about 10.5 ounces of edible meat.

Food Safety Questions?

Call the USDA Meat & Poultry Hotline

If you have a question about meat, poultry, or egg products, call the USDA Meat and Poultry Hotline toll free at **1-888-MPHotline (1-888-674-6854)** The hotline is open year-round

Monday through Friday from 10 a.m. to 4 p.m. ET (English or Spanish). Recorded food safety messages are available 24 hours a day. Check out the FSIS Web site at **www.fsis.usda.gov**.

Send E-mail questions to **MPHotline.fsis@usda.gov**.

Ask Karen!

FSIS' automated response system can provide food safety information 24/7 and a live chat during Hotline hours.

AskKaren.gov

PregunteleaKaren.gov

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Seafood

Introduction

Over 90% of the seafood consumed in the U.S. is imported from other countries to meet consumer demand. In addition, roughly 80% of imported shrimp is farm raised, primarily in Asia, Ecuador, and India. On average the Texas commercial shrimp harvest generates $371 million of economic activity and supports 5,400 jobs in Texas. Texas fishermen brought in 38.3 million pounds of brown shrimp worth $96.4 million. Shrimp represent over 25% of the nation's per capita seafood consumption and is the leading seafood product imported into the U.S., accounting for about 33% of all imports by weight.

Production

All retail seafood must be labeled with both country of origin and source – wild or farmed. Wild shrimp refers to either cold water or warm water varieties that are harvested from coastal ocean water with traditional vessels. Farmed shrimp refers to warm water varieties that are grown in open and closed pond systems supplemented with formulated feeds.

Over 90% of the shrimp eaten in the U.S. come from farmed sources grown in other countries around the world. Shrimp can be purchased fresh or frozen. Frozen shrimp products are the most common and are available year-round. Shrimp is usually sold by weight and are sized based on the number of individual shrimp per pound.

Shrimp commercially harvested from the Gulf of Mexico consist mostly of three species based on their color, and are commonly referred to as whites, browns, and pinks. Each of the Gulf wild shrimp species becomes sexually mature within 6-8 months, making Gulf shrimp an annual crop. To allow shrimp to grow to a larger and more valuable size before harvest, Texas waters and the federal waters off the Texas cast are typically closed to shrimp fishing from mid-May to mid-July. No species of Gulf shrimp has ever been considered overfished.

Seafood

Prepping Shrimp

Shrimp and related prawns are used in a variety of dishes and can be baked, broiled, steamed, fried, and grilled on a barbecue. The healthiest way to prepare any food is to avoid added fat from frying but remember moderation is the key to enjoying seafood.

Shrimp Nutrition

The USDA MyPlate recommends 5-6 ounces per day of lean protein; shrimp fit into this plan. Shrimp is a great source of protein, selenium, Vitamin B12, choline, copper and iodine.

The American Heart Association recommends including shrimp in a heart-healthy diet due to its lack of saturated fats and supply of beneficial essential omega-3 acids.

More than Just Shrimp

Americans consume more shrimp than any other seafood, but crustaceans are more than just shrimp. Crustacean shells contain three primary chemicals: protein, calcium, and chitin, that have many industrial uses. These include:

- *Protein* (good for animal feeds and fertilizers)
- *Calcium carbonate* (used in the pharmaceutical, agricultural, construction, and paper industries)
- *Chitin* (a nitrogen-rich chemical used in making many items, including pharmaceuticals, cosmetics, textiles, household cleaners, and skin-friendly soaps)

Seafood

Nutrition

Seafoods are rich in vitamins and minerals, low in sodium and a unique source of omega-3 fatty acids. A four-ounce serving provides nearly half the protein needed each day to help build and repair body tissue. Generally considered a low-calorie food, seafood can provide your daily protein needs with fewer calories and fat than other protein-rich foods such as meat and poultry.

Benefits of a seafood rich diet:

- Reduces the risk of cardiovascular disease
- Helps protect against heart attack and sudden death
- Decreases risk of heart arrhythmias
- Decreases blood triglyceride levels
- Increases HDL (good) cholesterol
- Improves circulation
- Contributes to neurological development in infants
- Contributes to vision development and nerve growth in the retina
- Helps build muscles and tissues

Seafood

Storing & Handling

The storage life of seafood depends on how well you take care of it, whether a whole fish or a live oyster. When your seafood purchase arrives home, store it immediately in your refrigerator or bury it in ice. When purchasing fresh-frozen seafood, place it in the freezer immediately.

Fish. The shelf life of fish depends on the variety and its quality at the time of purchase. In general, you should use fish quickly—within one to two days.

Shellfish. Buy live shellfish from reputable dealers, or ask to see the certification tags that indicated the shellfish were harvested from safe waters. Store live shellfish, such as oysters and mussels in the shell, in a shallow dish covered with damp towels or moistened paper towels. Never put live shellfish in water or in an airtight container. Scrub shells with a stiff brush just prior to shucking or cooking.

Mussels live in the shell should be used within two to three days; clams and oysters in the shell, within seven to ten days. If some shells open during storage, tap them. They will close if alive; if not, discard them.

Store shrimp, squid, and shucked shellfish in a leak-proof bag or container. Squid and freshly shucked clams have a shelf life of one to two days. Shrimp and scallops have a shelf life of about two to three days. And freshly shucked oysters have a shelf life of five to seven days.

Live lobsters and crabs should be cooked the day they are purchased. Store cooked, whole lobsters or crabs in a rigid airtight container and use them within two to three days. Cooked, picked lobster or crab meat may be stored in a sealed moisture-proof container or bag for three to four days. Pasteurized crab meat can be refrigerated for up to six months before opening; use it within three to five days after opening. Follow the “use by” dates on the package.

Seafood

Freezing. After shopping, immediately store commercially wrapped frozen seafood in your freezer. Put it in the coldest part of the freezer, at a temperature as close to –20 degrees F as possible. As with other frozen foods, avoid prolonged storage by planning your purchases, keeping in mind "first in, first out." Commercially frozen seafood can be stored in the freezer for up to six months.

Thawing. Plan ahead; defrost fish overnight in the refrigerator. This is the best way to thaw fish to minimize loss of moisture. A one-pound package will defrost within twenty-four hours. Never defrost seafood at room temperature or with hot or warm water as bacteria on the surface will begin to multiply. If you forget to take the seafood out of the freezer in time, place it in the sink (still in the package) under cold, running water. A one-pound package will defrost in about an hour. You can use your microwave oven to partially defrost fish. Use the lowest defrost setting (10% to 30% power). A pound of fillets defrosts in five to six minutes. The fish should feel cool, pliable, and slightly icy. Be careful not to overheat it and begin the cooking process. Foods defrosted in the microwave oven should be cooked immediately after thawing.

Preparation. Be sure all surfaces and utensils that will touch the food are clean.
Always wash your hands with soap and warm water for at least twenty seconds before starting food preparation, before working with a new food or utensil, after finishing food preparation, before serving, and after going to the bathroom. Don't let juices from raw seafood, meat, or poultry come into contact with other food. Wash cutting board, utensils, counter, sink, and hands with hot, soapy water immediately after preparing raw seafood, meat, or poultry.

Cooking. Cook fish and shellfish thoroughly. Fish is cooked when it begins to flake and loses its translucent (raw) appearance. Cook fish until it reaches an internal temperature of 145 degrees F for at least 15 seconds. Seafood is usually cooked under moderate to high heat (425 degrees F). You need a reliable, continuous heat source. So don't cook it on a hot plate. Avoid interrupted cooking—completely cook the seafood at one time. If you're microwaving fish, you need to compensate for uneven heating and shorter cooking times. Be sure to rotate or stir halfway through the cooking process, cover to retain moisture, heat to an internal temperature of 170 degrees F for fifteen seconds, and allow to stand covered for two minutes after cooking.

Seafood

Scallops and shrimp turn firm and opaque when cooked. It takes three to five minutes to boil or steam one pound of medium-sized shrimp, and three to four minutes to cook scallops. Shucked shellfish, such as clams, mussels, and oysters, become plump and opaque when cooked. The FDA recommends that shucked oysters be boiled or simmered for at least three minutes, fried in oil for at least ten minutes at 375 degrees F, or baked at 450 degrees F for at least ten minutes. Steam clams, mussels, and oysters in the shell for four to nine minutes after water reaches a full boil. Use small pots to steam shellfish. If too many shells are cooking at once, the centers may not cook thoroughly. Discard clams, mussels, or oysters that don't open during cooking. They may not have received adequate heating. When cooking frozen clams, mussels, or oysters in the shell, follow the directions on the package.

Marinades. Marinate seafood in the refrigerator in a glass or plastic container; avoid metal. Avoid cross-contaminating other foods by cleaning all utensils, bowls, or surfaces the marinade comes in contact with after it has been combined with raw seafood. Don't save marinades that have been combined with raw seafood unless they are immediately cooked in a sauce. Bring the marinade to a rolling boil before adding other ingredients. Then cook the sauce to at least 160 degree F. If fish is to be consumed raw, use only previously frozen fish. Do not consume raw or undercooked fish or shellfish if your immune system is compromised in any way.

Serving. Never put cooked seafood back on the plate that held the raw product. Place leftovers in smaller containers and refrigerate them within two hours when the temperature of the food serving area is below 90 degrees F and within one hour when the air temperature is 90 degrees F or above.

Keeping Seafood Safe at Home

by Annette Reddell Hegen, C.H.E.
Seafood Consumer Education Specialist
Texas Marine Advisory Service

Growing public awareness and concerns about seafood contamination have sparked a renewed interest in seafood safety, with inspection becoming a critical issue. Of the 13 billion seafood meals consumed annually, however, very few present risk more severe than other foods of animal origin.

Through the commercial industry's efforts, which are backed by state and federal government regulations, the consumer is assured of receiving a safe, wholesome, nutritious food. The safety and wholesomeness must be maintained through proper handling, storage and preparation — a responsibility that is also the consumers after purchase.

Seafood is no exception when it comes to the importance of handling and preparing foods properly to minimize the risk of food-borne illness.

Purchasing

* **Know Your Seafood Retailer.**

Buy seafood products from approved licensed stores and markets.

* **Purchase Raw Shellfish Carefully.**

Buy raw oysters, clams and mussels only from approved, reputable sources. If in doubt, ask the seafood market personnel to show you the certified shipper's tag that accompanies "shell-on" products or check the shipper number on shucked oyster containers. Shell stocked products must be alive when purchased. Do not accept dead oysters, mussels or clams unless they are cooked or the meat is shucked and chilled.

Storage

* **Keep Seafoods Cold.**

Keep fresh, pasteurized or smoked seafood products refrigerated at 32-34 degrees Fahrenheit. If this is not possible, store seafood "on the rocks." Wrap it tightly in a plastic wrap or securely in a plastic container and place ice above and below it. Store it in the coldest part of the refrigerator and replace the ice as it melts. Keep frozen products rigidly frozen until ready to use. Store in freezer at 0 degrees Fahrenheit. It is a good idea to check actual freezer and refrigerator temperatures from time to time with a thermometer.

* **Refrigerate Live Shellfish Properly.**

Live shellfish, such as clams, mussels and oysters should be stored in well-ventilated refrigeration, not in air-tight plastic bags or containers. Live lobsters and crabs should also be stored in a well-ventilated area. Cover them with damp paper towels in the refrigerator.

* **Keep Live Shellfish Alive.**

Do not cook or eat shellfish such as lobsters, crabs, clams, oysters or mussels if they have died during storage. Discard them.

Handling and Preparation

Proper handling of fish and shellfish varies depending on the type of product, the market form (fresh or frozen) and how it is to be prepared.

* **Don't Cross Contaminate.**

Handle raw and cooked seafood products separately. Thoroughly clean and rinse work space between each step. This also includes cleaning the knives, containers and cutting boards used during preparation. Plexiglass or plastic cutting boards are preferred over wooden ones that cannot be sanitized properly. Keep raw and cooked seafoods from coming in contact with each other.

* **Cook Fish and Shellfish Thoroughly.**

Fish is cooked when it turns opaque and reaches an internal temperature of 145 degrees Fahrenheit. Follow processors' directions when preparing frozen, packaged seafood products.

* **Eating Your Own Catch.**

If you catch your own fish or shellfish from local waters, make sure the waters are approved for harvest. Check with your state or local health department. The Texas Department of Health can tell you which bays are open for shellfishing. Call (512) 458-7277 for round-the-clock information on oyster, clam and mussel harvesting.

Frozen Seafoods

Follow the package directions when cooking or heating processed frozen seafoods. Where frozen seafood is to be thawed before cooking, thaw in the refrigerator or in cold water, not in warm water or at room temperature.

* **Thawed Seafood May Be Refrozen.**

There will be some quality loss, but it will not make you ill.

* **For Convenience, Head Shrimp Before Freezing.**

Shrimp may be frozen with heads on, but it makes for a bulky package and additional work at preparation time. Also, the sharp shrimp rostrum (horn) may puncture the package material and cause dehydration.

Raw Seafoods

Many consumers enjoy raw or lightly marinated seafoods. Just as the consumption of raw or rare meat, raw eggs and raw milk carries a risk of food-borne gastrointestinal illness, so does consumption of raw fish (sashimi, sushi and ceviche) and raw oysters, clams and mussels.

Here are some special tips to reduce this risk:

* If not previously frozen, hard freeze product intended for preparation of

Seafood is the Cause of Human Illness Only When

- **It comes from contaminated waters and you eat it raw.**
- **You eat it raw and it has spoiled because of improper handling.**
- **It spoils because it has not been handled properly either by the fisherman, the dealer, the restaurant or you at home.**
- **It spoils because there is damage to the package and bacteria has entered.**
- **It contains toxins produced by or found naturally in that species of fish.**
- **You are allergic to the seafood and you inhale fumes from that species of seafood, either raw or cooked. Food poisoning is often mistaken for food allergy.**
- **It contains certain parasites that have not been destroyed because it is served raw or lightly cured.**

sashimi, sushi or ceviche for seven days to avoid the slight risk of problems with parasites.

* Be certain that oysters, clams and mussels come from certified growing waters. Make certain they are kept well refrigerated until use. Do not buy dead oysters in the shell, dead mussels in the shell or uncooked whole crabs if they are dead.

Seafood Parasites

Although parasites are usually harmless, few of us would consider eating infested fish on purpose. Removing the "worms" or cutting away the affected portions leaves the fish perfectly edible. Fish parasites do not produce poisons. Parasites too small to see may be present and these are completely destroyed by cooking, freezing for at least 72 hours or by hot smoking. They may survive other procedures, such as brining, pickling, cold smoking and marinating. The occurrence of parasites depends on biological cycles. Virtually any species can be a host if the environmental conditions are right. The likelihood of encountering a seafood parasite is greatly enhanced by eating raw seafood.

To avoid all risk from parasites, enjoy your seafood cooked.

The food supply available to U.S. consumers is not only abundant and of wide variety, but it also is fundamentally safe.

This basic food safety, often taken for granted, is the responsibility of the food industry and assured by the regulatory activities of the federal Food and Drug Administration and the U.S. Department of Agriculture, as well as by state and local food regulatory agencies.

Consumers, too, have a responsibility to handle, store and prepare foods of all types properly to be assured of continued safety.

High-Risk Individuals

Individuals with chronic liver disease or compromised immune systems should avoid consuming raw or partially cooked oysters. The FDA has advised that a common saltwater microorganism, *Vibrio vulnificus*, carried at times by oysters especially in summer months from Gulf coast waters, can be the cause of severe illness and death for individuals with such medical conditions as:

Liver disease, including cirrhosis and hemochromatosis; chronic alcohol abuse; cancer (especially if taking anti-cancer drugs or radiation treatment); diabetes mellitus; chronic kidney disease; inflammatory bowel disease (or any person receiving immunosuppressive drugs); steroid dependency (as used for conditions such as chronic obstructive pulmonary disease, etc.); achiorhydria (a condition in which the normal acidity of the stomach is reduced or absent).

Since the microorganism is destroyed by heat, consumers with these conditions are advised to enjoy shellfish in their many delicious, cooked preparations.

In General Remember These Tips

Keep it safe, refrigerate. Refrigerate food you'll use quickly. Freeze raw seafood you can't use in one or two days. Your freezer should register 0 degrees Fahrenheit; your refrigerator, 32 to 34 degrees Fahrenheit.

Don't thaw food on the kitchen counter. Bacteria multiply fast at room temperature. Thaw in cold water, in the refrigerator or in the microwave oven.

Wash hands in warm, soapy water before preparing food. Wash hands and utensils after touching raw seafoods. Wash cutting boards and work surfaces, too. Don't let bacteria migrate from raw foods to other dishes.

Never leave perishable seafoods out for more than two hours.

Thoroughly cook raw products.

Freeze or refrigerate leftovers promptly. To reuse, heat to bubbling, 175 to 185 degrees Fahrenheit.

References

FDA Consumer, February 1989, p. 25.

National Fisheries Institute, Washington, D.C., 1989, 1992.

Seafood and Health, Joyce Nettleton, Osprey Books, 1987.

Tufts University Diet and Nutrition Letter. Vol. 7 No. 4. June 1989.

This seafood nutrition bulletin is furnished as a service of the Texas Marine Advisory Service in cooperation with the Texas Parks and Wildlife Department. The Texas Marine Advisory Service is a cooperative effort of the Texas A&M University Sea Grant College Program, Texas Agricultural Extension Service and participating county commissioners' courts.

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Texas A&M University
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Crops

Corn

Texas harvests nearly 2 million acres of corn every year which brings in a cash value of $514 million for Texas farmers! A typical ear of corn has approximately 800 kernels, but can vary from 500 to 1,200! Corn is grown across the state of Texas, but not all corn is the same.

Corn – human food use. More than 100,000 acres of corn grown in Texas for snack and staple foods processing including extruded products (chips), ethnic baked goods, tortillas, corn flakes, meal and other products. Food-grade corn is 80% white types and is produced under contract with irrigation and close adherence to pest management, mycotoxin avoidance, and quality assurance. Key production areas are Winter Garden/Uvalde area and High Plains.

Insects: corn earworm, annual weeds, molds.

Corn – pop. Production irrigated to assure good yields and consumer quality. Harvested with a special combine with smaller screens and modified cylinder bars to avoid kernel damage. Hard starch absorbs moisture with a 40-fold expansion when heated; kernels invert to make a snack food. Production is similar to field corn but with more pest scouting and treatment to avoid corn earworm damage. Quality assurance includes close adherence to pesticide labels.

Corn Cob Corn – sweet. High sugar content at soft dough stage distinguishes it from field corn. Commercial production for processing as canned or frozen product. Grown in small plots for fresh product; local sales in East Texas. Some shipped to area grocery stores in August and September. Both white and yellow types.

Insects: fall armyworm and corn earworm.

Diseases: foliar diseases.

Corn

Corn in Texas

Nutrition

One ear of corn provides –

- 10% of the daily recommended amount of fiber your body needs.
- Vitamin A (promotes growth and normal vision and protects against night blindness.)
- Corn is also low in fat and sodium which is important to heart health … just remember to skip the butter and cheese when eating corn so you aren't adding fat, sodium, and calories!

Production

Ever wonder the process corn undergoes to make it on your dinner plate or in your gas tank? Each year, Texas farmers plant and harvest millions of acres of corn.

We eat what is known as food grade or sweet corn and is the type that is found in the grocery store. I can be eaten off the ear fresh or bought in cans or frozen. Fresh sweet corn is found most often during the summer and is sweet and juicy.

Animals eat feed grade corn called field or dent corn. This type of corn is the most abundant form of corn grown across the United States, and Texas. Most of the corn seen in fields is probably field corn. This grade of corn is characterized by its' hard outer shell.

Both are grown in Texas due to favorable soil and climate. No matter what type, the plant looks the same.
The production of corn can be outlined in six steps:

- Field Prep
- Seeding
- Irrigation
- Silking & Pollination
- Harvest
- Processing

Texas corn growers:

- Plant more than 2 million acres annually.
- Yield an average of 105 bushels per acre.
- Averaged more than 285 million bushels annually in the past 5 years.

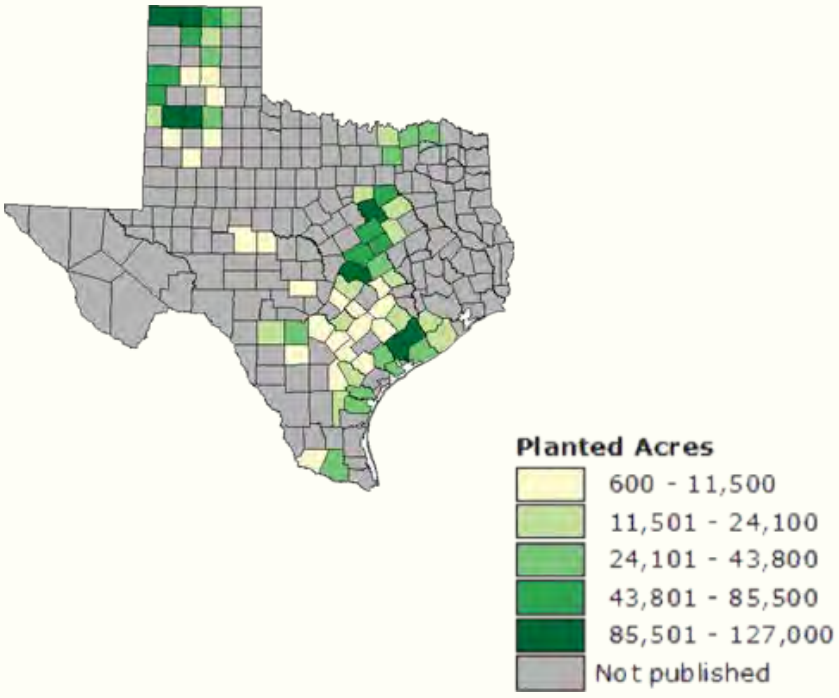
Corn

Planting & Harvesting

Planting corn is a balance of ensuring the soil is warm enough to germinate the seeds, but not so early that the young plants risk being damaged by frost. Depending on geographical location and climate, Texas farmers typically begin planting corn as early as January and as late as June. Corn typically takes approximately 120 days to reach maturity; however, different corn hybrids take different lengths of time to reach maturity. Once corn reaches maturity, it is then harvested. Similar to planting season, harvest season varies from region to region and greatly depends on weather conditions. Depending on geographical location, farmers typically begin harvesting corn as early as July and as late as November in the state of Texas.

Processing

In Texas, corn is harvested in the late Summer (July to November), depending on which part of Texas you live. Large machines called combines are used to harvest corn.



These machines pull the ear off of the corn stalk and shell it off the cob, leaving you with just the kernel.

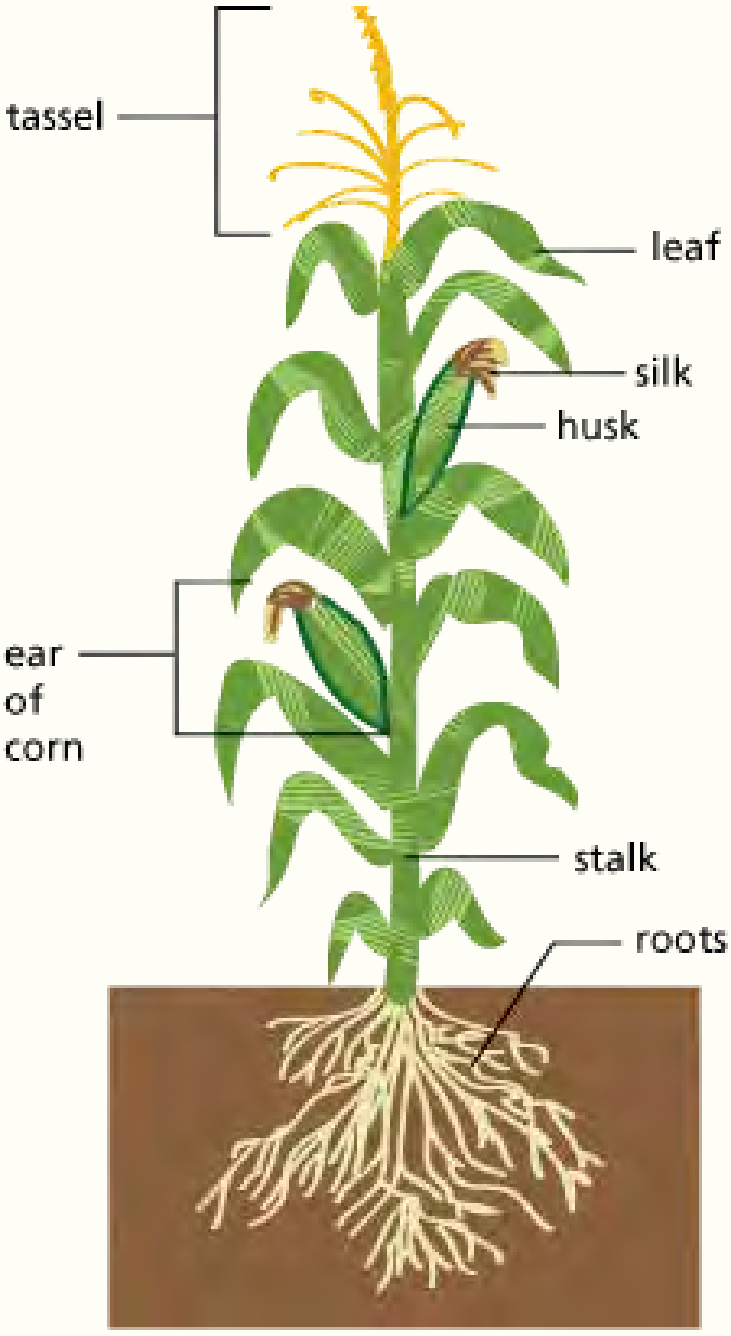
After harvesting, feed corn can be cleaned and bagged before going directly for animal consumption. It can also be cracked or ground for animal use. Corn is one of the best sources of energy and nutrition available for livestock production and is used in almost all livestock diets.

Sweet corn can be eaten fresh (on the cob), canned, frozen, or made into tortillas, chips, or other foods.

Corn

Parts of the Plant

- Tassel – this is the male part of a mature corn plant and sits at the top of the plant and attracts insects
- Stalk – the main body of the plant that is quite sturdy and stable because it must support the ears of corn
- Leaf – there are numerous leaves per stalk that are long and typically grow up slightly before curving downward
- Grain Kernel – this is the edible part of an ear, containing four main parts: endosperm, pericarp, germ, and tip cap
- Silk – this is the female flowers of a corn plant and each silk connects to an individual grain kernel
- Ear – this part is made up of the silk, husk, kernels, and cob of the plant. Ears are harvested when mature
- Prop Roots – this is the section of roots that grow just on top of the soil
- Roots – the main section of roots that grows beneath the soil



Corn

Corn Brief

Corn Production

- Texas harvests nearly 2 million acres annually.
- The cash value to farmers is $514 million, which generates $1.7 billion for Texas.
- Both food- and feed-grade corn are produced, due to favorable environmental factors.

Insect Pests

- Bt corn has been rapidly adopted in the High Plains where stalk borers are a problem.
- Integrated pest management, including crop rotation and planting resistant hybrids are commonly practiced.
- 66% of acreage is scouted and insecticides are applied based on economic tresholds. Soil insects are major pests in southern areas. Foliar insects and stalk borers are more common in the High Plains.
- Major insects include spider mites, European and southwestern corn borers, western corn rootworm, Mexican rootworm, corn earworm, and fall armyworm.
- Bifenthrin (Capture) is used to control borers and mites. Permethrin (Pounce, Ambush) and esfenvalerate (Asana) are also used.
- Carbofuran (Furadan- a carbonate), chlorpyrifos (Lorsban- an OP), dimethoate (Cygon- an OP), and terbufos (Counter- an OP) are commonly used but are targeted for review under FQPA.

Corn

Corn Brief

Diseases

- Corn hybrids are bred for genetic resistance to most diseases.
- Crop rotations and planting disease- resistant hybrids reduce disease impacts.
- Seed is treated but no fungicides are applied in the field.

Weeds

- Weed control is the primary concern of corn producers. 83% of all pesticide used in corn is aimed at controlling weeds.
- 82% of the producers rotate fields. Mechanical cultivation, adjusted planting and harvesting dates, and herbicide use are common weed control practices.
- Pigweed, annual grass, several perennial broadleaf weeds and johnsongrass are major problems.
- Atrazine is the primary herbicide and is used on 70% of the corn acreage. Atrazine is a mainstay herbicide but its use is under review by the EPA. Other herbicides commonly used include metolachlor (DUAL), dicamba (Banvel), nicosulfuron (Accent), and dimethenamid (Frontier).

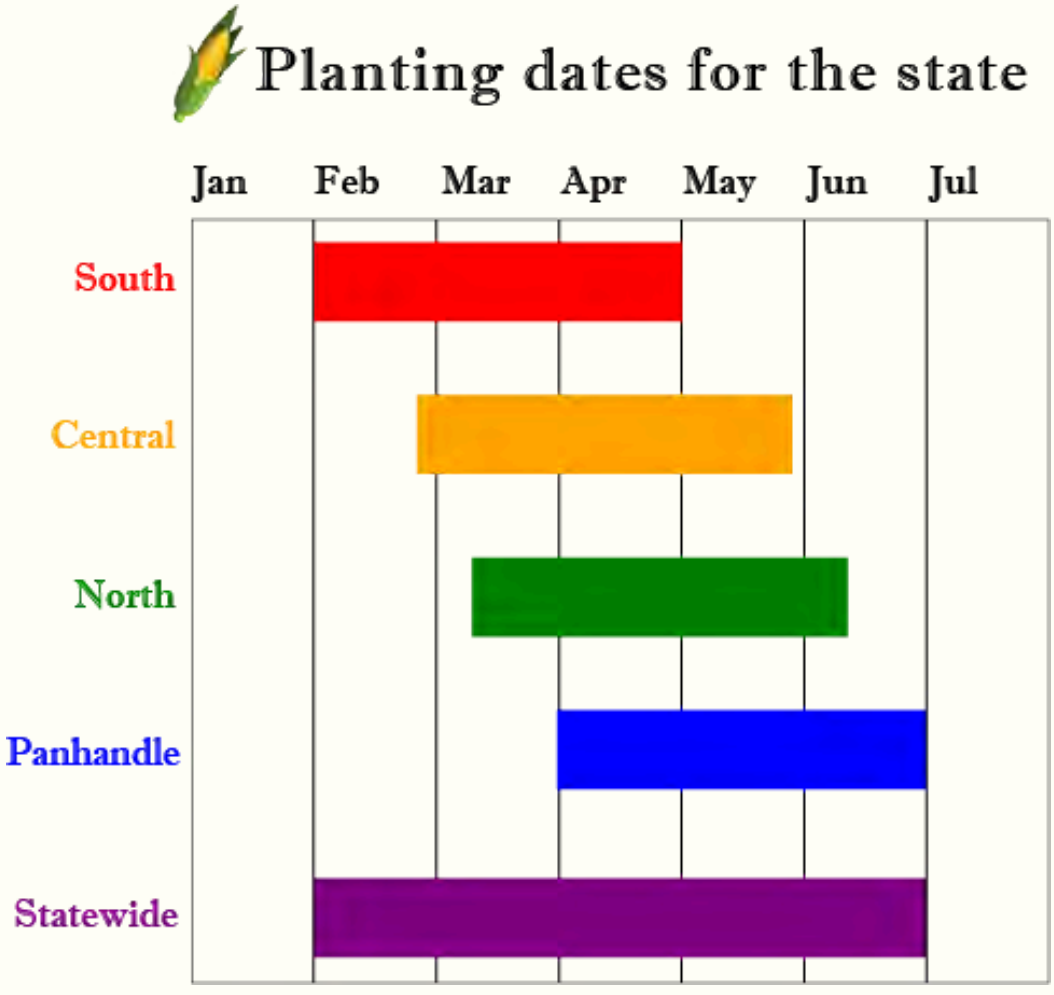
Outlook

- Public and private breeding programs strive to improve insect and disease resistance.

Corn

Corn Brief

- Independent crop advisors check most corn fields. Chemicals are costly, so use is based on scouting, pest presence, and expected markets.
- For latest information regarding these issues and status of risk assessments visit ipmwww.ncsu.edu/opmppiap and www.epa.gov/pesticides.



TEXAS A&M AGRILIFE EXTENSION
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Easy Gardening

SWEET CORN • SWEET CORN • SWEET CORN • SWEET

Joseph Masabni, Assistant Professor and Extension Horticulturist, and Patrick Lillard, Extension Assistant, The Texas A&M System

Sweet corn is a member of the grass family. In smaller gardens, it should be planted in square blocks instead of long rows to improve cross-pollination between corn stalks. Like most vegetables, corn will grow best in areas with plenty of sunlight.

Corn is one of the plants grown in the traditional Native American vegetable technique call the Three Sisters. The other two plants in the Three Sisters are beans and squash, and each had its role in this companion planting tradition. Corn served as a support for the vining beans. Squash served as a ground cover, preventing weeds from growing. Beans provided natural fertilizer for all.

Site selection

Corn can tolerate many soil types but prefers well-drained soils with a pH between 5.5 and 7.0. In sandy soils or soils with a low pH, corn may suffer from magnesium deficiency.

Varieties

Normal sugary	Sugary enhanced (se)	Shrunken (sh2)
Bonanza Merit Silver Queen Sweet G-90	Ambrosia Argent Bodacious Golden Queen Kandy Korn Legend Tendertreat	Crisp-N-Sweet Florida Staysweet Frontier Honey n Pearl How Sweet It Is Mirai Summer Sweet
Popcorn		
Robust White Strawberry		

Soil preparation

Remove weeds, rocks and trash, and work the top 8 to 10 inches of soil before planting. Work the soil only when it is dry enough not to stick to garden tools.

Fertilizing

Use 2 to 3 pounds of fertilizer, such as 10-10-10, for every 100 square feet of garden area. Spread the fertilizer evenly over the soil and work it into the soil 3 to 4 inches deep. Rake the soil to smooth the surface.

Planting

Sweet corn is a warm-season crop and must be planted after the soil warms and there is no more danger of frost. If you have room, plant again when the first corn plants have three to five leaves. This usually takes 2 to 3 weeks.

You will need 1 to 2 ounces of seed for every 100 feet of row. Do not use seed saved from last year's sweet corn as these seeds will not grow a good crop.

Sweet corn grows best when planted in several short rows instead of one long row. This makes it easier for the corn plants to pollinate, and good pollination is necessary for ears of corn to have plump, juicy kernels.

Figure 1. Plant corn in several short rows, not in one or two long rows.

Figure 2. Poorly filled corn is caused by poor pollination.

Plant the corn seeds about 1 inch deep and 3 to 4 inches apart in the row. Space the rows 2½ to 3 feet apart. After the plants are up, thin them to 1 foot apart. If you plant them closer, your corn will have small, poorly-filled ears (Figs. 1 and 2.)

Watering

Water sweet corn as needed to keep it from wilting. Do not let corn suffer from lack of water when the kernels are forming.

Care during the season

Hoe or till the soil just under the surface. Hoe the weeds off just below the soil's surface. Deep hoeing will cut the corn roots, which are close to the top of the soil.

When the plants are about 2 feet tall, apply 1 cup of fertilizer for every 10 feet of garden row. Scatter the fertilizer evenly between the rows and mix it lightly with the soil. Water after fertilizing (Fig. 3.)

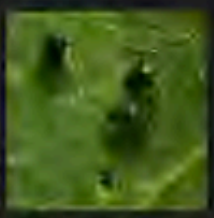
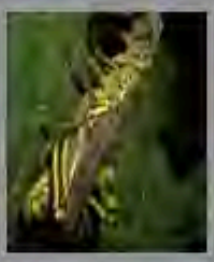
Figure 3. When corn is about 2 feet tall, scatter 1 cup of fertilizer for every 10 feet of row and water it in.

Diseases

If a few of your corn plants are stunted, they may have a viral disease and should be removed to keep the virus from spreading.

Harvesting

Corn is ready for harvest about 3 weeks after the tassel grows on top of the corn plant. Corn is ripe when juice from the kernels is milky white, the silk on the ears has turned dark brown, the ears are firm, and kernels on the tips of the unhusked ears are plump and milky. Sweet corn is not ready when the juice of the kernel is watery. It is overripe when the

Name and description		Control
 Corn earworm	Larva: Green, brown or pink, light strips along sides and on back; up to 1¾ inches long. Adult: Light to dark brown, or light olive green, with a wingspan of about 1½ inches.	Sevin® Bt garlic juice extracts
 European corn borer	Larvae are pinkish tan; adults are tan and about ½ inch long and hold their wings in a delta shape at rest.	Bt garlic juice extracts
 Fall armyworm	Young larvae have light bodies and black heads; fully grown larvae are 1⅓ inches long with three yellowish-white lines down the back; adult moths are ¾ inch long and 1½ inches wide with gray wings and irregular white spots near the ends.	azadirachtin Bt garlic juice extracts kaolin spinosad
 Flea beetle	Completely black beetle 1/16 inch long.	crop rotation resistant varieties permethrin Sevin® garlic juice extracts azadirachtin
 Grasshopper	Grasshoppers are chewing insects with mandibles that tear off food. They make sounds by rubbing their hind legs together.	garlic juice extracts azadirachtin pyrethrin Sevin®

kernels get large, chewy and pasty like dough.

The best time to pick corn is in the early morning or evening when it is cool. To harvest the ears, hold the stalk below the ear and twist the tip of the ear toward the ground until it breaks off. Cook the corn right away, or store it in the refrigerator until mealtime. Corn loses flavor and nutrients quickly when left at high temperature. Watch the corn closely because the quality changes fast.

Serving

Corn has small amounts of many vitamins and minerals and is best when cooked immediately after picking. It can be cooked either on or off the cob. Remove husks, silk and bad spots just before cooking. Corn which is past its best quality is still good as cream-style corn.

Storing

Store corn in the husk. Place it uncovered in the refrigerator for 1 or 2 days. Corn stored for more than 2 days loses its sweetness.

Cleanup

Old corn plants are good compost to add to the garden soil. They will break down much faster if shredded before composting.

Cotton

We've all heard the slogan "Texas is like a whole other country", and from a cotton production perspective it's certainly fitting. Almost anywhere you travel in Texas, you'll be in cotton country.

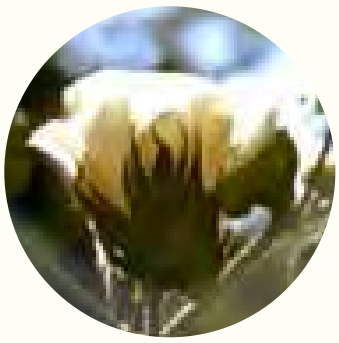
Texas leads the U.S. in cotton production and it is our leading cash crop, ranking only behind the beef and nursery industries in total cash receipts. Texas annually produces about 25% of the entire U.S. crop and plants over 6 million acres! That's over 9,000 square miles of cotton fields.

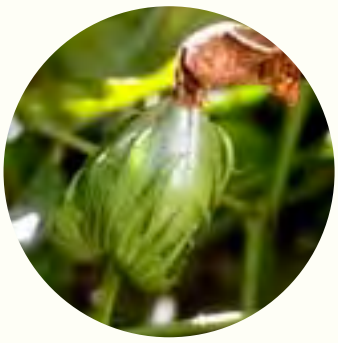
How Cotton is Grown

Step 1- Seeding is done with mechanical planters which cover as many as 10 to 24 rows at a time. The planter opens a small trench or furrow in each row, drops in the right amount of seed, covers them and packs the earth on top of them. The seed is planted at uniform intervals in either small clumps ("hill-dropped") or singularly ("drilled"). Machines called cultivators are used to uproot weeds and grass, which compete with the cotton plant for soil nutrients, sunlight and water.

Cotton

Step 2- Budding. About two months after planting, flower buds called squares appear on the cotton plants. In another three weeks, the blossoms open. Their petals change from creamy white to yellow, then pink and finally, dark red. After three days, they wither and fall, leaving green pods which are called cotton bolls. Inside the boll, which is shaped like a tiny football, moist fibers grow and push out from the newly formed seeds. As the boll ripens, it turns brown. The fibers continue to expand under the warm sun. Finally, they split the boll apart and the fluffy cotton bursts forth. It looks like white cotton candy.





Cotton

Step 3- Harvesting. Since hand labor is no longer used in the U.S. to harvest cotton, the crop is harvested by machines, either a picker or a stripper. Cotton picking machines have spindles that pick (twist) the seed cotton from the burrs that are attached to plants' stems. Doffers then remove the seed cotton from the spindles and knock the seed cotton into the conveying system.

Conventional cotton stripping machines use rollers equipped with alternating bats and brushes to knock the open bolls from the plants into a conveyor. A second kind of stripper harvester uses a broadcast attachment that looks similar to a grain header on a combine. All harvesting systems use air to convey and elevate the seed cotton into a storage bin referred to as a basket. Once the basket is full, the stored seed cotton is dumped into a boll buggy, trailer or module builder.

Step 4- Preparation for next year's crop. Since hand labor is no longer used in the U.S. to harvest cotton, the crop is harvested by machines, either a picker or a stripper. Cotton picking machines have spindles that pick (twist) the seed cotton from the burrs that are attached to plants' stems. Doffers then remove the seed cotton from the spindles and knock the seed cotton into the conveying system.

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Cotton By-Products

Cottonseed is an excellent source of protein. It is fed to animals as an important nutritional energy source. However, it naturally contains gossypol, a naturally occurring compound created by the plant to provide defense to pests and diseases. For cottonseed oil, gossypol is removed in the refining process. To remove gossypol and extend the uses of cotton seeds, new cotton strains are being developed minimal or reduced gossypol, which unlocks new opportunities for us to use cottonseed as a food product.

Innovative research has explored milling cottonseed for use as a wheat flour substitute in baked goods such as cookies and cakes, for example. So, what's the big deal about being able to eat cottonseed safely? Consider this: If all the cottonseed grown around the world were free of gossypol, the seed alone could meet the protein needs of 590 million people for one year. And it wouldn't take any more water, fertilizer, or land than is already being used to grow the crop since it is a byproduct of cotton production.

Cotton By-Products cont.

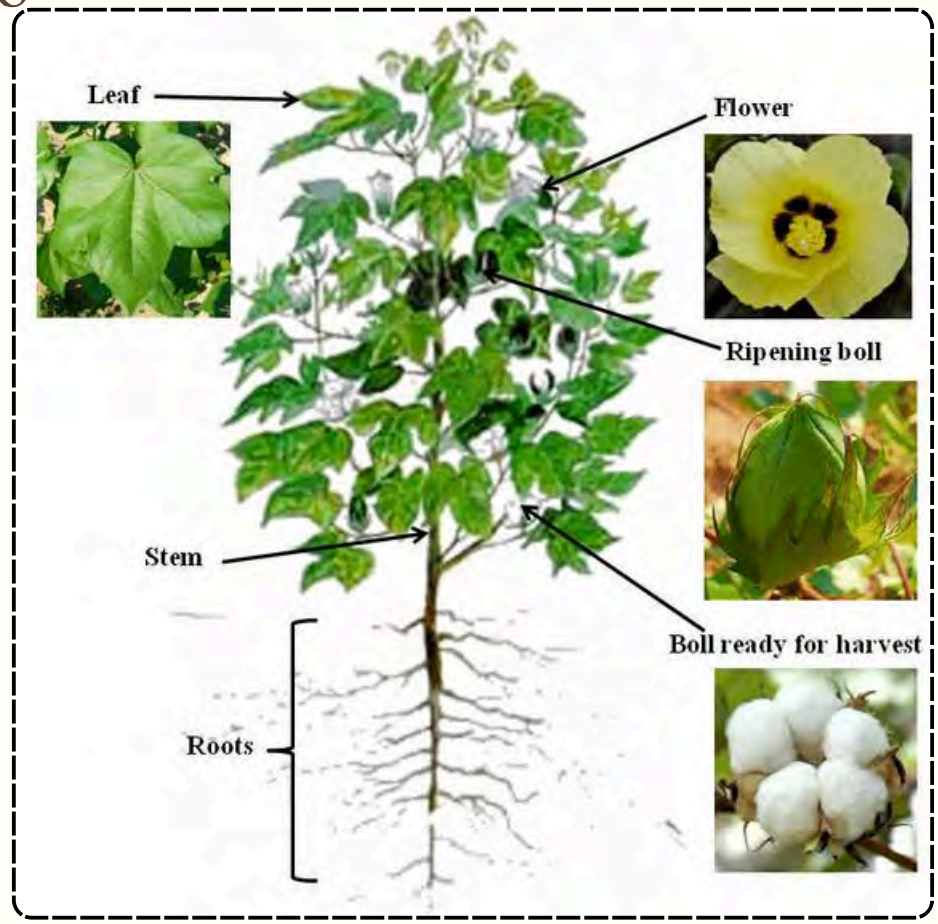
While global production of gossypol-free cottonseed is a long way off, incremental innovation and experimentation with new strains and new uses for cottonseed shows that cotton can become an even more valuable resource to growers and consumers everywhere.

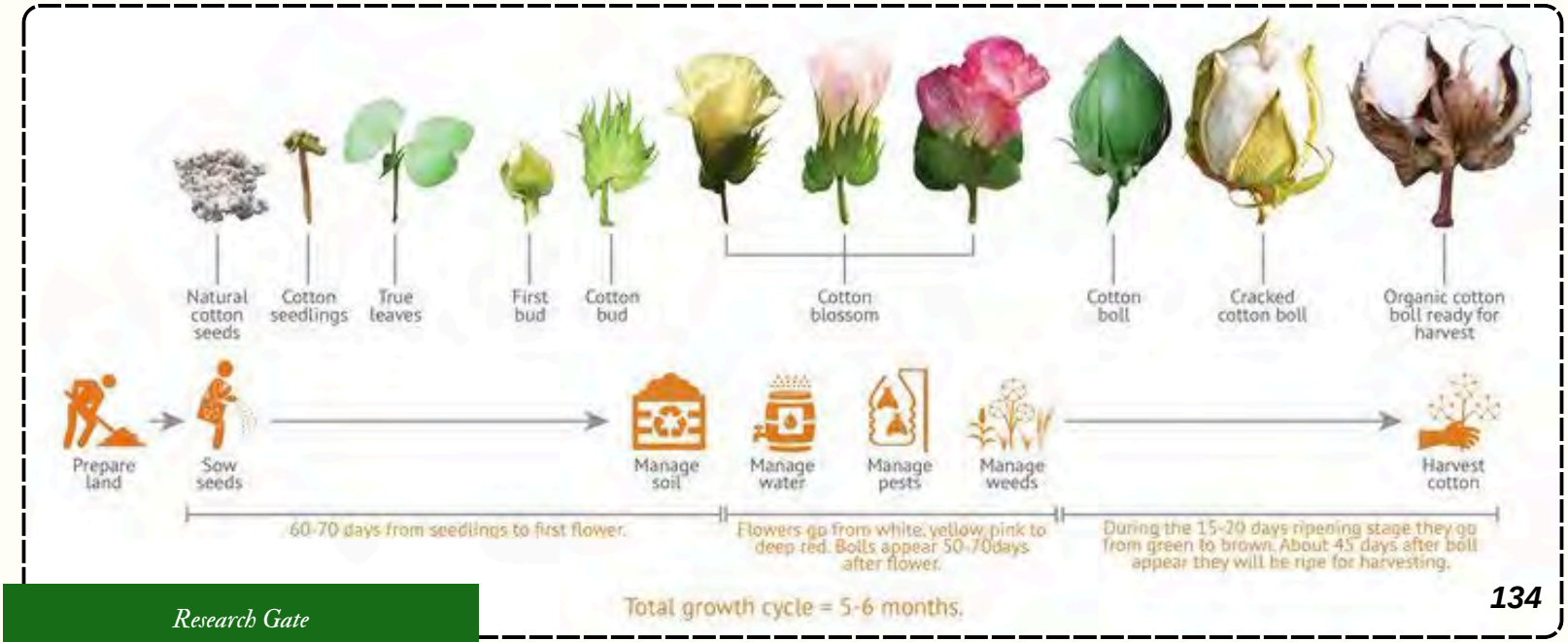
While cotton is known mostly for its natural fiber and its use in textile production, cotton does so much more than clothe us. Cotton production creates many byproducts, which is why it is known as an "and" crop – it produces fiber and linters and seed, without requiring extra land, water, fertilizer or other support. Once the lint has been taken off, cottonseed can be used to feed dairy cattle, and the seed kernels can be squeezed to make cottonseed oil, a protein-rich oil with countless uses. Cottonseed oil is used in a wide variety of products from salad dressing to makeup to toothpaste. It can also be processed and used for biodiesel to provide energy. Since cottonseed is a byproduct of cotton production, cottonseed oil has many environmental advantages over traditional vegetable oils.

Cotton linters, the tiny fuzz left on cottonseed hulls, are an extremely versatile by-product as well. Linters are commonly used to make products like paper, but it can also be found in food products such as ice cream. The cottonseed hulls themselves are used in hundreds of non-food products, including soap and fertilizers. Cotton's versatility and efficiency makes it an important crop for a growing global population striving for a more sustainable future.

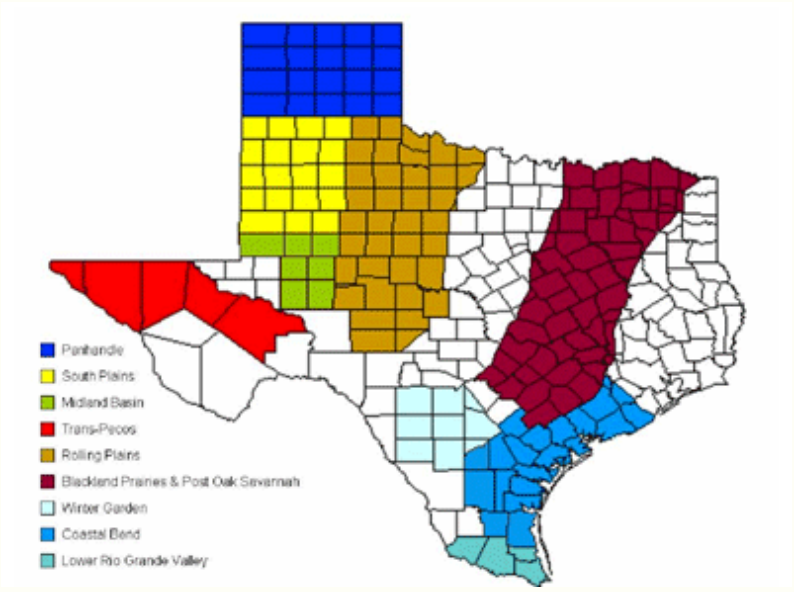
Cotton

Parts & Stages of Cotton Growth





Cotton Production Regions of Texas



Panhandle

The Texas Panhandle is the 20 northern most counties in Texas, bordered by New Mexico on the west and Oklahoma on the north and east. Cotton production in this area is relatively recent having begun in earnest in 2004. This area is largely rangeland; and corn, sorghum and wheat have traditionally been the crops of choice. Due to water constraints and fertilizer cost associated with growing corn, there has been significant interest in cotton as a rational crop with corn. Cotton is significant interest in cotton as a rational crop with corn. Cotton is used as a rotational crop in areas of dryland wheat production.

Elevation in this area ranges from about 2,000 to 4,700 ft and temperatures in this area are cooler than the rest of the state, averaging about 71degrees F (average 83:56 high:low degrees F) for the months of June-October. Because of cooler average temperatures and a shorter growing season, quicker ma turing varieties are preferred. High winds are common in this region, particularly in the spring months. Precipitation averages about 20 inches per year in the western Panhandle and occasionally up to 30 inches in the eastern portion; much of it occurs during the months of May-September. Approximately 50% of the cotton is irrigated. Cotton is planted in May and harvested in October through December. Irrigated yields average 500 to 1,000 pounds of lint per acre de pending on climate and irrigation capacity; dryland production averages 300 pounds of lint per acre.

South Plains

The South Plains is the largest cotton producing area in the world with acreage exceeding 3 million some years. This area comprises 19 counties north of the Caprock Escarpment and is centered at Lubbock. Much of this area is contiguous cotton production, particularly in the southern areas. In addition to cotton, other agricultural crops include peanuts, corn, grain sorghum and wheat. Temperatures on the South Plains vary with latitude and elevation, but average about 73de grees F (average 85:60 high:low degrees F) for the months of May-October for Lubbock. The South Plains is a transition area between desert conditions to the south and west and more humid conditions to the east and southeast. Precipitation in this area averages about 18 inches per year and occurs primarily from May-September. Much the rain comes from afternoon and evening thunderstorms, sometimes accompanied by large hail.

High winds are also prevalent on the South Plains, particularly during March-June. Approximately 60% of the cotton acreage in the South Plains is irrigated, but this varies greatly depending on location. Counties situated in the southeast and western portions of the South Plains tend to be primarily dryland, while counties in the southwestern and northern portions tend to have more irrigated acres. Cotton is planted in May and harvested in October through December. Irrigated yields average 500 to 1,000 pounds of lint per acre depending on climate and irrigation capacity; dryland production averages 300 pounds of lint per acre.

Cotton

Permian/Midland Basin

The Permian Basin is comprised of the area east of the Pecos River, is bounded on the north by the South Plains, extends south to Crockett County, and is bordered on the east by the Rolling Plains. This area is a major source of oil and natural gas and the majority of the area is comprised of rangeland. In addition to cotton this area produces grain sorghum. The Midland Basin is a semi-desert environment receiving about 15 inches of rain annually, much of which occurs from May-October. Despite the dry conditions, approximately 48% of the cotton grown in this area is dryland. Temperature for Midland averages about 77 degrees F (average 90:62 high:low degrees F) for the months of May-October. Cotton is planted from mid-April to mid-May and harvested in October through December. Irrigated yields average 500 to 1,000 pounds of lint per acre depending on climate and irrigation capacity; dryland production averages 300 pounds of lint per acre.

Trans-Pecos

The Trans-Pecos is the area west of the Pecos River, and is the only geography of Texas considered mountainous. It is bounded by the Rio Grande River on the south and west, and New Mexico on the north. This area is desert and receives about 10 inches of rainfall annually, primarily occurring during July-September. Because of the limited precipitation, 100% of the cotton in this area is irrigated. Most of the cotton production occurs along the Rio Grande River in El Paso and Hudspeth counties, and in Pecos County. In addition to cotton there are vast areas of rangeland. Vegetables, alfalfa and pecans are also grown. Temperatures for growing cotton are near ideal, averaging about 89 degrees F (average 89:64 high:low degrees F) for the months of May-October. Upland cotton varieties make up the majority of the acerage, although significant acerage of Pima is produced. Cotton is planted from mid-April to mid-May and harvested in October through December. Irrigated yields average 700 to 1,250 pounds of lint per acre depending on climate and irrigation capacity

Cotton

Rolling Plains

The Rolling Plains of Texas is situated south and west of the Caprock Escarpment and is bounded on the south by the Edwards Plateau and the east by the Cross Timbers. It extends from Hall and Childress counties in the north, to Schleicher to Mason counties in the south and Eastland County to the east. Approximately two-thirds of the area is rangeland. Cotton and wheat are the predominate crops in the area, along with, grain sorghum and hay. Peanuts are an important crop in the northern Rolling Plains. The Rolling Plains receives approxi mately 21 inches of precipitation per year, much of which occurs from May-October. About 85% of the cotton in the area is dryland. Temperature for growing cotton in the Rolling Plains is good, averaging about 77degrees F (average 87:61 high:low degrees F) for the months of May-October in San Angelo. Cotton is planted from mid-May to mid-June and harvested in October through December. Irrigated yields average 750 to1,300 pounds of lint per acre depending on climate and irrigation capacity; dryland yields average 350 pounds of lint per acre.

Blackland Prairies

The Blacklands consists of an approximate 300 mile belt of tall prairie grasslands bordered on the north by the Red River, west by the Cross Timber Area, east by the Post Oak Savannah., and stretches south to near San Antonio. It extends from Montague to Lamar Counties in the north, Guadalupe County to the south, Coryell and Bell Counties to the west and Brazos County to the east. The area originally consisted of native grassland with clumps of hardwood trees. However, today this area consists primarily of improved pasture and hardwood trees with dense understory brush. Because of the soil and climate, it is ideally suited for agriculture. In addition to cotton, other principle crops include wheat, corn and grain sorghum. Across the area, rainfall average about 33-39 inches annually. Temperature averages about 80 degrees F (average 90:67 high:low degrees F) with 70% relative humidity across the cotton growing season (April-September). Approximately 80% of the cotton is grown under dryland conditions. Most of the cotton produced with irrclimate and irrigation capacity; dryland production averages 400 pounds of lint per acre.

Winter Garden

The Winter Garden is between Laredo and San Antonio, and is centered in Frio County. This area is largely dominated by rangeland for cattle and game ranches, but includes notable corn, wheat, grain sorghum, cotton, vegetable and pecan production. The cotton growing season is from March-September, and temperatures during that time period average about 77degrees F (average 89:65 high:low degrees F). The Winter Garden averages about 30 inches of rain annually, which primarily occurs in the months of April-June, and September. Of the approximately 20,000 acres of cotton planted in this area, 78% of it is irrigated. Cotton is planted during March and harvested in August through October. Irrigated yields average 750 to 1,250 pounds of lint per acre depending on climate and irrigation capacity; dryland production averages 400 pounds of lint per acre.

Lower Rio Grande Valley

The Valley is situated at the southern tip of Texas and includes Starr, Hidalgo, Cameron and Willacy counties. The area is considered sub-tropical and is made up of flat, rich delta and alluvial soils. It is well suited for extensive agricultural production. Agriculture in the Valley is diverse and includes a variety of vegeta bles, citrus, corn, grain sorghum, soybeans and cotton. Temperatures during the cotton growing months of March-August average about 79 degrees F (average 89:69 high:low degrees F). The annual average rainfall in the Valley is about 27 inches, most of which occurs during May-October, with September being the wettest month. Approximately 40% of the cotton acreage is irrigated; most of it occurring in Cameron and Willacy counties. Cotton is planted in February through March and harvested in August through September. Yields vary widely depending on rainfall, with averages between 450 and 1,200 pounds of lint per acre.

Coastal Bend

The Coastal Bend stretches along the Gulf Coast from Fort Bend and Brazoria counties through Kleberg County. This area is typified by its flat coastal grasslands, igation capabilities is located along the Brazos River in Robertson, Brazos and Burleson counties. Cotton is planted from late March through April and harvested in August through October. Irrigated yields average 750 to 1,250 pounds of lint per acre depending on making it well suited for agricultural development. The Coastal Bend has a diverse array of agricultural industries including rangeland, improved pasture, rice, corn, grain sorghum, cotton and soybeans. The Coastal Bend averages 27-48 inches of rain annually, with diminishing precipitation north to south. In the northern area of the Coastal Bend, the rainfall distribution is fairly uniform throughout the year, while the southern areas typically see the majority of precipitation in the months of May, June and August-October, with September being the highest due to the frequency of tropical storms. Temperatures during the cotton growing season (March-September) average about 77° F (average 87:69 high:low degrees F). Only 6% of the cotton grown in this area is irrigated with most of that occurring in San Patricio, Bee and Wilson counties. Cotton is planted in late February through April and harvested in August through September. Yields vary widely depending on rainfall, with averages between 450 and 1,200 pounds of lint per acre.

Peanuts

Peanuts: a legume crop grown mainly for their edible seeds. They are widely grown in the tropics and subtropics and are important to both small and large commercial producers1. Peanuts provide protein, vitamins, minerals, and antioxidants. They may have other health benefits, including promoting fullness and helping protect against heart disease.

Weeds: pigweed, yellow nutsedge, morning glory, johnsongrass, nightshade, Texas panicum, sunflower, purslane, Russian thistle, and eclipta. Herbicides are applied on 93% of the acreage; mostly pendimethalin (Prowl), metolachlor (Dual), imazapic (Cadre), and imzethapyr (Pursuit).

Diseases: early and late leafspot, seed and seedling diseases, southern blight (stem rot), pod rot, tomato spotted wilt virus, peanut rust, Sclerotinia blight, Botrytis blight, and web blotch but less than 40% is treated.

Crop profile and crop brief provide more details on pests, scouting, and chemical use.

Texas ranks second in the U.S. in peanut production. Acreage has shifted to West Texas where 76% of the crop is produced south and east of Lubbock; 72% are runner types and 13% are Spanish, with some Virginia (12%) and Valencia types (3%). Insects include thrips, lesser cornstalk borer, southern corn root worm, burrowing bug, and armyworms, but less than 25% of crop is actually sprayed.

Peanuts

There are 4 varieties of peanuts. These are:

RUNNER

VIRGINIA

SPANISH

VALENCIA

Runner Peanuts

The most widely consumed variety, Runner peanuts have delicious flavor, great roasting characteristics and high yields. This medium-sized peanut is an ideal choice for use in peanut butters. Runner peanuts are grown in Texas, Georgia, Alabama, Florida and Oklahoma due to their need for a warm climate and sandy, well-drained soil.

Virginia Peanuts

Often called “cocktail nuts”, Virginia peanuts are considered large-kernelled. Its size makes it great for processing, particularly for salting, confections and in-shell roasting. Virginia peanuts are grown in Texas, southeastern Virginia and northeastern North Carolina.

Spanish Peanuts

Spanish peanuts are used mostly in peanut candies, peanut snacks and peanut butter. This peanut is easily identified by its smaller kernels and its reddish-brown skin. It also has a high oil content, which makes it an excellent choice for extracting oil. Spanish peanuts are grown mostly in Texas and Oklahoma.

Valencia Peanuts

Valencia Peanuts are a sweet peanut with a bright red skin. This peanut usually contains three or more kernels in a longer shell. Valencia peanuts are mostly served roasted and sold in-shell or boiled. While grown less frequently in the United States, its primary production region is in West Texas and New Mexico.

Peanuts

Nutrition

Pop a peanut in your mouth and you're snacking on 29 essential vitamins, minerals, phytonutrients and antioxidants. Naturally cholesterol-free, peanuts are also low in saturated fats and high in fiber, making them a delicious way to keep your muscles, skin, bones and organs functioning well. They're also an ideal treat for people with dietary issues like gluten intolerance or diabetes. So make peanuts and peanut butter a healthy part of your diet to reduce your risk of obesity, diabetes and many other diseases.

Peanuts & Diabetes

According to the U.S. Centers for Disease Control and Prevention, rates of type 2 or adult-onset diabetes have tripled in the last 30 years.

In the United States, more than 17 million people have diabetes, and 16 million more Americans are at high risk for developing the disease.

Did you know that eating peanuts and peanut butter can reduce your risk of diabetes?

A study from the Harvard School of Public Health found that women who ate five tablespoons of peanut butter each week could reduce their risk of type 2 diabetes by more than 20%. This relationship between peanut or peanut butter consumption and type 2 diabetes was linear – higher consumption resulted in a greater protective effect.

Peanuts

Allergies

Only a very small fraction of people suffer from peanut allergies. The Food Allergy and Anaphylaxis Network state that 0.6% of people in the United States have a peanut allergy, and that up to 20% of them are likely to outgrow it.

There are currently many promising new research efforts studying ways to successfully manage peanut allergies. Together doctors, parents and educators have been very successful in managing exposure to peanuts in schools and public settings.

Advances

One of the most significant advances in food allergy occurred with the release of the results from The Learning Early About Peanut Allergy (LEAP) study in early 2015. Led by Dr. Gideon Lack of King's College in London, LEAP showed a reduction in the development of peanut allergies of up to 86 percent in children who were exposed to peanut protein early.

The results led experts at the National Institute of Allergy and Infectious Disease (NIAID) to rethink how we approach food allergy prevention.

NIAID Guidelines

NIAID's new guidelines now recommend introducing peanut protein to infants as early as 4-6 months of age, depending on risk factors – including family history and signs of eczema.

Peanuts

Allergies (NIAID Guidelines cont.)

What's new about these guidelines is that they recommend the early introduction of peanut protein in infants between 4-6 months of age depending on risk (low, medium or high) to prevent peanut allergy. The NIAID guidelines also provide parents with simple ways to introduce peanut protein to babies (through thinned peanut butter, peanut puffs or powdered peanut butter) and recommendations for how frequently infants who are at-risk for peanut allergy should eat peanut foods (at least 3 times per week). If a baby isn't at risk for peanut allergy, parents can offer peanut foods as often as they would like.

Peanuts

Did you know these peanut fun facts?

- Texas is the only state to grow all four varieties and organic peanuts!
- Texas is the second largest peanut growing state in the nation!
- Peanuts are not nuts. They are legumes like beans, peas and lentils.
- The peanut plant originated in South America.
- Peanuts account for two-thirds of all snack nuts consumed in the U.S.
- One acre of peanuts will make 30,000 peanut butter sandwiches.
- Peanut butter is the leading use of peanuts in the U.S.
- It takes almost 850 peanuts to make an 18 oz jar of peanut butter!
- Peanut butter was the secret behind “Mr. Ed” – TV’s talking horse.
- March is National Peanut Month!
- November is National Peanut Butter Lovers’ Month!
- Two peanut farmers have been elected President of the United States: Thomas Jefferson and Jimmy Carter.
- Americans eat 3 pounds of peanut butter per person every year. That’s about 700 million pounds, or enough to coat the floor of the Grand Canyon!
- The average American child will eat 1,500 peanut butter sandwiches by the time he or she graduates from high school.

Peanuts

Added September 2025

Peanut Brief

Peanut Production

- Texas ranks 2nd in U.S. peanut production.
- Peanuts generate $560 million for farmers. The state impact exceeds $1.8 billion.
- Over 70% of the state's production is in the west Texas region.

Insect Pests

- Insects are scouted on 80% of peanut acreage but less than 25% of the crop is actually sprayed. Key insects are thrips, lesser cornstalk borer (LCB), burrowing bugs, and worm/foliar feeders.
- Organophosphates are important in Texas and are applied on 10% of the acres. These include phorate/Thimet, chlorpyrifos/Lorsban, disulfoton/Di-syston, and acephate/Orthene.
- Aldicarb (Temik-carbamate chemistry) is used on 10% of Texas peanuts to combat thrips and nematode problems. Nematodes cause an estimated 4-5% yield loss in Texas peanuts. There are no commercial replacements for aldicarb, except organophosphates or other carbamates.

Diseases

- Over 80% of peanut acreage is scouted for diseases and 72% of the crop is treated.
- Major diseases include early and late leafspot, seed and seedling disease, southern blight (stem rot), pod rot, tomato spotted wilt virus (TSWV), peanut rust, sclerotinia blight, botrytis blight, and web blotch.
- Two FQPA-targeted fungicides are tebuconazole (Folicur), which is used on 37% of the crop, and chlorothalonil (Bravo a B1 carcinogen) used on 32% of peanut crop. Commercial alternatives include azoxystrobin (Abound) and propiconazole (Tilt).

Peanuts

Added September 2025

Peanut Brief

Weeds

- Weeds are the most common pest encountered by peanut growers. Weeds reduce grower profits by competing for sunlight, water and nutrients. Weeds also host pathogens, viruses, and insects plus disrupt harvesting operations.
- 86% of Texas peanut acreage is scouted for weeds. Over three-fourths of the crop is cultivated, an average of 1.8 times, and over 70% is hand hoed. One-third of the acreage is rotated to other crops for two or more years to reduce weed problems.
- Essentially all growers (97%-100%) use herbicides and treat at least 93% of Texas peanut acreage. 95% of the herbicides are applied with ground sprayers.
- The most troublesome weeds in peanuts are pigweed, yellow nutsedge, morningglory, johnsongrass, nightshade, Texas panicum, sunflower, Russian thistle, and eclipta.
- Key herbicides include pendimethalin (Prowl), trifluralin (Treflan), ethalfluralin (Sonalan), metolachlor (Dual), 2,4-DB (Butyrac), imazapic (Cadre), and imazethapyr (Pursuit). While these herbicides are not in the Phase I of FQPA-targeted products, they will be eventually reviewed.

Outlook

- A major concern is the lack of effective soil-applied insecticides and nematicides.
- Diseases continue to be a problem, especially viruses transmitted by insects.
- For latest information regarding these issues and status of risk assessments visit ipmwww.ncsu.edu/opmppiap and www.epa.gov/pesticides.

Rice

Introduction

Rice is one of the most widely consumed foods in the world. It provides energy, nutrition, and cultural identity to billions of people. Nearly 85% of the rice we eat in the U.S. is grown by American farmers. Rice was grown by early American colonists as a major crop in 1700. Rice is grown in over 100 countries and on every continent except Antarctica. There are more than 40,000 different varieties of rice. In fact, rice is the main food for half of the people in the world. Commercial production of rice began in Texas in the 1800s. Texas is ranked 5th for rice production in the U.S. Rice is grown in the upper Gulf Coast area of Southeast Texas. In 2019, Texas farmers grew 157,000 acres of rice planted on 272 farms.

Basics

Rice grains are enclosed in a tough hull which must be removed. Underneath is the nutritious whole grain which may be brown, reddish, or black depending on the color of the bran layers.

All rice can be eaten at this stage which is 100% whole grain, but most are processed further. Whole grain rice is sometimes called brown rice. Each grain is made up of three main parts:

- *Bran*– the bran is the multi-layered outer skin of the edible rice grain.
- *Germ*– The germ is the embryo which has the potential to sprout into a new plant. It contains many B vitamins, some protein, minerals, and healthy fats.
- *Endosperm*– The endosperm is the germ's food supply, which provides essential energy to the young plant so it can send roots down for water and nutrients, and send sprouts up for sunlight's photosynthesizing power. The endosperm is by far the largest portion of the rice grain. It contains starchy carbohydrates, proteins and small amounts of vitamins and minerals.

In contrast to the short and medium-grain rices grown in Asia, Texas produces an extra-long grain paddy rice for high-end domestic and export markets.

Rice

Basics cont.

Although acreage in the ten upper Gulf Coast counties has declined 50% since the 1970s, yields have increased due to genetics, pest resistance, water management, and ratoon (second crop) production. RiceTec, in Alvin, Texas, operates a molecular breeding program for hybrid rice development. Red rice, a genetic contaminant, lowers quality and is extremely difficult to control.

Insects: rice water weevil, rice stink bug, and grasshoppers.

Diseases: sheath blight, crown rust and blast.

Nutrition

Rice is a source of carbohydrates to fuel the body and is a staple food for more than two-thirds of the world's population. Rice is also fat, cholesterol, and sodium free, as well as being non-allergenic and gluten-free. MyPlate recommends that at least one-fourth of the plate should be grains, specifically whole grains. In addition, at least 1/2 of our serving should be whole grains. Whole grain foods provide fiber, protein and carbohydrates, vitamins and minerals. Not all grains are considered whole grains. An example of this is white rice that has been milled to remove the bran and germ layers. This results in many of the vitamins and minerals being lost in the process and added back, which is known as enriched grains.

Rice

Process

Step 1: Field Prep – Rice fields are prepared for planting with precision GPS or laser-guided grading equipment to ensure the field is level.

Step 2: Flooding and Seeding – Water is flooded 5 inches deep into the fields. Rice seed is soaked in water and loaded into a plane which flies 100 mph over the field and drops the seed from the air. The heavy seeds sink into the soil and begin to grow.

Step 3: Rice Grows and Matures – Rice seedlings grow to maturity in four or five months. Early applications of crop protection materials ensure pure rice at harvest. The rice reaches a height of 3 feet as it matures. As the rice grows, the water level is maintained at 5 inches deep. In late summer, the grain heads begin to appear on the top of the plants.

Step 4: Harvest – In late summer, the grain heads are mature and ready for harvest. Before harvest can begin, the fields must be drained and allowed to dry. State of the art harvesters enter the fields and collect the ripe grain. Specialized tractors and wagons receive the harvested grain to carry it from the field.

Step 5: Milling and Storage – The harvested rice is carefully dried to the ideal moisture level for storage until a customer places their order. At the mill, the hull is removed first, leaving brown rice. White rice is the result of gently removing the bran layers to leave the inner, pearly grain.

Rice By-Products

The by-products of rice can be turned into edible and inedible products. Some common edible products include:

- Rice bran oil (*high quality cooking oil*)
- Rice flour, white or brown
- Cereals and snacks
- Rice starch (*thickener in sauces and desserts*)
- Rice syrup (*natural sweetener*)

Inedible by-products include:

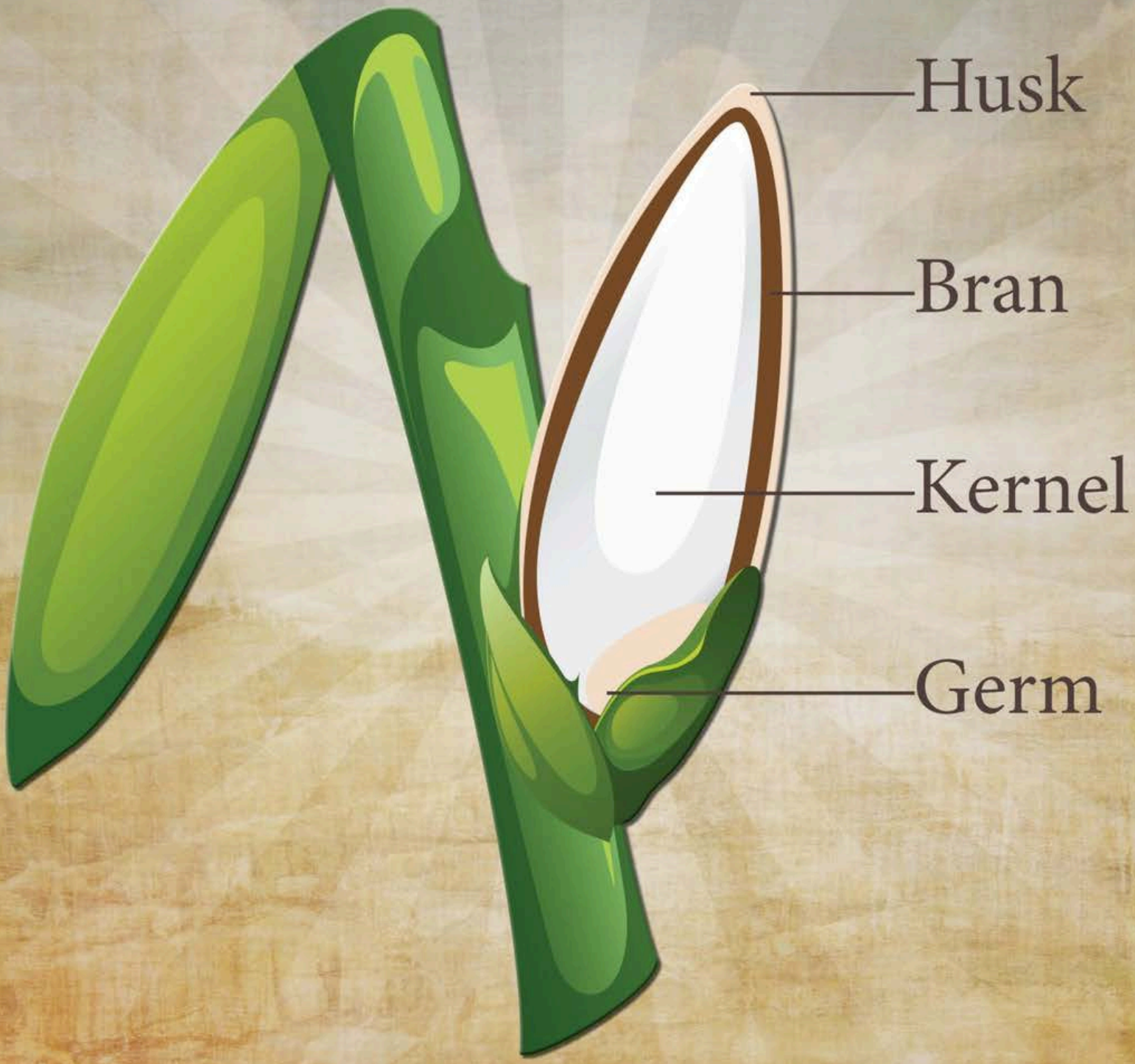
- Rice hulls can be used for (*mulch*)
- Broken rice (*rice flour and pet foods*)

Other common by-products include:

- Packing peanuts
- Abrasives

Parts of a Rice Plant

Rice is eaten around the world as the primary food in the diet by more people than any other single food.



PATH TO THE PLATE

TEXAS A&M AGRILIFE EXTENSION

Rice

LONG GRAIN RICE has a long, slender kernel, three to four times longer than its width. Due to its starch composition, cooked grains are lighter, fluffier, and more separated than their medium or short grain counterparts

MEDIUM GRAIN RICE has a shorter, wider kernel than long grain rice, two to three times longer than its width. Cooked grains are moist and tender, with a tendency to cling together.

TEXAS JASMINE is an aromatic long grain rice with a distinct flavor. Cooked grains are soft, moist, and cling together.

TEXAS BASMATI is an aromatic long grain rice with its own distinctive aroma and flavor. While cooking, the grains become longer, not wider. Cooked grains are long, separate, and fluffy with slightly chewy texture and a savory, nutty flavor.

TEXAS ARBORIO is a medium grain rice with a characteristic white dot at the center of the grain and a higher protein content than other medium grain varieties. This rice develops a creamy texture when cooked.

Rice

Rice Brief

Rice Production

- Texas ranks 5th in rice production
- 157,000 acres of rice planted on 272 farms in 2019
- Rice production contributes $140 million to the state economy
- Pest control is essential in both first- and “ratoon” crop rice.

Insect Pests

- Insects are devastating and are a major concern for rice growers every year. 98% of acreage is scouted and economic thresholds are commonly followed.
- Stink bug causes pecky rice, which reduces quality and lowers revenues 10 to 12%. Rice water weevil reduces yields by 10 to 15% if unchecked.
- Other pests include fall armyworm, chinch bug and stem borers.
- Non-chemical practices to reduce water weevil damage include laser leveling and delayed flooding for water management, seeding rates for uniform stands, and selective planting dates.
- 100% of the Texas rice acreage is treated with an insecticide at least once.
- Key insecticides include lambda cyhalothrin (Karate), diflubenzeron (Dimilin) and fipronil (Icon). Carbofuran (Furadan) is no longer used.

Rice Brief

- Methyl parathion and malathion (both OP's) are targeted by the FQPA but are important in the rice industry.

Diseases

- Diseases reduce yields 12%, in the humid gulf coast climate. 47% of the acreage is treated with one or more fungicides each year.
- Sheath blight is most damaging, followed by stem rot, rice blast, kernel smut, narrow brown leaf spot, panicle blanking complex, black sheath rot, and straight head. Texas A&M AgriLife
- Key fungicides include propiconazole (Tilt) and azoxystrobin (Quadris).
- Benomyl (Benlate– a carbamate) is important but used to a lesser extent.
- Capton, macozeb (Dithane), and other seed treatments are applied to planting seed but will be reviewed under FQPA.

Weeds

- Halsulfuron (Permit) for sedges and triclopyr (Grandstand) for broadleaves are important.
- Weeds cause economic losses in rice, even with widespread use of herbicides and non-chemical control measures.
- Integrated Weed Management includes cultural and mechanical practices, coupled with herbicide applications. Scouting determines infestations and herbicide timing.

Rice Brief

- Annual grasses (barnyard grass and sprangletop) and broadleaf weeds (hemp sesbania -coffeebean and alligatorweed) reduce yields 12 to 22%. Dayflower seed and red rice seed contaminates market rice and reduces grades by 4 to 8% or more.
- 97% of acreage is treated with a herbicide. Propanil (Stam) is usually applied with a residual herbicide, such as molinate (Ordram), thiobencarb (Bolero), quinclorac (Facet), or clomazone (Command).
- Molinate (Ordram) is under EPA review for worker safety concerns. But occupational exposure is now reduced with closed system bulk loading and GPS equipment on aircraft has totally replaced field flaggers.

Outlook

- Blackbirds are the most damaging avian pest, eating seed at planting and near harvest. Brush removal, early planting, scare tactics, and avicide DRC-1339 help resuce losses.
- Feral hogs, alligators, turtles, and nutria damage ditch banks, and levees.
- For latest information regarding these issues and status of risk assessments visit ipmwww.ncsu.edu/opmppiap and www.epa.gov/pesticides.

Wheat

Introduction

Wheat is a member of the grass family that produces a dry, one-seeded fruit commonly called a kernel. It is the primary grain used in U.S. grain products — approximately three-quarters of all U.S. grain products are made from wheat flour and is grown in 42 states in the United States.

Wheat originated in the “cradle of civilization” in the Tigris and Euphrates river valley, near what is now Iraq. More than 17,000 years ago, humans gathered the seeds of plants and ate them. After rubbing off the husks, early people simply chewed the kernels raw, parched or simmered. Wheat was introduced by the first English colonists and quickly became the main cash crop of farmers who sold it to urban populations and exporters.

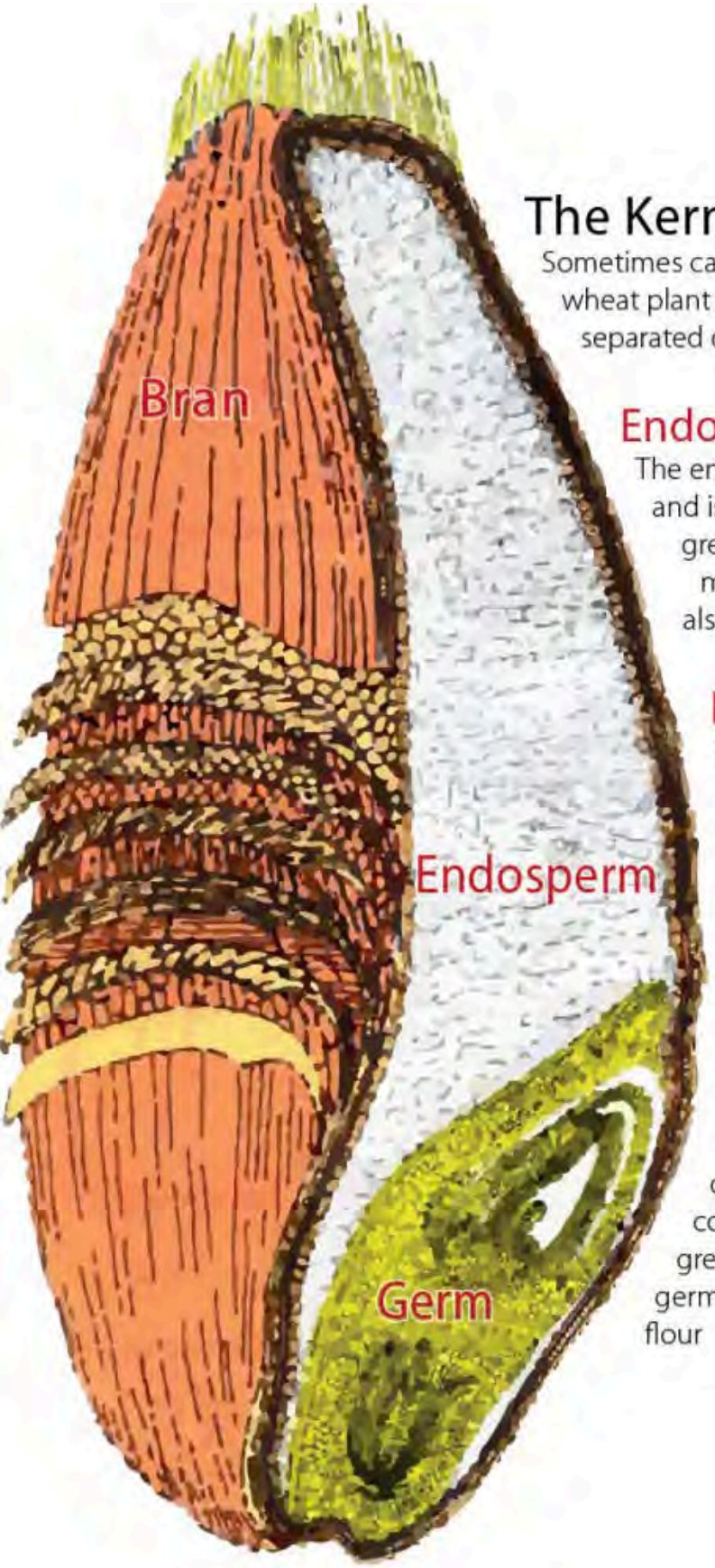
In colonial times its culture became concentrated in the Middle Colonies, which became known as the “bread colonies”. It has been used for white bread, pastries, pasta, and pizza, has been the principal cereal crop since the 18th century.

Six classes bring order to the thousands of varieties of wheat. They are: hard red winter (HRW), hard red spring (HRS), soft red winter (SRW), hard white (HW), soft white (SW) and durum. In the United States, one acre of wheat yields an average of around 40 bushels of wheat. One bushel of wheat weighs approximately 60 pounds and contains approximately one million individual kernels. About half of the wheat grown in the United States is used domestically.

Parts of a Wheat Plant

PATH TO THE PLATE

TEXAS A&M AGRILIFE EXTENSION



The Kernel of Wheat

Sometimes called the wheat berry, the kernel is the seed from which the wheat plant grows. Each tiny seed contains three distinct parts that are separated during the milling process to produce flour.

Endosperm

The endosperm comprises about 83 percent of the kernel weight and is the source of white flour. The endosperm contains the greatest share of protein, carbohydrates and iron, as well as the major B-vitamins such as riboflavin, niacin and thiamine. It is also a source of soluble fiber.

Bran

Bran makes up about fourteen and a half percent of the kernel weight. Bran is included in whole wheat flour and can also be bought separately. The bran contains a small amount of protein, large quantities of the three major B-vitamins, trace minerals and dietary fiber -- primarily insoluble.

Germ

Germ is about two and a half percent of the kernel weight. The germ is the embryo -- or sprouting section -- of the seed, often separated from flour in milling because the fat content (10 percent) limits flour's shelf-life. the germ contains minimal quantities of high quality protein and a greater share of B-complex vitamins and trace minerals. Wheat germ can be purchased separately and is part of whole wheat flour

Wheat

Wheat Brief

Wheat Production

- Texas is the third largest producer in the U.S., harvesting 3.4 million acres annually.
- The cash value to farmers is $288 million, generating $973 million for the economy.
- Texas' hard red winter wheat land is commonly fallowed or rotated with other crops.

Nutrition

- Fiber- Having a high fiber diet can reduce the risk of heart disease and type 2 diabetes. It also reduces inflammation associated with certain types of cancer.
- B Vitamins- like thiamin, riboflavin, niacin, and folate help the body release energy from protein, fats, and carbohydrates. Also essential for healthy nervous system.
- Folic acid- this B-vitamin has many health benefits, including the prevention of neural tube birth defects in newborns. Also linked to helping prevent Alzheimer's by protecting the neurons for learning and memory.
- Minerals- Iron is used to carry oxygen in the blood. Magnesium is use in building bones and releasing energy to the muscles. Selenium protects cells from oxidation.

Insect Pests

- 74% of irrigated wheat is scouted and sprayed. Dryland production receives fewer inputs and is less economical to spray for insects.
- Greenbugs and Russian wheat aphid are the primary pests. Other pests include mites, fall armyworms, and cutworms.
- Chlorpyrifos (Lorsban), dimethoate (Cygon) and methyl parathion are three OP insecticides and targeted by FQPA that, if withdrawn, could cause yield losses of 8 to 10%. Lorsban is primarily used for greenbug control.

Wheat Brief

Diseases

- Wheat is bred with genetic resistance to most fungal diseases. Disease resistant varieties are the most effective means of disease control.
- Principle diseases are rusts, powdery mildew, septoria leaf blotch, and viruses in some areas.
- Fungicides are available to protect against leaf rust and stem rust but are not cost-effective in most dryland fields.
- Propiconazole (Tilt) is used on 2% of the acreage, mostly for leaf rust.

Weeds

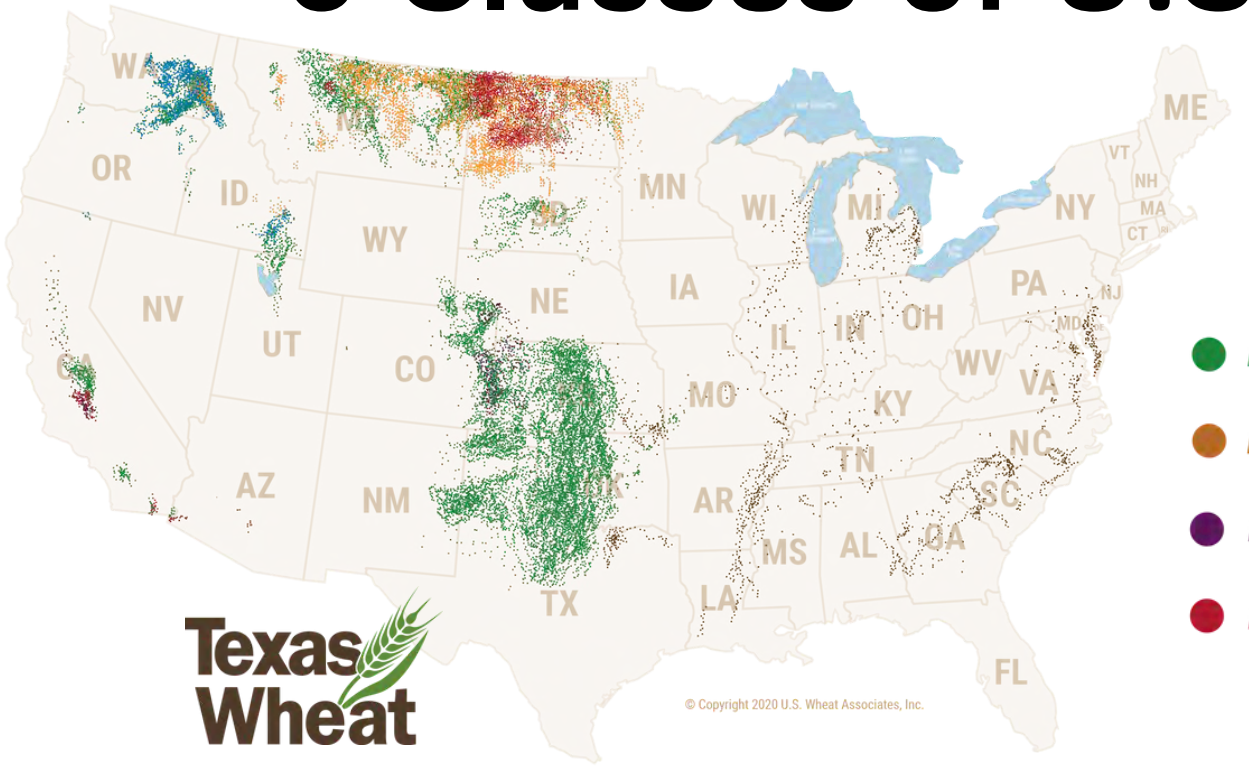
- Crop rotations, fallow and soil tillage are widely practiced as a form of integrated weed management.
- Common weed problems include field bindweed, and other perennial weeds, such as annual grasses, such as ryegrass and rescue grass, and winter annual broadleaf weeds, such as mustards.
- 25% of acreage is treated with herbicides. 2,4-D is the most common, followed by metsulfuron (Ally), dicamba (Banvel) and chlorsulfuron (Glean). All of these herbicides are essential for economic wheat production.

Wheat Brief

Outlook

- Irrigated and dryland wheat will continue as a major crop in Texas for food use and winter pasture.
- Breeding and non-chemical practices will continue but pesticides are essential to sustain production.
- Conservation tillage is widely practiced but perennial weeds are difficult to suppress.
- For latest information regarding these issues and status of risk assessments visit ipmwww.ncsu.edu/opmppiap and www.epa.gov/pesticides.

6 Classes of U.S. Wheat



- Hard Red Winter (HRW)
- Soft Red Winter (SRW)
- Hard Red Spring (HRS)
- Soft White (SW)
- Hard White (HW)
- Durum

HARD RED WINTER

Versatile, with excellent milling and baking characteristics for pan bread, HRW is also a choice wheat for Asian noodles, hard rolls, flat breads, general purpose flour and cereal.

HARD RED SPRING

The aristocrat of wheat when it comes to “designer” wheat foods like hearth breads, rolls, croissants, bagels, and pizza crust, HRS is also a valued improver in flour blends.

HARD WHITE

The newest class of U.S. wheat, HW receives enthusiastic reviews when used for Asian noodles, whole wheat or high extraction applications, pan breads and flat breads.

SOFT RED WINTER

Versatile weak-gluten wheat with excellent milling and baking characteristics for cookies, crackers, pretzels, pastries and flat breads.

SOFT WHITE

A low moisture wheat with high extraction rates, providing a whiter product for exquisite cakes, pastries and Asian-style noodles, SW is also ideally suited to Middle Eastern flat breads.

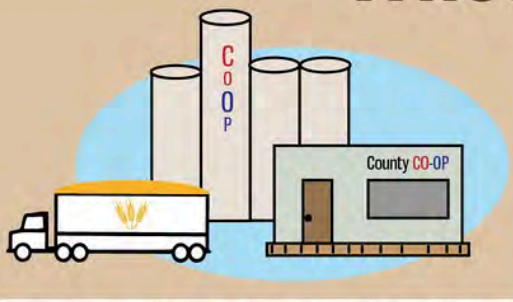
DURUM

The hardest of all wheat, durum has a rich amber color and high gluten content, ideal for pasta, couscous and some Mediterranean breads.

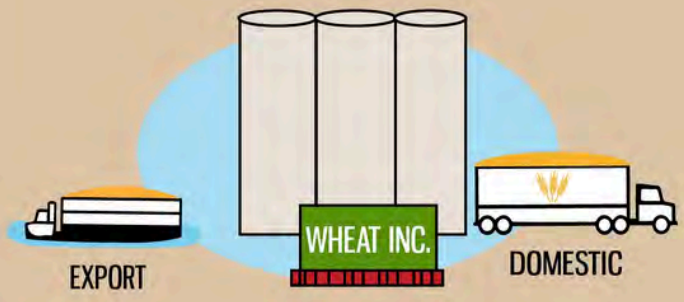
From Field to Table

The Journey of Texas Wheat

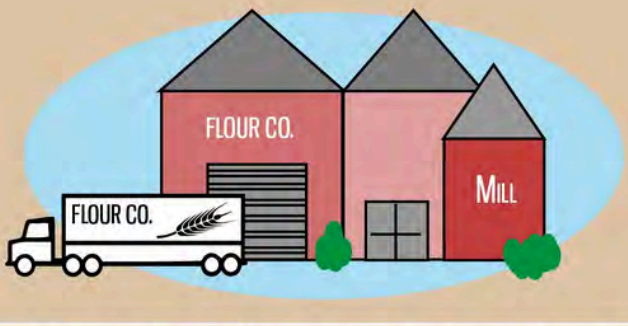
Farmers spend time planting seeds, checking for disease and monitoring plant health until harvest. Combines harvest the wheat kernels, which are then loaded into a semi-truck. 1



2 The harvested grain is sold at market price to a local grain elevator, known as a country elevator. The elevator can store the grain until the right market price, or it can sell it.



Country elevators sell their grain to terminal elevators, which clean, separate and maintain the value of the grain. The grain is then sold to flour millers for domestic consumption, or it is loaded onto ships bound for overseas markets. 3



4 The flour mills grind the grain into different types of flour – whole wheat, all-purpose, bread flour, etc. The mills can also use the flour to make ready-to-eat products. Both the flour and wheat products are shipped to grocery stores and other food retailers.

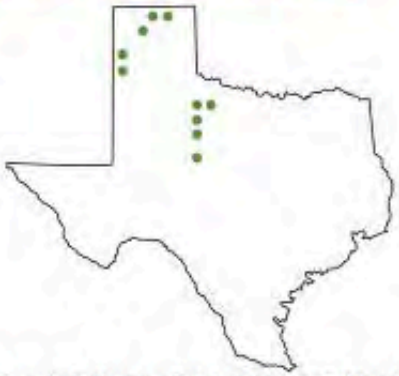
Bakers and chefs also use flour to make a wide variety of delicacies. Consumers can either buy these products, or buy flour produced by the flour mills to make their own creations at home. 5

6 Finally, the wheat products make their way to your table. These products are essential to many holidays and celebrations and go through a safe process to get to you. Whenever you open that next package of hamburger buns for a weekend cookout, think of a wheat farmer and all of those in between.

Texas Wheat Facts

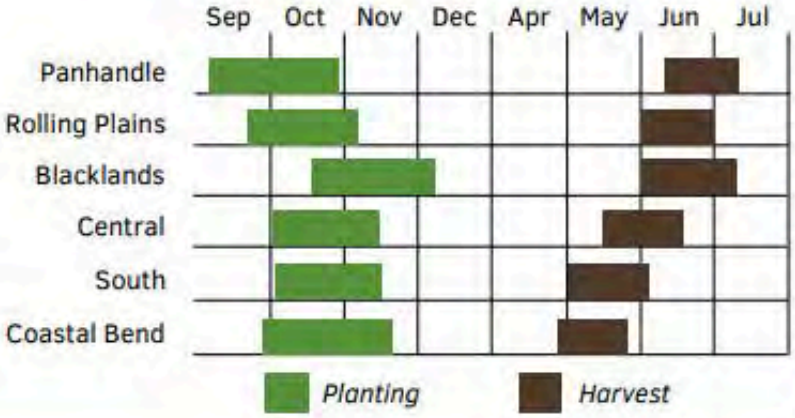
TOP 10 LARGEST WHEAT PRODUCING COUNTIES

1. Deaf Smith
2. Knox
3. Ochiltree
4. Haskell
5. Hansford
6. Runnels
7. Jones
8. Baylor
9. Moore
10. Parmer



(Source: USDA NASS County Estimates Quick Data, 2020 Wheat Production in Bushels)

TEXAS WHEAT PLANTING AND HARVEST



5 MILLION
average number of wheat acres planted in Texas

#9
where Texas ranks out of all 50 states for wheat production

50%
amount of Texas wheat planted acres grazed out by cattle

65 MILLION
average number of bushels of wheat produced in Texas

THE CYCLE OF TEXAS WHEAT

Farmers harvest wheat in the summer.

Grain is transported to an elevator for processing and storage.

The grain is either sent to a flour mill or exported overseas. Texas exports about half of its wheat.

The wheat is milled into flour and sent to grocery stores or baked into ready-made foods.

Farmers plant wheat in the fall.

Wheat goes into winter dormancy after emerging. Then it develops over the spring.

There are six classes of wheat grown in the U.S. In Texas, 85% is hard red winter wheat, 10% is soft red winter wheat and 5% falls into other classes, including hard red spring and white wheat.

Each class has its own purpose. Hard red winter wheat is typically used for bread, while soft red winter wheat is mostly used for crackers and cookies.

Fruits

EHT-017
1-14

TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Apples

Jim Kamas, Monte Nesbitt, and Larry Stein
Extension Fruit Specialists, The Texas A&M University System

Of the many attempts to grow apples commercially across Texas, the most successful have centered in the Davis Mountains and the High Plains region near Lubbock. More apple varieties can be grown in these areas because they have fewer fungal and bacterial diseases and higher winter chilling, which is traditionally the number of hours of temperatures below 45°F from November to March.

In Texas, apples ripen from July to October (Fig. 1), depending on the variety, and the flavor of Texas-grown apples can be outstanding. However, if nights are warm during fruit ripening, the color of red varieties can be poor, a problem for commercial producers in the wholesale market. The in-hand eating quality of these apples is unaffected for homeowners and local sales.

Figure 1. Apple tree at harvest

Climate

The major factor limiting the selection of apple varieties is the chilling requirement. Temperate fruit trees need a specific range of winter chilling to break down the trees' internal growth inhibitors and enable the blooms and leaves to emerge normally in the spring.

Many commercial apple varieties grown in areas such as the Pacific Northwest, along the Great Lakes, and in New England have chilling requirements of 1,000 to 2,200 hours. However, the highest chill hour zone in Texas averages only 800 to 1,000 hours each year (Fig. 2).

Apple varieties selected for a particular growing

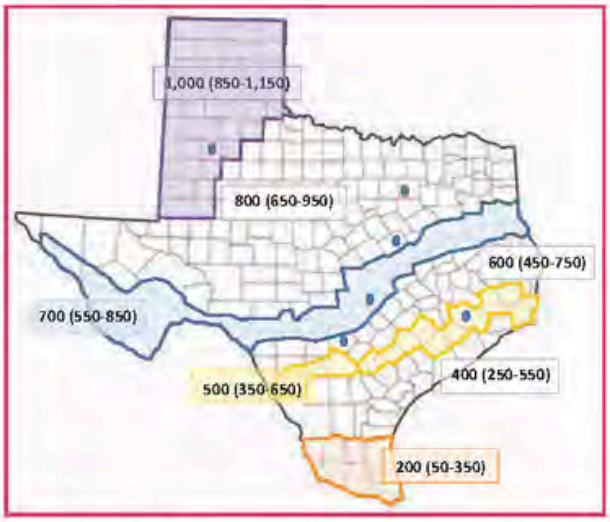


Figure 2. Chill hour zones in Texas

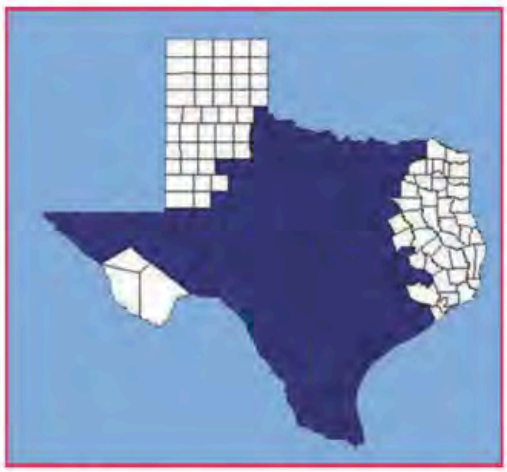


Figure 3. Texas counties where cotton root rot probably occurs (Source: S. D. Lyda)

Figure 4. 'Anna'

Figure 5. 'Fuji'

Figure 6. 'Gala'

area should have a chilling requirement within 150 hours of the average winter chilling. If the chilling requirements are too low, bloom can occur too early in the year, and later spring freezes and frosts can reduce or destroy the crop.

In years when a variety's chill requirement is higher than what actually accumulates, many buds will not form flowers, and the bloom crop will be reduced and develop over a protracted (prolonged) period. Leaf buds have chilling requirements as well, and low-chilling years cause the canopy to develop late.

Lack of chilling is very stressful on trees, and the stress can be cumulative. Consecutive low-chilling years can actually kill unadapted apple trees.

Soil

Apple trees prefer deep, well-drained soils with a pH of 6.5 to 7.0. Production is generally unsuccessful in areas (Fig. 3) that are warmer and have alkaline soils (above 7.0) because of cotton root rot *(Phymatotrichopsis omnivora)*.

Because apples are strongly cross pollinated, you'll need to plant more than one variety with overlapping bloom dates (similar chilling requirements) for good fruit production. Although some apple varieties can produce with a moderate amount of chilling, all moderate-chilling varieties perform best in years with more than average chilling hours.

In high-chilling years, bloom is less protracted and fruit set is more uniform. This is important in thinning fruit appropriately to prevent overcropping (excessive production) and to help control diseases.

Varieties

For areas with more than 400 hours of winter chilling, suitable apple varieties include 'Fuji', 'Gala', 'Imperial Gala', 'Mollie's Delicious', 'Mutsu', 'Pink Lady', and 'Royal Gala'. In areas receiving 400 or fewer hours of chilling, two varieties will grow and fruit reliably: 'Anna' and 'Dorsett Golden' (Table 1, Figs. 4 through 8).

Figure 7. 'Mollie's Delicious'

Figure 8. 'Mutsu'

Table 1: Apple varieties suitable for growing in Texas

Variety	Chill hours needed	Fruit	Harvest	Notes
'Anna'	400	Relatively large; light greenish-yellow skin and slight red blush; sweet, slightly tart, crisp with a creamy white flesh; stores very well	Late June	Produces at an early age; from Israel; a good southern choice for fresh eating, pies, or applesauce
'Dorsett Golden'	350	Medium size; yellow skin with an orange-red blush; firm, smooth, crisp flesh; sweet and tart flavor	Early July	Moderately vigorous with rounded, upright growth habit; a reliable pollinizer for 'Anna'
'Fuji'	600	High quality; marginal commercially acceptable appearance; medium size; tall; rectangular shape, yellow-green skin with orange to red stripes; crisp, juicy, white flesh; good texture; good shelf life in cold storage	140–160 days from bloom; ripens in mid-summer	Vigorous, productive, somewhat bushy tree; needs some annual detailed pruning; developed in Japan and introduced in 1962; cross between 'Ralls Janet' × 'Red Delicious'; heat resistant; susceptible to bitter rot and red mites
'Gala'*	600	Red striping on golden skin, giving it a red-orange color; crisp, dense, and aromatic; excellent quality; stores well	140–160 days from bloom	Large, vigorous tree; shows some self-fertile characteristics but should be pollinated with other varieties with similar chilling requirements; Texas growers struggle to produce consistently large fruit from 'Gala' or any of its sports; high rainfall seasons produce good-sized apples without compromising in-hand eating quality
'Imperial Gala'*	600	Medium size, oval to round; bright scarlet over yellow ground colored fruit; extremely firm, very juicy and distinctly aromatic with yellow, creamy flesh	Ripens with 'Gala'	Vigorous, upright tree, relatively precocious bearer; sport of 'Gala'
'Mollie's Delicious'	450–500	Large, attractive fruit with unique, slightly conical shape; light yellow background about half covered with a red blush; high-quality flesh with good flavor; stores for about 10 weeks in refrigeration	Summer	Vigorous, productive tree; excellent pollinator with a protracted bloom period; introduced in 1966; not to be confused with 'Red Delicious' strains; fruit tends to set in clusters, requiring two or three pickings; some disease resistance
'Mutsu' ('Crispin')	600	Large, round, yellow fruit; crunchy flesh; good juice and tartness; distinctive, delicate, spicy flavor; good dessert and processing apple; excellent for cider and applesauce	~180 days after bloom	Large, spreading, vigorous, and reliable tree; developed in Japan in 1948; resistant to powdery mildew; susceptible to scab, bitter rot, and blister spot
'Pink Lady'	500–600	Oblong green fruit turns yellow at maturity, overlaid with pink or light red; fine-grained, white flesh; thin skin bruises easily	October	Hard to train; prone to producing blind wood (dormant buds); a cross between 'Golden Delicious' and 'Lady Williams' from the Western Australian apple-breeding program
'Royal Gala'*	600	Matures to a bright overall red; medium size, conical to round fruit; bold red stripes over a yellow background; firm, juicy, fine textured, yellow-white flesh; sweet, slightly tart flavor	Ripens with 'Gala'	Compact growth habit; prolific bearer; requires heavy thinning to maintain fruit size and prevent biennial bearing; developed in New Zealand

*Note: 'Gala', 'Imperial Gala', and 'Royal Gala' will not serve as adequate pollinizers for each other.

Selecting a rootstock

Many years ago, most apple orchards were planted on seedling 'Red Delicious' root systems. These trees were tall, inefficient yielders and came into production very slowly.

Rootstocks were first used in apples to overcome the wooly apple aphid, a soil-borne insect that kills the roots of susceptible trees; some of these rootstocks had the advantage of reducing the size of the bearing tree. The benefits of dwarfing apple rootstocks are that they come into production at a younger age, can better produce high-quality fruit, use space more efficiently, and bear fruit that can be harvested easily.

Figure 9. Trellised apple trees

Decisions on tree spacing and trellising are based largely on the degree of dwarfing caused by the rootstock:

- Rootstocks that are somewhat dwarfing, such as M7 and MM111, do not need a support system and are more efficient and precocious (bearing at a young age) than are standard seedling stocks. For these reasons, these two stocks are common in both commercial and home plantings.
- Extremely dwarfing stocks such as EM 26 and M9 have shallow roots and must have a trellis-type support structure. In areas where space is limited, the expense of a small trellis may be justified for a home planting.
- Avoid MM106, an intermediate dwarfing stock, because it does not grow well in poorly drained soils and is susceptible to the soilborne fungus *Phytopthora cactorum*, or collar rot.

Pruning and training

Apples have a naturally erect growth habit and traditionally are trained in a central leader system. The central leader system resembles a Christmas tree shape, with a dominant central trunk and an array of scaffold limbs (primary branches) every 4 to 5 feet. The goal is to minimize shade and effectively intercept sunlight to manage vigor, minimize disease pressure, and produce high-quality fruit.

Scaffold limbs are strongest when they are trained to a 90-degree angle. In some cases, spreaders or limb weights are used to achieve these ideal angles. Some apple varieties develop specialized lateral fruiting branches, or spurs, that produce fruit

yearly. Spur-type trees tend to be more compact, easier to train, and come into production earlier than non-spur types.

Although many younger commercial Hill Country apple orchards are trellised, this practice is an option, not a necessity. Trellis support is needed for sev rely dwarfing rootstocks like M 9 because of their shallow, brittle, poorly anchored root systems (Fig. 9). Trees on less dwarfing rootstocks such as MM 111, EM 7, and MM 106 are best grown freestanding (Table 2).

Table 2: Apple rootstock characteristics

Rootstock	Size (% of standard)	Remarks
EM 26	40–50%	Semi-dwarf rootstock; less precocious but anchored better than M9; more cold hardy than other dwarfing stocks but susceptible to collar rot
EM 7	50%	One of the most popular free-standing stocks in the commercial industry; tolerates a wide range of well-drained soils and is moderately resistant to collar rot; prone to suckering (producing shoots from the ground or below the graft union)
MM 106	60–70%	Well-anchored and deep-rooted stock; does not sucker but is very susceptible to collar rot
MM 111	75%	Better adapted to heavy soils and resistant to collar rot; considered by some to be a standard-sized tree but is more precocious than seedling 'Delicious' stock; rather tolerant of wetter soils; is commonly used in replant situations

Irrigation

The water needs of apple trees vary depending on tree age, soil type, and rootstock. Table 3 offers general recommendations for irrigating young apple trees.

Table 3: Recommended number of gallons of water to apply per tree per week*

Year	Month					
	April	May	June	July	August	September
1	7	7	14	21	21	14
2	14	14	21	28	28	21

*The amounts will vary according to temperature, soil type, and natural rainfall.

Trees need more water as they age. The amount needed is determined by the amount and density of the tree canopy, which varies by site, variety, and rootstock. Increase irrigation gradually until individual trees receive as much as 40 gallons of water per week if environmental conditions warrant.

Because apple trees are sensitive to *Phytopthora* and other soil-borne pathogens, pay close attention to water placement. The irrigation emitters must be placed 12 to 15 inches from the trunk in Year 1. Afterward, move them 6 to 12 inches farther from the trunk each year, depending on tree growth.

The point is to supply water to the area of the root system that is actively drawing water and nutrients and to keep the crown of the tree relatively dry.

Figure 10. Bitter pit disorder

Figure 11. Lenticel blotch pit

Fertilization

Before establishing the orchard, have the soil tested. If soil pH is too low, apply lime to make the soil more neutral in its acidity. It is extremely difficult if not impossible to lower soil pH effectively, which is why commercial apple endeavors have failed where soils are infested with cotton root rot. If elements that move very slowly in the soil, such as potassium and phosphorous, are needed, incorporate them into the soil before planting.

Nitrogen fertilizer is usually needed every year because it leaches (seeps) into the soil past the roots. Although large amounts of nitrogen inputs are probably not needed, small, frequent applications will promote early canopy development and maintain leaf health throughout the fall. Stop applying nitrogen no later than August 1 each year to enable the vegetative tissue to mature properly and to become hardy for winter.

Calcium deficiency is common on the fruit of apple trees grown in Texas, even where soils have abundant calcium. Most of the calcium that the trees take up from the soil goes to the developing leaf tissue, not the fruit. The resulting calcium deficiency in fruit can cause several maladies, all of which affect the integrity and storage quality of apples.

Two common calcium-related disorders are bitter pit and lenticel blotch pit.

Bitter pit: Areas of brown, dry tissue develop initially in the fruit flesh (Fig. 10). The peel then discolors and browns, and a pit forms on the fruit surface. Most of the affected areas are usually toward the calyx end (opposite the stem end) of the fruit. Symptoms typically appear before and after harvest.

Lenticel blotch pit: Small, dark, dying areas surround the fruit lenticels (pores) and then develop slight pits (Fig. 11). Although lenticel blotch pit may occur just before harvest, it usually appears during storage.

Calcium deficiencies are more severe when the trees are under environmental stresses such as high heat or drought. To reduce the incidence of these disorders, spray calcium during fruit development, and harvest when the fruit have matured properly.

Calcium nitrate and calcium chloride can help supply needed calcium, but check with the local Extension horticulturist to determine the timing, rate, and risks associated with these sprays under some environmental conditions.

Weed control

Like all other perennial crops, apples compete with native plants for nutrients, sunlight, and water. The most limiting factor to orchard establishment is the failure to control weeds in new apple orchards (Fig. 12).

Figure 12. Inadequate weed control in apple tree rows

Although cultivation (plowing or disking) has long been considered the most cost-effective and environmentally sound way to manage weeds, it should be the method of last resort because of the potential for erosion and harm to tree roots. Most of an apple tree's feeder roots are in the top 6 inches of soil. Cultivating weeds cuts the feeder roots, leaving the trees less able to absorb water and nutrients.

Many nonrestricted contact herbicides are approved for weed control in apple orchards. Some target only grasses; others manage both grasses and broadleaf weeds. Unlike many chemical herbicides used in the past, these newer formulations are relatively safe to apply and have little effect on the environment.

Organic and inorganic weed barriers are popular today for controlling weeds around fruit trees, especially in landscapes or small home orchards. Although inorganic weed barriers control competitive plants acceptably, organic mulches have many added benefits. Besides reducing weed competition, organic mulches conserve moisture, improve soil structure, and moderate soil temperatures.

To be effective, organic mulches need to be about 6 inches thick and reapplied regularly as breakdown and natural erosion dictates. To help prevent collar rot, apply organic mulches no closer than 1 foot from the trunk.

Diseases

Pesticides are used more on apples than perhaps any other deciduous fruit crop grown in North America. A multitude of fungal pathogens (disease-causing organisms) such as powdery mildew, bitter rot, black rot, and apple scab can injure foliage, fruit, and woody tissue. Commercial growers commonly apply conventional fungicides and insecticides, and noncommercial growers in more humid regions of Texas struggle to grow clean fruit without spraying.

Collar rot *(Phytophora cactorum)* is a soil-borne disease problem of apples in Texas. The incidence of collar rot can be

Figure 13. Pulling up trees killed by cotton root rot

reduced by proper site and rootstock selection and managed with fungicide applications as needed.

Fireblight, caused by the bacterial pathogen *Erwinia amylovora*, causes twig and limb dieback and can even kill the tree. Apple trees in humid areas of the state are more prone to serious fireblight damage. Varieties differ in their resistance to the disease, and susceptible varieties should be avoided.

To manage the disease, grow resistant varieties, prune infected limbs, apply agricultural antibiotics during flowering, and reduce nitrogen fertilization to slow vegetative growth.

Managing cotton root rot

There is no diagnostic test to determine whether cotton root rot is present at a site. Previous cotton plantings likewise have no bearing on whether the disease may be problematic. There are no known resistant rootstocks, and no fungicides have proven effective in preventing losses from cotton root rot in apple orchards (Fig. 13).

The best management tactic is to choose sites in areas where the pathogen is not known to occur and to plant new orchards in soils that are slightly acidic. Neutral or acidic soils severely limit the potential losses from this pathogen.

Attempts to acidify high-pH soils have largely failed. Likewise, biological agents or organic supplements that are sold as "natural" solutions to cotton root rot may work on shallow-rooted annual crops, but it is virtually impossible to deliver and maintain enough of these agents deep in the soil profile.

In all susceptible fruit crops, the cotton root rot fungus moves easily from tree to tree or vine to vine. Dense plantings of apple trees worsen the problem within an orchard once infection begins. This has especially been true on very dwarfing stocks, which are commonly planted 4 or 5 feet apart within the row. Some apple growers have transitioned toward less dense plantings, even on dwarfing stocks, as a way of keeping the root systems of trees separated and managing cotton root rot.

Insects

Apple trees and fruit can be severely damaged by many insect pests, including apple maggot, coddling moth, scale insects, tar-

nished plant bugs, flat-headed apple tree borer, and several stink bug species.

Growers must be extremely cautious about applying insecticides, especially during bloom, to protect important pollinators such as bees and other beneficial insects. Because pesticide products and their labels change often, contact your county Texas A&M AgriLife Extension office for current recommended pest-management suggestions.

Harvest

Apple maturity is judged by fruit color, firmness, and soluble solid content. For local sales, many growers keep the fruit on the trees until they intend to place it in their stands. This practice allows them to select the ripest fruit on an ongoing basis, affording buyers the highest quality fruit.

For more distant markets, the fruit is generally picked according to the ground color, which is the color of an apple's skin other than the areas that have turned red. The fruit is ready for harvest when the ground color changes from green to yellow or pink on colored varieties. At this point, the apples are firmer and better able withstand transport and arrive at the market in good shape.

After they are harvested, the apples will continue to soften, change internally, and give off ethylene. To maintain optimal quality, refrigerate and humidify the apples after harvest.

For more information

Fruit and Nut Resources, Aggie Horticulture®:
http://aggie-horticulture.tamu.edu/fruit-nut

Texas A&M AgriLife Extension Service

AgriLifeExtension.tamu.edu

More Extension publications can be found at AgriLifeBookstore.org

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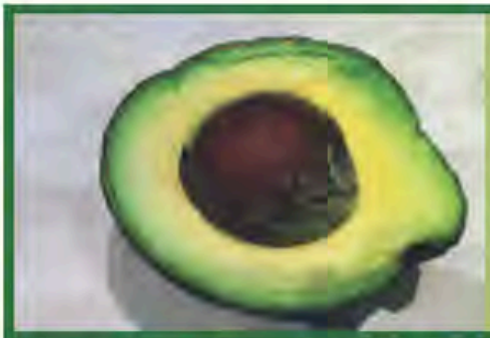
New



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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Avocados

Monte Nesbitt , Larry Stein, and Jim Kamas
Extension Fruit Specialists, The Texas A&M University System

Avocados are widely consumed in Texas, in part because of the popularity of Tex-Mex cuisine. In addition to their unique flavor, they have nutritional benefits. Avocados have more potassium than do bananas and are a good source of vitamins K, E, and B, especially B6 and B5.

The flesh is about 15 percent oil or fat, much of which is in the healthy, monounsaturated form. The fruit has been studied for its role in lowering cholesterol and limiting certain forms of oral cancer.

Avocados are tropical evergreen trees that can grow 40 to 80 feet tall. The leaves are large, leathery, and deep green with paler veins, and they live for 2 to 3 years. Mature trees will shed a portion of their aging leaves each spring during the flowering period. Some varieties drop more than others during this time. New leaves will develop almost immediately.

Figure 1. Avocado fruit and leaves.

The avocado fruit is a large berry (Fig. 1). Other names for the fruit are alligator pear and aguacate (Spanish).

There are three species of avocados:

- Guatemalan *(Persea nubigena var. guatamalensis L. Wms.*
- Mexican *(P. americana var. drymifolia Blake)*
- West Indian *(P. americana Mill. var. americana)*

Hybrids of all three species have created additional varietal types. Blooms form from January to March, with the fruit maturing in as few as 6 months for Mexican types and 18 months for Guatemalan types.

Commercial production

Mexico leads the world in avocado production, with over 1 million metric tons produced annually. In the United States, avocados are produced commercially in California (65,000 acres), Florida (6,500 acres), and Hawaii (600 acres).

In Texas, production is so small that it is not reported in U.S. Department of Agriculture statistics. The only Texas counties that are suitable for commercial avocado production are in the Lower Rio Grande Valley, where avocados represent a very small percentage of commercial farm acreage.

Growers south and southwest of San Antonio have experimented with avocado varieties purported to survive the winters there with little damage. But because no formal, long-term research has been conducted on those varieties, commercial plantings should be considered very risky unless they are well protected from freezes.

Climate

The most limiting factor to success with avocado trees is severe cold:

- West Indian types tolerate almost no subfreezing temperatures.
- Guatemalan types may tolerate 26 to 30°F.
- Mexican types are the most cold hardy and suited to Texas' climate, with some varieties tolerating temperatures around 19 to 20°F as mature trees.

Possible freeze injuries to avocado trees include partial damage to the above-ground tissue, total death of all above-ground tissue, or total death of all portions of the tree (above and below ground). The extent of the injuries is affected by the cold hardiness of the variety and the depth and duration of the freeze.

The trees are also grown in protected landscapes in the lower half of the state. Trees in protected residential settings may have microclimatic advantages over those planted in orchards.

Growing avocados north of the Lower Rio Grande Valley is risky, despite the claims and testimonies otherwise. Trees sometimes escape a harsh winter or two and look promising, only to be severely damaged in a subsequent freeze with different conditions.

Soil

Although avocado trees can grow in a wide range of soil types, the most suitable soils are coarse and well drained. Avocados do not tolerate flooding or poorly drained soils. A range of pH values from acidic to alkaline is acceptable.

Because salinity can injure avocados, have the soil and irrigation water tested before planting. If salinity is a problem, use a West Indian variety as a rootstock, which will tolerate the salinity better. Mexican varieties in particular are not salt tolerant and may need to be grafted if salinity is a potential problem.

Figure 2. 'Brogdon'.

Varieties

Avocado varieties fall into one of two pollination types, A and B. They differ in the time of day (morning or afternoon) when the male and female flowers can reproduce:

- **Type A** flowers open in the morning as receptive females and close in the afternoon. They reopen the following afternoon for pollen shed.
- **Type B** avocado flowers open in the afternoon as receptive females, close overnight, and reopen the following morning to shed pollen.

In important avocado-producing areas, orchards are interplanted with varieties of both types to ensure good pollination. In South Texas conditions, the flower phases overlap enough that pollination and fruit set are rarely a problem.

Because they tolerate freezes better, the best avocados to grow in Texas are seedling varieties of the Mexican type avocado. Grow Guatemalan and West Indian types or hybrids if you accept that they probably won't survive freezes outdoors.

Fruit quality is variable, with some being more appealing than others. For the varieties described in Table 1, no formal variety trials have been conducted to determine which are superior in production, fruit quality, or freeze tolerance in Texas conditions.

Mexican varieties grown in Texas include 'Brogdon', (Fig. 2) 'Holland', 'Wilma', and 'Winter Mexican'. 'Lula' is a popular Guatemalan x West Indian hybrid variety grown commercially in the Lower Rio Grande Valley (Fig. 3).

Figure 3. 'Lula'.

Fruit size varies considerably among the species. West Indian varieties produce very large fruit that is low in oil and has a milder flavor than the other types. The fruit of Mexican types is rarely larger than 8 to 12 ounces, is green to purple or black, and has very thin skin. Because the skin is so thin, the fruit are very susceptible to disease. Guatemalan varieties are essentially intermediate between the former two, and its hybrids with the other two races include many of the more important varieties in commerce.

The pebbly skinned 'Hass' is the most widely consumed avocado in the United States and the main commercial variety in

TABLE 1: Characteristics of avocado varieties grown in Texas

Species	Variety	Climate	Fruit	Skin	Harvest	Other characteristics
Guatemalan x Mexican hybrid	'Hass' seedling or hybrid variety	Little cold tolerance; plant only if it can be protected from freeze often; best in dry areas	Good quality, well liked	Thick, black, pebbly, rough textured	September–October	Most widely grown and consumed variety; ships well; main commercial variety in California
Mexican	'Brogdon' complex hybrid	Average– below average cold tolerance	Oval to pear shaped	Thin; purple	Summer	Flowering type B
	'Holland'	Little cold tolerance	Less than optimum quality, thick, rubbery	Green	Summer	Found by the Holland family in Uvalde, TX; also sold as 'Opal'
	'Wilma'	Good cold tolerance	Large, good quality	Black	Summer	Newer variety planted in landscapes in Austin, San Antonio, and Houston areas
	'Winter Mexican' hybrid	Excellent cold and good heat tolerance	Large, average to fair quality	Thick, green	December	Popular in the Valley for many years
West Indian		Almost none ≤32°F	Very large	Light green to reddish purple	September – October	Mild flavor; low in oil
Guatemalan x West Indian hybrid	'Lula'	Severe freeze damage below 27°F; usually regrows from below ground	Nears 1 pound; pear shaped	Thick, green, slow to darken, making it good for restaurant use	October–February	Resists diseases well; grown commercially in the Lower Rio Grande Valley; the preferred rootstock for all avocados in South Texas

California. 'Hass' originated as a seedling and is thought to be a Guatamalan x Mexican hybrid. It has insufficient cold hardiness for Texas.

Figure 4. Avocado trees spaced 20 to 30 feet apart.

Site selection

When choosing a site, keep cold protection in mind, especially where frosts or freezes are common. In a residential site, the south or southeast side of a house or shed is generally the warmest at night because of north wind protection and the sun's warmth radiating from the structure. Fruit production is greatest in full sun.

Propagation and planting

Do not grow seedlings from supermarket avocados, for several reasons: Avocados do not come true from seed; ungrafted seedlings may take up to 10 to 15 years to bear fruit; and salty irrigation water can cause moderate to severe leaf tip burn on these plants.

In Texas, the most common propagation method is cleft (tip) grafting. Other grafting methods also work. Some Mexican avocado varieties can be rooted or air-layered, but their lack of salinity tolerance will remain a problem.

Plant the trees no closer than 10 to 15 feet from the house. Space avocado trees 20 to 30 feet from each other and from other large trees (Fig. 4).

Avocado trees are produced in containers of soilless media. Just before placing a tree in the planting hole, wash much of the outer layer of media off the sides and top of the root ball. This encourages the roots to grow out into the soil of the site.

Position the grafts of the rootstock close to the soil line. Plant the trees deeper than you would other trees to set the graft at or below ground level. During the winter, mound soil around the trunk to insulate the graft with warm soil. If cold weather kills the tree to the ground, it will regenerate from the grafted wood instead of the less desirable rootstock.

In commercial plantings, newly planted trees are usually staked for support and shaded during the first several months

of hot weather and strong sunlight. Rio Grande Valley growers often place burlap-covered cages about a foot higher than the trees to protect them from sun and wind damage.

Freeze protection

To protect the trees from severe freezes, plant them deep to facilitate soil mounding. When a severe freeze is forecast, mound more soil around the trunk for extra protection, and water thoroughly 2 or 3 days before the cold weather sets in.

During a freeze, drape but do not wrap the young trees with a blanket, quilt, tarp, or plastic. Pull the corners of the covering outward and anchor them to the ground—the cover need not reach to the ground.

Set a heat source under the tented tree. Any practical heat source will probably save even the leaves—examples include decorative lights, electric heaters, incandescent lights, or camp lanterns or stoves.

North of the Lower Rio Grande Valley, growers who want to grow avocados as a commercial crop should consider erecting permanent enclosures such as high-tunnel greenhouses. These structures store the sun's warmth and can use ice formed from water sprinklers and heat from light sources to protect the trees from occasional nights of freezing.

Effective but expensive are true greenhouses with climate-control capabilities. However, the trees' size poses challenges for growing them indoors permanently.

Irrigation

Avocado irrigation is similar to that for citrus and other fruit and nut trees. Apply water at a rate and frequency that will prevent wasting water or leaving water standing around the tree for more than a few hours.

Fertilization

Annual applications of fertilizer will help the growth and fruiting of avocados. Soil testing should be conducted before planting and every second or third year thereafter to identify deficiencies in phosphorus, potassium, and other elements. Nitrogen is needed each year, regardless of soil test results.

In Year 1, divide 1 pound of ammonium sulfate (21-0-0) into three to six equal doses applied every second or third month from February to early August Increase the total amount of ammonium sulfate to 2 pounds in the second and third years,

and increase to 3 total pounds per year in the fourth year after planting. Thereafter, apply one-half pound of 21-0-0 per inch of trunk diameter each year, split into equal applications in February, May, and August.

Pruning and training

Avocados do not need to be trained or pruned for normal growth and cropping. Prune freeze-damaged trees to remove dead wood. If only limb damage occurs, wait until regrowth begins, and cut back to live tissue.

If the tree is killed to the ground, cut it off at ground level. If the roots are alive, many suckers or trunks will emerge (hopefully above the graft line) that will need to be pruned if a single-trunk tree is desired.

Weeds

Protecting newly planted trees from weed and grass competition is critical during the first 2 or 3 years. First treat the weeds with herbicides or by mechanical means; then apply organic mulches to suppress weed regrowth.

Problems

The most common disorder of avocados in Texas is tip burn and marginal necrosis (browning on the leaf edges) caused by water stress and salinity, which is most prevalent during hot, dry weather. This problem is most acute on Mexican-race seedlings and rootstocks; it can be tempered somewhat by watering more uniformly and regularly. Have the water used for irrigation tested for total salinity and presence of particular harmful salts. Water, as with soil, may be tested at the Texas A&M AgriLife Soil, Water and Forage Testing Laboratory (http://soiltesting.tamu.edu).

Insects and other pests

Few insects have been documented on Texas avocados, although mites sometimes occur on the foliage.

Opossums apparently thrive on mature avocado fruit and will climb the tree to feed when none are on the ground.

Diseases

The most serious disease of avocados is anthracnose, which primarily affects fruit that are nearing maturity. It starts as tiny, brown to black spots that are circular and sunken. With time, the

spots can enlarge to ½ inch or more. They can cause the fruit to crack horizontally and vertically across the spot.

Anthracnose is particularly severe on thin-skinned varieties; it rarely causes significant losses on 'Lula' or other thick-skinned fruits.

Other fungal diseases such as cercospora spot, powdery mildew, and scab are rarely encountered in Texas but are serious problems in the humid tropics.

Harvest

An avocado tree will produce a few fruit 2 or 3 years after establishment if it is a grafted variety, has grown well, and has been protected during the winters. With good management, mature trees can produce 2, 3, or more bushels of avocados, depending upon the variety.

Mexican-race seedlings and varieties typically mature during the summer; 'Lula' and most other hybrids mature in September or October. Storage on-tree is common, and 'Lula' will store on-tree into January because of cooler temperatures.

Oil content increases with time on the tree for many varieties. Avocado fruits do not ripen on the tree--they must be harvested and held for several days before they are ready to be consumed. The optimal temperature range for ripening includes the cooler range of most home air conditioning settings.

To determine whether the avocados are mature, pick a couple of fruit and set them inside the house out of direct sun. A mature fruit will soften in 3 to 8 days. If the fruit doesn't soften, pick fruit again every week or so until they soften.

Check soft fruit for eating quality. Summer-maturing avocados will begin to drop heavily because of disease as they mature. Some types do not always soften well under Texas conditions.

Uses

Avocados are usually consumed fresh, either alone or in salads, dips, appetizers, guacamole, or pico de gallo. Overripe fruit can be pureed and frozen for later use, particularly for avocado dips and cream soup.

The peel of thick-skinned varieties is undesirable to eat but edible on thin-skinned varieties, in some cases adding unique flavors.

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Blackberries

Monte Nesbitt, Jim Kamas, and Larry Stein
Extension Fruit Specialists, The Texas A&M University System

Blackberries are an excellent fruit plant for Texas home landscapes: They are relatively easy to grow in small areas, they tolerate hot Texas summers well, and they bear good fruit in spring, summer, and fall (Fig. 1).

Although blackberries have some challenging diseases and insect pests, they produce well for growers who follow Earth-Kind® orchard principles. Earth-Kind uses research-proven organic and traditional gardening techniques to maximize production while protecting the environment (http://earthkind.tamu.edu).

Figure 1. Abundant fruit.

Blackberries can also be a profitable commercial crop. Mature blackberry plants can produce 5,000 to 10,000 pounds per acre per year, and fresh fruit commands good prices. Varieties are available that bear large fruit, have an extended harvest period, and are firm enough to be transported to distant markets (Fig. 2).

Figure 2. 'Rosborough' fruit.

However, because of the high labor requirements for harvesting, most commercial plantings are restricted to small-acreage ventures.

Growth habits

The cultivated blackberry is an improved form of wild southern blackberries, or *dewberries*. All blackberries are biennial plants—flowering plants that take 2 years to complete their biological life cycle.

Blackberries have two types of canes: primocanes, which grow during the current season (Fig. 3); and floricanes,

Figure 3. Primocaine.

which are 1-year-old, flower-bearing canes that die after the berry crop matures.

Cultivated blackberries are classified into two fruiting types:

- **Floricane-bearing**, which flower and set fruit only on floricanes
- **Primocane-bearing**, which flower and set fruit on primocanes late in the growing season, and then bear on floricanes also the following spring

The amount of fruit produced is related to the growth and vigor of the primocanes and their adaptation to climate. The primocane-bearing varieties available to date are not well adapted to the hot summers in Texas and therefore may not set good primocane crops in some areas.

Primocane bearers can produce a small crop during the first year that they are planted, increasing in the second season. Floricane bearers can produce a sizeable crop of berries the second year after planting if the primocanes grow well during the first year.

The varieties that live longest in Texas are those that were developed here. With proper care, they may remain productive for 20 years or longer. University of Arkansas varieties (those having American Indian tribe names such as 'Apache') generally produce for only 5 to 10 years, depending on the variety and growing location. Good yields on healthy, mature plantings range from 5 to 10 pounds per plant or 5,000 to 10,000 pounds per acre.

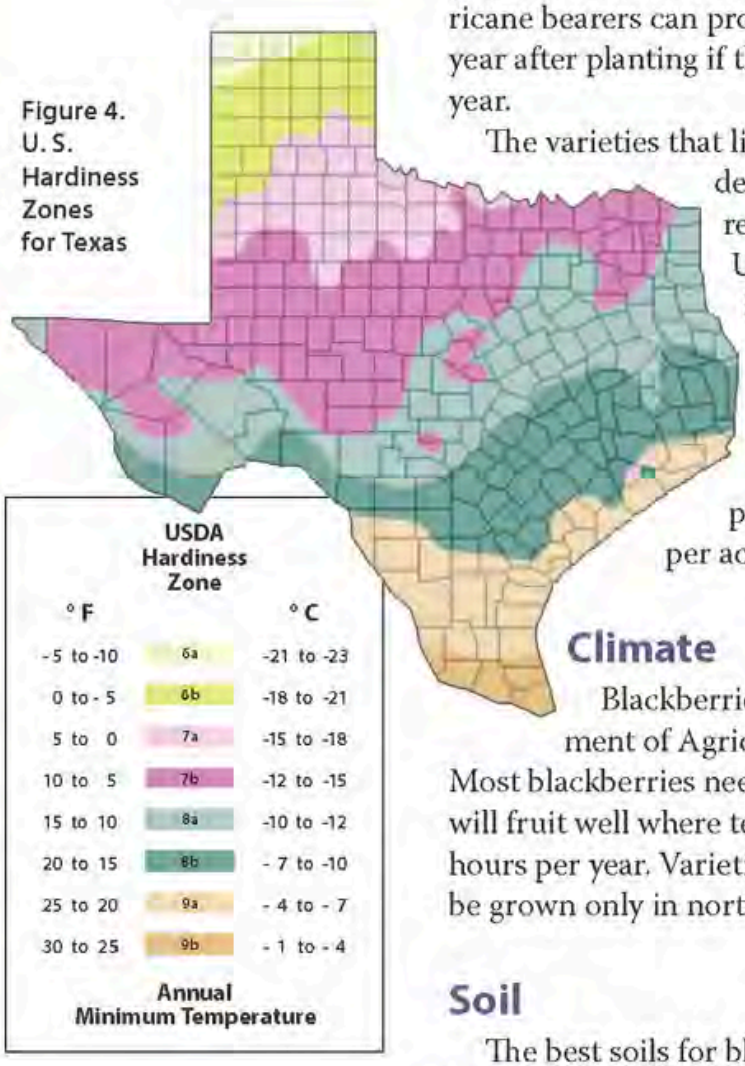

Figure 4. U. S. Hardiness Zones for Texas

Climate

Blackberries can be grown anywhere in U.S. Department of Agriculture Hardiness Zones 7, 8, and 9 (Fig. 4). Most blackberries need relatively few winter chilling hours; they will fruit well where temperatures are below 45°F for 300 or more hours per year. Varieties that require more chilling hours should be grown only in northern Texas.

Soil

The best soils for blackberries are well drained soils, are at least 1 foot deep, and have a pH range of 4.5 to 7.5. On soil with a pH of 8.0 or above, the plants will experience iron chlorosis, which requires that chelated iron products be added to the foliage and soil.

Site preparation

If the soil drains slowly, plant the blackberries on raised beds or berms (mounded planting rows), which will enable the soil to dry faster and help keep water from ponding near the crown of the plant.

Varieties

Three categories of blackberry varieties can be grown in Texas:

- **Thorny varieties** are generally most productive and bear larger fruit than do the thornless types, although fruit of 'Apache' and 'Natchez' compare well to many thorny varieties. All of the varieties of blackberries developed in Texas have thorns (Fig. 5).
- **Thornless varieties** are easy to harvest, train, and prune.
- **Primocane-bearing varieties** have been introduced in Texas only recently, and their potential for long-term performance is not well understood. They should be considered experimental and planted in limited quantities.

Figure 5. Blackberry thorns.

New blackberry growers should consider experimenting with all three types to learn which grows and fruits best in their area, and which they prefer to maintain. The harvest season for commercial blackberries can be extended by growing all three types (Table 1).

Propagation

Blackberry plots may be established from rooted cuttings, bareroot plants, or small, tissue-culture plants. New commercial plantings should be made from disease-free stock obtained from traditional nurseries or tissue-culture labs.

Dormant bareroot blackberry and rooted cuttings are planted in mid to late winter. Space the plants 2 to 3 feet apart in rows 8 to 12 feet apart.

Tissue-culture plants are generally disease free and grown in propagation laboratories. Most of the tissue-culture labs that grow blackberries are in the Pacific Northwest production region (Oregon, Washington). They are best planted in spring or fall, when mild temperatures favor establishment.

Nursery plants in containers are generally bigger and have more extensive root systems. With appropriate watering, they can be established in fall, winter, or spring.

Table 1. Blackberry varieties suitable for growing in Texas

Plant type	Variety	Production	Description
THORNY	'Brazos'	High yields; large fruit; typically the first blackberry variety to ripen in Texas	An old, reliable, and tough variety, developed at Texas A&M in 1950; bears well for many years; acidic fruit is usually better for cooking than for the fresh market; vigorous canes; drought and heat tolerant
	'Brison'	Abundant crops, very large fruit	Texas A&M variety released in 1977; has done better in South Central Texas and on blackland clay soils; erect
	'Chickasaw'	Ripens a little before 'Kiowa'; yields well; bears large, desirable fruit	Requires 500–700 chilling hours
	'Choctaw'	Soft, medium to large fruit; small seeds	Early-maturing, erect
	'Kiowa'	Bears the largest fruit of any variety; good yields of large, firm, high-quality berries	The top-performing thorny Arkansas variety for Texas conditions; requires 200 chilling hours
	'Rosborough'	Large fruit; sweeter than 'Brazos'; yields are often higher	Texas A&M variety; released in 1977; the best early variety for East and South Central Texas; erect
	'Shawnee'	Very productive	Not being planted because of the success of 'Kiowa'
	'Womack'	Yields similar to 'Rosborough', but fruit are smaller	Texas A&M variety; released in 1977; does best on deep, sandy soil; erect
THORNLESS	'Apache'	Bears large, sweet fruit	Plants grow rapidly, but yields have been variable; white drupelet is a serious problem; requires 800 chilling hours
	'Arapaho'	Very productive; medium-sized, firm, high-quality fruit over a 4-week season	Resistant to double blossom and orange rust; suitable for Zone 8 and above; erect; requires 500 chilling hours
	'Natchez'	Large fruit; good production and growth	Not widely tested, but results are very promising where growers have tried it; requires 500 chilling hours
	'Navaho'	Firm, medium-sized, sweet berry; ripens later than 'Arapaho', but yields are usually higher	Should not be grown in Central or South Texas; difficult to establish from root cuttings but produces a dense hedgerow once established; erect; requires 800 chilling hours
	'Ouachita'	Matures in mid–late season; heavy yields; firm berries	Fruit size similar to 'Arapaho' and 'Navaho'; requires 300 chilling hours
PRIMOCANE BEARING	'Prime-Jim' 'Prime-Jan'	Fruit size and quality similar to some thornless varieties; canes are thorny	Have performed poorly in the hot, humid South; should be tried only by hobbyists and home gardeners; set fruit on primocanes Jul–Aug, on floricanes in May
	'Prime-Ark 45'	Nice-sized fruit	Thorny; better adapted to hotter climates; set fruit on primocanes Aug–Sept; on 1-year-old floricanes, May–June

Irrigation

Blackberry plants must be watered regularly to grow well and to produce full-sized fruit. Drip irrigation lines can be laid at planting, attached to trellis wires, or laid on top of the ground beside the plants and covered with mulch.

Begin irrigating in March or April, paying careful attention to watering well during the bloom and early fruit-sizing periods, continue watering through the harvest period, and reduce it by September to slow new growth and to allow the canes to harden. In the winter of drought years, the plants may need to be watered occasionally.

Fertilization

The most important nutrient in annual fertilization is nitrogen. For best results, apply it in split applications, the first in spring as the buds begin to break dormancy, and the second in summer after the fruit harvest is completed.

Other nutrients may be deficient occasionally. Have your soil tested at least every 3 years to identify potential deficiencies and pH changes. If soil pH is over 8.0, blackberries can exhibit interveinal chlorosis (leaf yellowing between the veins) from iron deficiency, which is corrected by applying iron chelate products to the soil and/or foliage.

Training and trellising

Most of the varieties for Texas are semi-erect to erect. Although the growth is generally upright, a heavy fruit crop can cause the floricanes to bend over and touch the ground. Trellises can help prevent fruit decay caused by ground contact.

Figure 6. Simple two-wire trellis, with horizontal wires at 30 and 60 inches high.

In home gardens, blackberry plants may be trellised, planted near a fence for support, or left free-standing. They should be regularly tip-pruned—pinched or pruned back a few inches—to prevent the canes from growing too long and to encourage many short floricanes to form.

All floricanes die after fruiting. To reduce disease-causing organisms, prune and remove all dead canes every year as early in the growing season as possible. Keep the trellising and sup-

Figure 7. A supported hedge-row training system, with T-posts supporting two parallel wires 18 inches apart and about 30 inches high.

ports simple to make it easier to remove dead floricanes.

Commercial blackberry plants should be trellised to make it easier to control weeds, prevent diseases, and hand harvest the fruit. Two systems are most common: a simple, two-wire/two-level trellis (Fig. 6), and a two-wire retainer trellis, also known as a *supported hedge-row* (Fig. 7).

In both training systems, tip-prune the primocanes at strategic heights to encourage branching and to better distribute the blooms on the floricanes. When needed, use clips or ties to attach the fruiting canes to the support wires.

In blackberry plantings that are infested with double blossom and other diseases, you may mow all of the canes back to the ground in midsummer. Although this mowing reduces yield the following year on floricane-bearing varieties, it will reduce only the floricane crop of primocane bearers.

Weed control

Weeds should be controlled to increase fruit yields, reduce disease pressure, and make it easier to find and harvest low-hanging fruit. Before planting, kill all perennial weeds, especially native dewberries, which can harbor diseases and are nearly impossible to remove later. They may be sprayed with glyphosate or glufosinate herbicides the year before the blackberries are planted.

Organic mulches of hay, chipped limbs, pine straw, or bark chips reduce weed growth and make it easier to control weeds. Do not use pruned blackberry canes as mulch in Texas.

Weed-barrier fabrics may also be used in strips to retard weed growth. Do not allow them to cover the center of the blackberry row, as they can prevent new primocanes from emerging.

Both organic and fabric mulches help retain soil moisture and cool the soil in the summer, which enhance plant growth and development. Selective chemical herbicides can be used to control grass and weeds in established blackberry plantings. Nonselective and broadleaf weed-killing herbicides can damage blackberry plants if applied directly to growing plants.

Table 2. Common blackberry diseases

Disease	Symptoms	Prevention	Treatment/notes
Anthracnose	Oval spots on new primocanes; small, purplish spots on new shoots and leaves in spring; shothole effect on leaves; canes may die back; fruit is usually small, dry, and scabby	Plant in sites with good air circulation; control weeds; prune and remove all dead canes each year	A fungal disease; use copper sprays in the delayed dormant period or early spring as buds begin to open; strobilurins are effective if applied between budbreak and flower petal fall
Crown gall	Irregular, swollen galls at the plant crown (stem/root junction) and on any roots and canes	Buy cuttings or plants from reliable sources; avoid areas known to be infected; prune and remove all dead canes each year	A bacterial disease; remove infected plants
Double blossom, rosette, witches broom	Short, broom-like clusters of foliage arising from infected canes; large, misshapen blooms with wrinkled and distorted petals; leaves may grow in the flowers	Plant highly resistant thornless varieties; 'Brazos', 'Womack', and 'Kiowa' have some tolerance; many other thorny varieties are highly susceptible; prune and remove all dead canes yearly	The most serious fungal disease in East and southeast Texas; remove and destroy infected canes; destroy wild berries in the area; may need to mow the plants to the ground; during bloom, fungicides are effective
Orange rust	Masses of orange spots on leaves in spring; moves through the plant, and all canes produced afterward will be nonproductive	Plant disease-free nursery stock; prune and remove all dead canes each year	A fungal disease; a serious problem for susceptible varieties, especially thornless; Quickly remove infected plants exhibiting symptoms
White drupelet	Light beige to white drupelets that may or may not be softer than normal-colored drupelets	—	A serious problem for 'Apache'

Pests

You may reduce the need for chemicals to control insects and diseases by keeping the blackberry plants trellised properly, pruned meticulously, and spaced widely. Prune branches near the ground to promote airflow, enable the leaves to dry faster, and reduce the incidence of diseases.

A few diseases attack blackberries (Table 2). Fungal diseases that affect blackberries include anthracnose; double blossom, also called rosette or witches broom (Fig. 8); and orange rust (Fig. 9). Crown gall (Fig. 10) is caused by bacteria. The cause of white drupelets (Fig. 11) is not fully understood; possible factors include stinkbugs and sunscald.

Insect and mite pests include leaf-footed plant bugs, red-neck cane borers, spider mites, stink bugs, strawberry weevils, thrips, and white grubs. Nematodes may infest the roots and reduce the plants' vigor and productivity.

Figure 8. Healthy blackberry branch (left) and one affected with double blossom.

Figure 9. Orange rust.

Richard Klerk, University of Arkansas Cooperative Extension

Figure 10. Crown gall disease.

Harvest

Thousands of wild dewberries are harvested and marketed by the gallon along Texas highways in May and early June. Cultivated blackberries are either sold in "pick-your-own" farms or hand-harvested and sold fresh in local markets (Fig. 12).

Blackberries do not continue to ripen after harvest—their flavor is best when they are fully mature, having changed color from red to glossy black to dull black at maturity. To prevent the loss of ripe fruit, small commercial operations usually harvest three to four times a week. Varieties differ in shelf life, but they all will soften in a matter of hours if not refrigerated after harvest.

Rebecca Barocco, University of Arkansas Cooperative Extension

Figure 11. White drupelet.

Although few crops are as easy to grow and as rewarding as blackberries, economic success is based on having affordable, readily available labor. Blackberries are not machine harvested in Texas. Economic analyses of commercial blackberry farms have found that labor for harvest and other operations comprises about 70 percent of total annual variable expenses.

While growers may find harvesting blackberries a challenge, the fruit is easy to market, as many people are attracted to this flavorful and healthful fruit.

Figure 12. Blackberry flats.

For more information

Fruit and Nut Resources, Aggie Horticulture®:
http://aggie-horticulture.tamu.edu/fruit-nut

Insect Answers, Texas A&M AgriLife Extension Service:
http://insects.tamu.edu/extension/insctans/

Texas Plant Disease Handbook, Texas A&M AgriLife Extension Service:
http://plantdiseasehandbook.tamu.edu/

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Blueberries

Monte Nesbitt, Jim Kamas, and Larry Stein
Extension Fruit Specialists, The Texas A&M University System

Blueberries are truly an American fruit, with several species native to North America. They are relatively easy to grow when given acid soils and the right growing climate. The best blueberry for Texas is the rabbiteye blueberry *(Vaccinium ashei)*. It is grown commercially in East Texas, where the humid woodlands are typical of native rabbiteye blueberry habitat.

A single rabbiteye blueberry plant can produce 15 pounds of berries per year (Fig. 1), and the berries are easily marketed. Their popularity is growing because of the fruit's high concentration of antioxidants, which are thought to help prevent cancer and heart disease.

Rabbiteyes are an excellent choice for organic or Earth-Kind® orchards, because they have few serious pests, need little fertilization, and are native to the southeastern United States. The Earth-Kind program uses research-proven organic and traditional gardening techniques to maximize production while protecting the environment (http://aggie-horticulture.tamu.edu/earthkind/).

Figure 1. A mature rabbiteye blueberry bush can produce 15 pounds of berries per year. An orchard can produce 9,000 pounds per acre per year.

Varieties

Rabbiteye blueberry varieties differ in ripening date, productivity, and fruit size, with some bearing from dime-to nickel-size fruit.

Rabbiteyes bloom in the spring. The date that the flowers appear is affected by the number of hours below 45°F that an area receives in a year, or *chill hours*, and warming spring weather. The varieties that need the fewest chill hours typically bloom and set fruit early; they are most likely to be injured

Table 1. Recommended rabbiteye varieties for Texas

Variety	Chill hours	Pollenizers	Harvest season	Comments
Prince	350	Climax, Brightwell	Mid May–early June	New variety for very early marketing; high risk of frost damage
Woodard	350	Climax, Premier	Mid/late May–early June	Older variety; excellent quality; softer fruit; home variety
Brightwell	400	Austin, Premier	Early June–early July	Partially self-fertile; blooms with 500s; fruit sensitive to wet conditions and splitting; medium–large fruit
Climax	450	Austin, Premier	Late May–early June	Concentrated ripening season; small–medium fruit
Alapaha	500	Austin, Premier	Late May–early June	Vigorous plants; medium-sized berries
Austin	500	Climax, Premier	June	Productive; medium–large berries; less firm than some
Premier	550	Austin, Alapaha	Late May–early June	Medium–large berries; young limbs are too limber to fruit heavily
Vernon	550	Austin, Premier, Alapaha	June	Good productivity and vigor
Powderblue	600	Tifblue, Brightwell	Late June–late July	Medium-sized, light blue fruit; good production
Tifblue	650	Brightwell, Brightblue	Late June–July	Small–medium berries are tart if not fully ripe; self-fertile
Ochlockonee	700	Powderblue, Brightwell	July	Very vigorous, productive plants; medium–large fruit

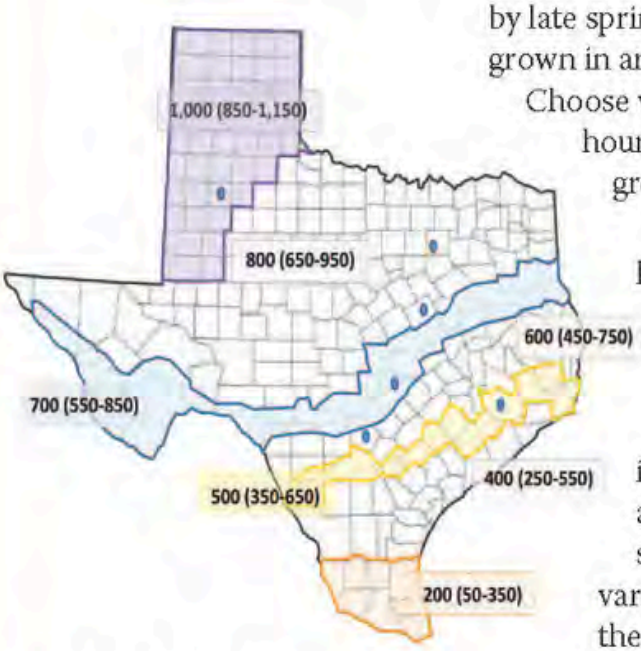


Figure 2. Chill hours for Texas counties.

by late spring frosts. Higher chill varieties may not yield well if grown in areas that do not receive enough chill hours (Fig. 2). Choose varieties that have a chill requirement within 150 hours (above or below) of the average chilling for your growing area. Buy them from a reputable nursery.

With proper management, commercial blueberry plantings in Texas can yield from 5,000 to 9,000 pounds per acre per year. If you want a longer harvest period, plant early, mid-season, and late-ripening varieties.

Most rabbiteye blueberry varieties need a pollenizer variety planted nearby to produce the maximum amount of fruit. A few varieties, such as tifblue, are somewhat self-fruitful (Fig. 3). To ensure that each variety is pollinated, choose pollenizers that bloom in the same part of the season as the main variety being grown (Table 1).

Soil and climate

Rabbiteye blueberries are calcifuges—plants that do not tolerate alkaline soil or water. They will not thrive unless the soil pH is in the range of 4.0 to 5.5. Some growers have tried to grow rabbiteyes on alkaline soils by lowering the soil pH with acidic media or fertilizers. The plantings often fail because of the complexities of soil chemistry. Commercial growers should plant rabbiteyes on soil that has a naturally favorable pH.

To determine the pH of your soil, have a sample tested. Soil testing is available from the Texas A&M AgriLife Extension Service Soil, Water and Forage Testing Laboratory (http://soiltesting.tamu.edu/). For more information on soil testing, see *Testing Your Soil: How to Collect and Send Samples*, available at https://agrilife-bookstore.org.

Blueberries may produce satisfactory yields if planted in containers or raised beds with mixtures of peat moss and pine bark. Rabbiteyes respond favorably to mulch, which prevents soil drying and moderates root temperatures.

The soil should drain well because rabbiteye roots are shallow and fibrous. Sandy soils are ideal for growing blueberries. However, drip irrigation should be provided in these soils because the plants are not drought tolerant. Do not plant blueberries on heavy clay soils that have poor internal drainage, which will cause root decline and poor vigor.

Late spring frosts can occasionally damage rabbiteye flowers. To reduce the risk of crop damage, plant on a site that is not lower than the surrounding topography. Commercial growers may also need to protect the plants with irrigation sprinklers, row cover material, or plastic-covered high tunnel greenhouses.

Figure 3. A 4-year-old Tifblue blueberry plant early in the ripening period.

Spacing and planting

Most plants reach mature size in 7 to 8 years, when they will be 15 feet tall and 10 feet wide. The bush will consist of many trunks that develop from the crown (base).

Three months before planting new blueberries, use glyphosate herbicide to kill all the grass and weeds in the row, and cultivate the soil to loosen tight areas. In low, flat areas, raise the beds to direct surface water away from the plants.

Before setting out the plants, thoroughly incorporate ¼ to ½ bushel of organic matter per plant at each planting spot. Because

of their acid-forming properties, shredded pine bark and peat moss are good sources of organic matter to use with blueberries.

Space the plants at least 6 feet apart in rows that are at least 12 feet apart. More space can be left between the rows of hedgerow plantings that are harvested by machine (Fig. 4).

Set bare-root or container-grown plants at the same depth at which they grew in the nursery, and water them soon after planting. Cut back the tops of bare-root plants by half while the roots are establishing. Lighter pruning may be sufficient for container-grown stock.

Figure 4. Blueberry plants should be spaced 6 feet apart in rows at least 12 feet apart.

Fertilizer and mulch

Rabbiteye blueberry plants do not produce the root hairs that are needed to take up water and nutrients. Instead, they depend entirely on a fungus that acts as root hairs for the plant. The plant provides nourishment for the fungi called mychorrhizae.

When rabbiteye blueberries are planted in an unsuitable soil or irrigated with unsuitable water, the fungi usually die, and the blueberry plant exhibits many symptoms of nutritional deficiencies. This type of rooting deficiency cannot be corrected by adding these nutrients.

Rabbiteye blueberries are sensitive to excessive fertilizer and to some types of fertilizer. Instead of one high-dosage feeding, apply fertilizer two or three times a year at low rates. Organic and slow-release synthetic fertilizers are preferable for this reason.

Avoid fertilizers that contain nitrate forms of nitrogen, which may slow plant growth. Instead, use fertilizers with nitrogen in the form of urea or ammonium. Check the fertilizer package to determine the form of nitrogen that it contains. The most effective and most commonly used nitrogen fertilizer for blueberries in Texas is ammonium sulfate (21-0-0).

Soils can become too acidic over time if fertilized with ammonium sulfate. Urea-N fertilizers are less acidifying with repeated use.

Do not fertilize newly planted blueberry plants with nitrogen until the plants have established. If the plants are well watered and appear to be thriving, apply ½ to 1 ounce of 21-0-0 fertilizer

per plant in the summer of the planting year. If the plants do not grow vigorously, wait until the second season to fertilize.

Beginning the second year after planting, fertilize the plants with 21-0-0 at a rate of 1 ounce per year of plant age, up to a maximum of 8 ounces per plant per year for those 8 years old or older. This rate should put the annual nitrogen application at or near 60 pounds of nitrogen per acre per year for orchards with 605 bushes per acre.

Broadcast the fertilizer evenly around the plant, avoiding concentrations of fertilizer in small areas. Good times to fertilize rabbiteyes are late winter to early budbreak (the beginning of bud growth) and early summer after harvest is complete.

Have the soil tested before planting and every third or fourth year thereafter to determine whether it needs other nutrients. Texas soils vary tremendously from site to site, and deficiencies in other macro- and micronutrients can hinder blueberry production. Regular soil testing will also track changes in pH that could reduce growth and production.

Mulch is vital for growing blueberries, especially during the first 2 years of establishment. It helps acidify the soil, control weeds, conserve soil moisture, and moderate soil temperatures. Apply a layer of mulch 4 to 6 inches deep over an area of 2 feet or more outward from the plant crown.

Appropriate mulches include peat moss, pine straw, pine bark, leaves, and grass clippings (Fig. 5). Do not use barnyard manure, which has a high salt content. Some weeds will grow through the mulch; remove them by hand or with a contact herbicide targeted to grass.

Figure 5. Pine-straw mulch in a mature rabbiteye orchard.

Irrigation

The irrigation water for blueberries must have little to no calcium bicarbonate. There are no cost-effective methods of removing calcium from water. Rabbiteye plants are also extremely sensitive to sodium.

Apply water according to the season, plant size, and soil texture. Plants bearing developing fruit are most sensitive to dry soils. The initial spring watering should be relatively light; once in full growth, give 1-year-old plants about ½ gallon per day.

Figure 6. A dormant blueberry plant. The lines indicate where to prune to reduce height; the circles show where to make cuts to thin the number of older trunks in the plant.

Double the rate during the second year, adding a gallon per plant each year to a maximum of 5 gallons per plant per day, or 35 gallons per week. Light-textured soils (sands) hold less water and dry out more quickly; for them, irrigate more often and for shorter periods.

Pruning

Rabbiteye blueberries need occasional pruning. Head back (thin out) the lower limbs to keep the fruit from touching the soil. Also thin out any overly vigorous upright shoots several feet from the ground to keep the center of the bush open and to keep the bearing area within reach.

As the trees begin to age and form thick, gray branches, begin thinning about 20 percent of the branches at ground level every year. This thinning encourages new, productive shoots to emerge from the crown area, keeping the plant younger and smaller (Fig. 6).

Harvest

Blueberries may be harvested by hand or by machine. Most of the fruit grown in Texas is picked by hand and sold for fresh consumption. A successful strategy in many areas is pick-your-own blueberry marketing.

In most Texas locations, the harvest season extends from May through July, depending on the varieties grown. Because rabbiteyes ripen unevenly within a fruiting cluster, pick individual berries over a period of 4 to 6 weeks (Fig. 7).

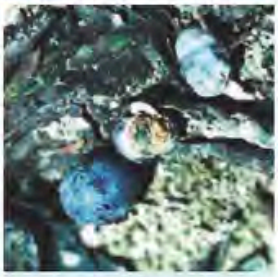
The berries do not ripen further after harvest; for maximum flavor and minimal bitterness, allow them to ripen on the bush.

Figure 7. Typical size of Climax fruit and variability of maturity stages.

Insect pests, diseases, and birds

The main fruit-attacking insect is the blueberry maggot. Diseases caused by fungi include mummy berry, botrytis blight, and anthracnose, or ripe rot (Table 2). Birds are a major problem in many areas, requiring special protective measures such as netting and noise makers.

Table 2. Insect and disease problems of rabbiteye blueberries

Problem	Photo	Symptoms	Prevention treatment	Comments
Anthracnose (ripe rot)		Excessive amount of rotting fruit during and after harvest; leaf spotting and defoliation	Harvest fruit promptly and move it into cold storage quickly	Sometimes infects developing leaves in warm, wet weather, and then infests more fruit in successive harvests
Blueberry maggot		Small larvae (worms) infest the berries, which decay and drop before or during harvest	Monitor annually with yellow sticky traps to identify when eggs are being laid on maturing fruit and to accurately time insecticide spray applications where the pest has become established	The adult is a small fly with black and white speckling
Botrytis blight		A powdery decay of flowers; small fruit	Apply fungicide during bloom	Spurred by cool, wet weather; frost-damaged flowers are more susceptible; damage may be hard to distinguish from frost injury
Mummy berry		Developing fruit is off-color and wrinkled or shriveled (mummies)	Destroy fallen fruit mummies with cultivation and copper sprays to the tree and soil surface in late winter. In orchards with serious problem, spray fungicide from when flower buds swell until petals fall; usually 1 or 2 sprays are needed	A fungal disease that infects leaf petioles, then small twigs and branches, then flower stigmas

Photos courtesy of George Philley, *Texas Plant Disease Handbook*, (mummy berry); James Theuri, University of Illinois Extension (botrytis blight and blueberry maggot adult and larva); and William Turechek, Cornell University (anthracnose).

For more information

Visit these websites for further information about growing rabbiteye blueberries:

http://aggie-horticulture.tamu.edu

http://www.extension.org/blueberries

Texas A&M AgriLife Extension Service

AgriLifeExtension.tamu.edu

More Extension publications can be found at https://agrilifebookstore.org
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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Figs

Jim Kamas, Monte Nesbitt, and Larry Stein
Extension Fruit Specialists, the Texas A&M AgriLife Extension Service

Figs are one of the most problem-free fruits that can be grown in areas with mild winters. Prized since ancient times, figs are believed to be native to western Asia. They were brought to California from Spain in the mid 1700s and then spread to the warmer growing regions east of the Rocky Mountains.

Common figs are generally grown as spreading, multi-trunked trees that can grow to 20 feet tall (Fig. 1). They have shallow, fibrous root systems and are relatively sensitive to drought stress.

The "fruit" of common figs are formed without fertilization (parthenocarpic) and are actually fleshy stem tissue with no seeds. The gelatin-like interior is actually unfertilized flower structures.

Although commercial fig cultivation in Texas has been largely unsuccessful, small dooryard plantings can meet a family's needs and provide some limited income from local sales. Because figs must be ripened on the tree and are quite perishable, even modest commercial ventures must have well-planned marketing strategies

Figure 1. Multi-trunked fig tree

Climate

Figs are generally limited to areas where temperatures do not drop below 5°F, although the stem tissues can be injured at much higher temperatures. In winters with sustained cold, mature

Figure 2. *'Alma'*

Figure 3. *'Celeste'*

Figure 4. *'Texas Everbearing'*

Table 1. Standard fig varieties used for home or limited commercial production in Texas

Variety	Climate	Fruit	Harvest	Notes
'Alma'	Very frost sensitive, especially when young;	Very high quality, excellent, rich, sweet flavor; skin is unattractive	Very productive; produces at an early age; late season; produces little or no fruit in years after severe freeze injury	Moderately vigorous tree; eye is closed; best grown no more than 200 miles from the Gulf of Mexico
'Celeste' ('Celestial')	Appears to be the most cold hardy of all fig varieties that have been evaluated in Texas	Small, brown to purple; excellent fresh dessert quality with a rich sweet flavor; an excellent processing fig, either frozen or processed as fig preserves	Very productive; harvest is often in mid to late June, well before most other fig varieties in Texas; usually produces fewer fruit in years after winter injury; heavy pruning of mature trees reduces the crop	Large, vigorous tree; tightly closed eye; adapted to the most diverse portions of Texas
'Texas Everbearing' ('Brown Turkey', 'Ramsey', 'Everbearing')	Less cold hardy than *'Celeste'*	Medium to large; plump with a short stem; reddish-brown skin; reddish-pink pulp; mild, sweet flavor	Reliable producer almost every year; fruit ripens over an extended period from June through August; produces a fair to good crop on new growth after severe freeze injury	Moderately closed eye; the fruit can sour or crack in very wet years

trees can survive temperatures in the low teens. However, trees can sustain severe damage during dry winters or if they are not properly acclimated.

Because of the wide swings in winter temperatures, figs commonly suffer mild to severe winter injury in all but the warmest parts of Texas. When fig trees are frozen to the ground in severely cold winters or more northern areas, some varieties produce a crop on the current season's growth; others return to production the next year.

Soil

Plant figs in well-drained soil. Although they will grow in soils ranging from coarse sands to relatively heavy clay, they can suffer extensive damage from root knot nematodes in sandy soils.

Figure 5. Fig eye characteristics: a) open eye, and b) closed eye

Varieties

Of the four distinct horticultural types of figs, only the common fig is produced in Texas and other Gulf Coast states. Three standard fig varieties have been grown throughout the South and are reliable choices for home or limited commercial production: 'Alma', 'Celeste', and 'Texas Everbearing' (Table 1, Figs. 2 through 4).

A major consideration in variety choice is the characteristics of the fruit "eye." Varieties with an open eye may be susceptible to feeding by the dried fruit beetle or souring when rain enters the interior of the fruit (Fig. 5).

Research has identified additional promising varieties that are suggested for trial plantings. They are 'Blue Giant', 'Bournabat', 'Lemon', and 'LSU Purple' (Table 2, Figs. 6 through 9).

Propagation

Figs are one of the easiest fruit crops to propagate. Hardwood cuttings that are taken when the plants are fully dormant will readily root and are most commonly used to propagate figs.

The cuttings should be 6 to 10 inches long and about ½ to 1 inch in diameter. To encourage callus formation, place the cuttings in a warm, humid environment such as in a moist paper towel placed in a plastic bag for 10 to 14 days.

Plant the cuttings in pots in commercial potting media to encourage root and shoot formation. Although softwood cuttings can also be used for propagation, they usually need a mist system for successful plant production.

Site selection

Figs perform best when planted in locations that receive full sun exposure. It is common to see figs planted on the south or

Figure 6. *'Blue Giant'*

Figure 7. *'Bornabat'*

Figure 8. *'Lemon'*

Figure 9. *'LSU Purple'*

Table 2. Fig varieties suggested for trial plantings in Texas

Variety	Climate	Fruit	Harvest	Notes
'Blue Giant'	Less cold hardy than 'Celeste'	Large; purple skin and a pinkish flesh	Quite productive in south and coastal parts of the state; mild flavor and is quite sweet when fully ripened on the tree	Introduced by Fanick's Nursery in San Antonio; closed eye
'Bournabat'	Rather cold tender in the Hill Country, but should perform well in coastal areas	Large; pinkish skin; juicy, sweet luscious flesh; unique flavor and texture	Modest production after hard freeze in late summer through fall	Believed to have originated in the town of Bournabat, on the Turkish Aegean coast; closed eye
'Lemon'	Somewhat cold tender; suggested for trial plantings on the southern half of Texas	Attractive yellow skin; creamy, smooth flesh; unique flavor with mild citrus notes	Produces moderate crops on new growth in years that winter freezes kill it to the ground; has produced well in Fredericksburg and San Antonio	Found growing on the banks of a levee near Del Rio, Texas; closed eye
'LSU Purple'	Relatively cold hardy; widely adapted across the Gulf Coast	Medium to dark purple skin; strawberry-colored flesh; mild, sweet flavor	Good productivity in most years	Released in 1991 byLouisiana State University; quickly becoming a standard in many fig growers' fields; closed eye

east side of a home or barn to help protect from cold winter weather and to make sure that morning sun helps the fruit and foliage dry quickly after an evening rain.

Planting and care

Fig trees are traditionally planted in late winter or early spring as dormant rooted cuttings. Plant them 2 to 3 inches deeper than they were grown in the nursery. Because the trees can reach 20 feet tall, plant them no closer than 16 feet apart.

Dig a hole deeper and wider than necessary for the root system. Place the tree upright at the proper depth. Crumble the soil around the roots, and pack it down several times during the filling operation to bring all roots into contact with moist soil. After

planting, water the tree to settle the soil firmly around the roots.

Do not fertilize at planting. The initial growth of the young fig tree will come from stored carbohydrate reserves in the young trunk and roots. Cut back the dormant trunk by about a third at planting to help compensate for root loss when the tree was dug up in the nursery. Even dormant potted plants should be cut back to encourage vigorous growth the first season.

Mulching

Because their roots are shallow, figs will benefit from organic mulch. The mulch will conserve soil moisture and improve the soil structure.

Fertilization

Small, frequent applications of nitrogen will benefit both young and mature fig trees.

Pruning and training

In subtropical locations, figs can be grown as single-trunked trees. But they are commonly grown as multi-trunked plants in more temperate parts of Texas (Fig. 10).

In years when figs are frozen to the ground, they typically respond by sending up a multitude of new shoots. Once shoots are about 2 feet high, select five or six strong shoots to be kept as new trunks.

To lessen the shock of leaf area loss, consider reducing the number of new shoots over a 2- to 3-week period. In a single growing season, a fig tree that was frozen to the ground can rebound, perhaps bear fruit late that summer, and be positioned to be in full production the following year.

Figure 10. Young, multi-trunk fig trees

Freeze protection

Figs can withstand varying degrees of subfreezing temperatures. The degree to which they can avoid cold injury depends on the variety, the amount of moisture in the soil moisture, and the trees' level of conditioning for the cold.

To minimize freeze injury during dry falls and winters, thoroughly water the fig trees a few days before a hard freeze. Figs can usually tolerate sus-

Figure 11. Young fig plants fitted with wire cages to be packed for freeze protection

tained temperatures to 17°F, but young plants and young, tender trunks are more susceptible than are older, mature trunks.

Some growers mound spoiled hay 2 to 3 feet above the ground line of mature trees for insulation. Young plants can similarly have wire cages placed over them at the onset of winter (Fig. 11). These cages can be stuffed with organic matter such as hay, lawn clippings, or leaves for protection.

After the risk of spring frost has passed, remove the cages from both old and new plants. The organic matter can be pulled back from the trunk and be used as organic mulch for weed control.

Diseases

The greatest disease threat to fig production in Texas is fig rust *(Cerotelium fici)*. Fig rust is more severe in rainy areas and seasons.

Infected leaves turn brown and develop orange fruiting structures on the lower part of the leaf (Fig. 12). Severely affected leaves fall prematurely, leaving the tree weakened and unable to adequately ripen the crop.

To control the disease, rake and destroy the infected leaves. No conventional fungicides are approved to control fig rust. Organic materials containing copper are generally effective at controlling fig rust if applied at the onset of the disease.

Another disease is fig mosaic virus, which is thought to be caused by a complex of viruses that invade fig trees. The disease first appeared in California but has now spread to most areas in the United States where figs are grown.

The leaves on infected fig trees become mottled, usually in the heat of midsummer. The trees bear fewer, smaller, misshapen fruit.

There is no control for fig mosaic virus other than to carefully inspect nursery material before purchase

Insects and other pests

The only insect pest that typically affects the quality of ripening figs is the dried fruit beetle. To limit injury, plant varieties with closed eyes.

Although no conventional insecticides are approved to control this beetle, elemental sulfur can deter it from colonizing fig trees with ripening fruit. Because the registration of organic materials

changes often, refer to the National Organic Program or Organic Materials Review Institute for current registration information.

Root-knot nematodes, *Meloidogyne* sp., are microscopic worms that attack and feed on roots, causing them to swell or gall. They disrupt the roots' ability to take up water and nutrients. These galls are easily seen on root samples.

Nematode problems may go unnoticed for several years. As a heavy population builds up, the tree loses vigor and declines gradually. Nematodes contribute to premature fruit drop.

To prevent root-knot nematodes in figs, obtain nematode-free plants and plant them in nematode-free soil.

Figure 12. Fig rust on foliage

Harvest

Figs bear their first crop in late spring, but many varieties produce a larger crop in late summer through fall. When frozen to the ground, the fall crop may be smaller, delayed, or in some varieties, absent.

For more information

Fruit and Nut Resources, Aggie Horticulture®.
http://aggie-horticulture.tamu.edu/fruit-nut

Texas A&M AgriLife Extension Service

AgriLifeExtension.tamu.edu

More Extension publications can be found at AgriLifeBookstore.org

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Olives

Larry Stein, Jim Kamas, and Monte Nesbitt
Extension Fruit Specialists, The Texas A&M University System

The olive is an exotic fruit crop in Texas. Olives are native to the Mediterranean Basin, which usually has mild, rainy winters and hot, dry summers. In contrast, Texas sometimes has severe winter freezes that can kill olives to the ground.

The best area in Texas to attempt commercial olive production is in the southwest region north of Laredo and southwest of San Antonio (known as the Winter Garden). The late Earnest Mortensen of the Texas Agricultural Experiment Station brought olive trees to the Winter Garden in the 1930s. Some of Mortensen's trees survive today.

Although research by Texas A&M University has indicated that olives could be grown for fruit production in large parts of East, Central, and South Texas, those studies also found that growers should expect severe winter freezes to kill trees to the ground about 3 years of every 10.

Figure 1. In Texas, 'Manzanilla' olives are primarily pressed for oil.

Over the past 10 to 15 years, olive plantings have increased in Texas, primarily southwest of San Antonio and in the Hill Country. Not all of these plantings have been successful. In North and West Texas and the Hill Country, freezing temperatures occur too often to allow for olive cultivation. Extreme South Texas does not typically experience enough cool weather for the olive to set fruit. There, it may be grown as an ornamental.

Most of the olives grown commercially in Texas have been pressed for oil (Fig. 1). Some growers and hobbyists have also

successfully produced table olives, which must be brined to remove the fruit's natural bitterness.

The olive is related to the desert olive *(Forestiera sp.)* and the American wild olive *(Osmanthus sp.)*, which are not edible. It should not be confused with the Russian olive *(Elaeagnus angustifolia)* or the anacahuita *(Cordia boissieri)*, which is sometimes called the Texas or Mexican olive. These plants belong to different botanical families.

Climate

The best olive production and quality occur where conditions are similar to those in the Mediterranean: mild winters and long, warm, dry summers. The tree's growth begins in the spring after average temperatures rise to 70°F and continues until temperatures drop below that point in the fall. Unlike many other temperate fruits, olives are evergreen trees that do not experience a winter dormancy period.

Figure 2. Young trees severely damaged by cold.

Olive trees freeze in extreme cold (Figs. 2 and 3). For the above-ground portions of trees to survive, they must be protected, especially during the first 3 years of establishment (Fig. 4). Their cold hardiness is like that of citrus, improving with tree age and increased trunk size:

- Young trees may be killed when the temperature drops below 25°F.
- The leaves and small stems on mature trees can be damaged at 17°F; more severe damage occurs at 12°F.
- Mature trees can be killed to the ground when the temperature drops below 12°F.

Figure 3. Bark splitting from freeze injury.

Freezes in Texas are unpredictable—they can occur unexpectedly in the fall, spring, and winter. The survival and extent of freeze damage of olives depend on several factors, including seasonal timing, warm versus cool day/night temperatures before the freeze, and the depth and duration of low temperatures experienced. Less damage occurs when the temperature decline is gradual rather than sudden and steep.

The tree's winter survival can be affected by late-summer and fall growing conditions. Trees may be more likely to sustain freeze damage if they were

given too much water and fertilizer late in the growing season, causing them to continue growing too long.

Mature trees can regrow from the underground crown after a severe freeze.

Once established for 3 to 5 years, olive trees become more resistant to freeze damage. However, they can lose their cold hardiness when temperatures fluctuate in the winter. Texas climatic conditions are erratic, particularly in midwinter. In many areas of Texas, temperatures can rise to the 60s in January and upper 80s to 90s in February, only to be followed by severe cold in March. This pattern may result in severe tree damage or death.

Fruit set can be seriously hampered by rain, near-freezing temperatures, very high humidity, and/or hot, dry winds during bloom in the spring.

Figure 4. A 3-year old olive tree.

Unlike most fruit trees in Texas, the olive does not set fruiting buds in the fall. Instead, the tree sets flower buds during the winter only after being exposed to cool nights (35 to 50°F) and mildly warm days (less than 80°F). This warm day/cool night exposure is called *vernalization;* varieties differ in the temperature ranges required.

Olive trees bear two types of flowers: staminate and perfect. Staminate flowers contain only male parts. Only perfect flowers can become fruits.

Bees and other insects play a minor role in olive pollination; wind moves most of the pollen from tree to tree. Although most olive varieties are self-fertile, some varieties are naturally self-incompatible, requiring cross pollination with another variety to set fruit. Self-incompatibility can also occur in some varieties as a result of high air temperatures.

Soil

Olive trees grow in a wide variety of soils, from sands to clays, and the pH ranges from 5.5 to 8.5. They also have better tolerance to soil and water salinity than many commercial fruit crops.

Because olive trees have fairly shallow root systems, the soil need not be deep. However, it must be well drained. For opti-

mum production, the site should have 3 to 4 feet of unstratified (unlayered) soil.

Clay or rock layers and/or different soil textures can hinder water drainage and cause the olive trees to drown out. Of concern are not the dry periods, but rather those when the area gets an abundance of water from either irrigation or rainfall. If the groves remain saturated for an extended period, the trees may die.

Varieties

Many olive varieties have been tried in the state, with cold hardiness being the key selection factor. Table 1 lists the varieties that have exhibited better survival and production in Texas.

TABLE 1: Olive varieties that survive and produce best in Texas.

Variety	Height at maturity	Cold hardiness	Pollinizer	Uses	Notes
'Arberquina'	12–15 ft	Very good	Self	Oil is very sweet with a delicate almond overtone; the fruit can be brined also	The cultivar planted most in Texas to date; small fruit; from Spain
'Arbosana'	12–15 ft	Moderate	'Arberquina'	Oil or table olive	Spanish variety; good quality
'Frantoio'	20+ ft	Low	Self	Oil	Has grown well in many areas of Texas; productive in some areas; in others, only a handful of olives produced per tree; from Italy
'Manzanilla'	<20 ft	Moderate	'Pendolino' or other pollinizer	Primarily a table olive; in Texas, fruit are usually pressed for oil	Most canned black olives are of this variety; widely planted in the United States, Spain, and the Middle East
'Mission'	<20 ft	Good	Self	Oil or table olive	Developed in California
'Pendolino'	20+ ft	Moderate	N/A	Oil	Has performed poorly in many areas; the only reason to plant this variety is solely as a pollinizer for 'Manzanilla'; from Italy
'Picual'	20+ ft	Moderate	'Manzanilla'	Oil tends to be pungent and has a long shelf life	Yields in Texas have been disappointing; the No. 1 variety in Spain for oil

Of the varieties listed, not all perform equally well at all locations. Cases of very different variety performance even among orchards of close proximity have been noted.

Site preparation

Prepare the orchard site 12 to 18 months before planting the trees. Kill perennial weeds and grasses, and break up any hard layers by deep chiseling or ripping down (using a long shank pulled by a tractor) the planting rows.

Have the soil tested, and apply any needed amendments before planting so you can incorporate them more easily in the planting site.

Install an irrigation system. Although the trees should be watered with a tank and hose at planting, it is impractical for ongoing establishment and maintenance of the orchard.

Figure 5. A mature, bearing olive grove.

Planting

The amount of space needed between olive trees depends on the variety and the anticipated harvest method—hand versus machine. Traditional spacing for most varieties where row harvesters are not used is 30 feet by 30 feet, or 48 trees per acre (Fig. 5).

Varieties with more compact growth, such as 'Arberquina' (Fig. 6) and 'Arbosana', could be spaced at 25 feet by 25 feet, or 70 trees per acre. Where over-the-row harvesting is planned, plant hedgerow trees 5 to 11 feet apart in the row, with 13 to 22 feet between rows. Mechanical harvesting equipment for olives is expensive and requires higher tree density and fruit production per acre.

Figure 6. 'Arberquina' is the cultivar planted most in Texas.

Space the trees to ensure that each gets adequate sunlight—they bear fruit only on 1-year-old wood on the outer periphery of the trees. Shoots in full shade will not flower or produce fruit. Crowding leads to shading and poor production.

Growers often plant trees closer than normal, with plans to remove temporary trees as the permanent trees mature.

The ideal time to plant olive trees is in early spring after the danger of frost has passed. Make the hole large enough to accommodate the root ball and at the same depth that the tree grew in the container.

At planting, cut the tips off the branches at 30 inches to stimulate the tree to produce lateral, or secondary, branches. Water the trees thoroughly at planting and regularly afterward.

Protect the trunks of young trees from sunburn; many growers use tree shelters or grow tubes.

Irrigation

Although the olive is drought tolerant, it grows best when irrigated. Mature olive groves should be irrigated at a rate of about 1 acre-inch per week.

To mature properly, olive fruit need water, and the tree needs water to store reserves for a potential crop next year. Some growers cut back on water at this time hoping to improve oil quality. However, if water is curtailed and then a deluge of rain falls, the quality will be lower than if the trees had received regular irrigation throughout this period.

Avoid overwatering and waterlogging the roots.

Fertilization

Olives are tolerant of low soil nutrition and can grow well in infertile soils. Nitrogen is needed annually to support growth and fruit production. Depending on their size, mature trees need ½ to 2 pounds of actual nitrogen per year. Rare but possible are deficiencies of potassium and boron.

Fertilize in the spring when new growth begins. If growth is poor, more fertilizer may be applied in the summer. Excessive nitrogen will stimulate growth at the expense of fruiting (both the amount and quality of fruit), and luxuriant late season growth is more susceptible to freeze damage.

Training and pruning

Olive trees require little training. During the first growing season, tip-prune any long, whiplike trunks at 30 to 36 inches in height to encourage the formation of lateral-growing scaffold branches on the main trunk.

To prune standard (non-hedged) olive trees, thin out dead wood and dense areas that may have become unproductive.

High-density orchards that are hedge-pruned are pruned annually beginning in Year 4 or 5 to provide access for over-the-row harvesters.

To reduce the risk of freeze damage, delay all training or pruning until early spring. Pruning can stimulate growth of olive trees, which do not go dormant but instead stop growing actively in the winter.

Freeze protection

Most commercial olive trees are grown from cuttings rather than from grafting onto seedling rootstocks. This provides an advantage in climates that have harsh freezes. Trees grown from cuttings that are frozen to the ground usually grow back from the ground and will be true-to-type, provided that the crown of the tree does not also freeze.

Mound, or "bank," additional soil around the base of the tree to ensure the survival of the crown and any above-ground portions of the trunk or lower limbs that are covered in soil. Create these soil banks in late November; allow them to stay in place through the winter; and remove them by shoveling or raking in early to late March, once threat of serious freezes has passed.

Mounding with hay, straw, mulch, or fabrics is not as effective as with soil because soil conducts heat better.

Soil banks are usually not needed for crown protection once the trees have reached 4 or 5 years old and have made good trunk caliper (diameter at 12 inches above the ground) growth. However, growers who wish to continue protecting the trunks may continue to bank them with soil or use commercial trunk wraps made from Styrofoam or other insulating materials.

Irrigation water can be used to protect olives from freeze damage where growers have microsprinklers and ample water available. Water must be applied continually with sprinklers during a night when freeze damage is anticipated. However, if the right amount of water is not provided continually to each tree, serious injury will occur. If you are considering using irrigation for freeze protection, consult your county AgriLife agent or a licensed irrigator with experience in freeze protection of plants.

Weeds

Use mulch and/or herbicides to prevent competition from weeds and grass. Because of the shallow growth habit of olive feeder roots, do not plow or cultivate the soil to remove weeds.

Diseases

Although stress from cold or heat has been the main cause of tree death in Texas, many diseases also attack olives. One of the most damaging is cotton root rot *(Phymatotricopsis omnivora)*, a soilborne fungus that is prevalent in the high-pH soils of southwest Texas.

To help protect against cotton root rot, keep the trees healthy and provide good growing conditions. This fungus more readily affects plants that are weakened from water stress or other deficiencies. Control weeds around the trees to reduce the competition for water and nutrients and to minimize additional food supply for the fungus, which has many alternate hosts.

Texas olive trees have not been affected by two diseases that commonly attack olives in other parts of the world: *Verticillum* wilt and olive knot. Olive knot has been found on other plant species in Texas but not on olive.

Figure 7. Coloration in maturing olive fruit.

Fruit and foliage diseases have been minimal in Texas as well, but wet springs and summers can hinder fruit set and lead to foliage and fruit issues.

Mechanical damage from string trimmers has led to girdling and death of trees.

Insects and vertebrate pests

The main insect injuries to olive fruit in Texas have been caused by leaffooted bugs and/or stinkbugs. Spray insecticide directly on the trees or protect them indirectly by spraying on "trap crops," which are plants that attract agricultural pests, usually insects, away from nearby crops. Examples of trap crop plants for olives in Texas include black-eyed peas, pearl millet, and sunflower. Plant them in time to attract inspect pests during the critical fruit-development period.

Even though the most damaging olive insect worldwide is scale, it has not been a serious problem so far in Texas. Lesser problems here have been associated with nematodes, borers, and thrips.

Deer have been a serious deterrent to tree growth in many areas, making high fences a necessity for commercial production.

Harvest

Under the proper conditions, an olive tree will begin bearing a harvestable amount of fruit at about 4 or 5 years old. The fruit is borne on panicles, or fruiting branches, that grow from buds above the point where the leaves join the stem on the previous season's growth.

Olive harvest typically begins in mid to late September or early October. A mature olive at harvest can be completely green to totally black, depending on the variety. Most fruit are harvested as they begin to color (Fig. 7).

Some growers delay harvest to allow the crop to reach the desired size and weight; however, if harvest is postponed too long, the crop value will be reduced by poor fruit quality.

In most cases, olive crops are removed from the trees by hand. A harvester moves a cupped, gloved hand down the limb in a milking action. The olives drop either into a bag or onto a sheet spread on the ground around the tree.

If you will be using hand harvesters, you must have a well-trained labor force available to remove the fruit within a 2-week period. This method harvests about 95 percent of the fruit, with about 5 percent cullage.

Larger operations must harvest the fruit mechanically, using a shaker that vibrates the tree and dislodges the fruit. The challenge is to remove the fruit without damaging it or the tree. Shakers harvest only about 75 percent of the fruit, with up to 20 percent cullage.

Regardless of how the fruit is removed from the tree, it must be processed promptly because the fruit deteriorates fast.

When fresh, the fruit is not palatable because it contains phenolic compounds and oleuropein, a bitter glycoside. To be used as food, olives must be processed—either pressed for the oil or treated with lye and salt to produce the canned or preserved table fruit.

The fruit processed in California has almost all of the bitterness removed; that processed in the Mediterranean basin area may be left somewhat bitter.

Economic considerations

The high cost of olive oil in grocery stores and the health benefits associated with eating olive oil have led many to believe that producing Texas extra-virgin olive oil is lucrative. However, the costs to produce olive oil are high and the competition fierce. Depending on the cultivar, it takes from 75 to 125 pounds of olives to produce 1 gallon of oil.

Olive oil marketing is complicated. The use of the term *extra virgin*—which is generally assumed to be pure, high quality, and mechanically, rather than chemically extracted—is not legally enforced globally.

Olive oil producers/retailers in the United States may certify their olive oil through the U.S. Department of Agriculture (USDA). The USDA Standards for Grades of Olive Oil and Olive-Pomace Oil, passed in 2010, defines *extra virgin olive oil* as having excellent flavor and odor and free fatty acid content of not more than 0.8 grams per 100 grams (0.8 percent).

U.S. Customs laws do not prevent an oil product sold in the United States from saying "imported from Italy (or any other country)" on the bottle, regardless of where it was produced, as long as the real country of origin of the product is also shown somewhere on the same side of the bottle.

For more information

Ferguson, L, G. S. Sibbett, and G. C. Martin. 1994. *Olive Production Manual*, University of California, Oakland, CA

http://aggie-horticulture.tamu.edu/fruit-nut

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Texas Fruit and Nut Production

Peaches

Jim Kamas, Larry Stein, and Monte Nesbitt
Extension Fruit Specialists, The Texas A&M University System

Peaches are the leading deciduous fruit crop grown in Texas. An estimated 1 million trees are planted statewide, only half of which are planted in commercial orchards of 1 acre or larger.

The demand for high-quality, locally produced peaches remains good, and the future appears bright for the industry. Selling fresh peaches is more likely to be profitable if the orchard is close to a metropolitan center, where high-quality, tree-ripened fruit command premium prices (Fig. 1).

Figure 1. Tree-ripened peaches

The most limiting factor in orchard profitability is late spring frost, and growers should plan on losing one in six or seven crops even in the best of orchard locations. At times, frost has caused crop loss for 2 or 3 years in a row, prompting some growers to leave the business because of loss of revenue and enthusiasm.

In planning a new orchard, prospective growers should take this risk into account and plan orchard size accordingly. If peach production is a part-time enterprise, 2 to 5 acres of orchard may be appropriate; a full-time, one-person enterprise may require closer to a 20- to 25-acre planting.

Site, soil, and water requirements

For long-term profitability, the most important decision a prospective grower will make is selecting an appropriate site. To be healthy and productive long-term, an orchard site must have the proper soil type and internal drainage, water quality, elevation that accentuates air drainage, site use history, and market access.

Soils: Peaches are very susceptible to waterlogged soils. Excellent internal soil drainage is essential to long-term tree productivity and survival. The roots cannot grow without air in the soil profile.

The ideal is a sandy loam topsoil that is at least 18 to 24 inches deep and is underlain with a well-drained red clay subsoil. Avoid subsoil that is blue, gray, mottled, or dull colored because it usually drains poorly.

The subsoil and topsoil must be relatively fertile and have satisfactory water-holding capacities. Although soil testing through an accredited lab will provide information on soil fertility, pH, salinity, and nutrient-holding capacity, it may not indicate the soil's drainage properties. Consult your county agent or and Extension horticulturist to determine if your site and soil is appropriate for peach production.

The ideal soil pH for peach production is between 6 and 7. If the pH is below 6.0, you may need to apply lime before establishing the planting beds. In some high-pH sites, proper rootstocks may help overcome the nutritional deficiencies that are common to alkaline soils.

Water: Avoid sites with high salinity levels in the water. Abundant, clean, salt-free water is essential for commercial peach production. Irrigation water is considered adequate if it has a sodium absorption ratio (SAR) below 3.0 and total salts below 1,000 ppm. A mature, bearing peach orchard can use more than 2,000 gallons per acre per day.

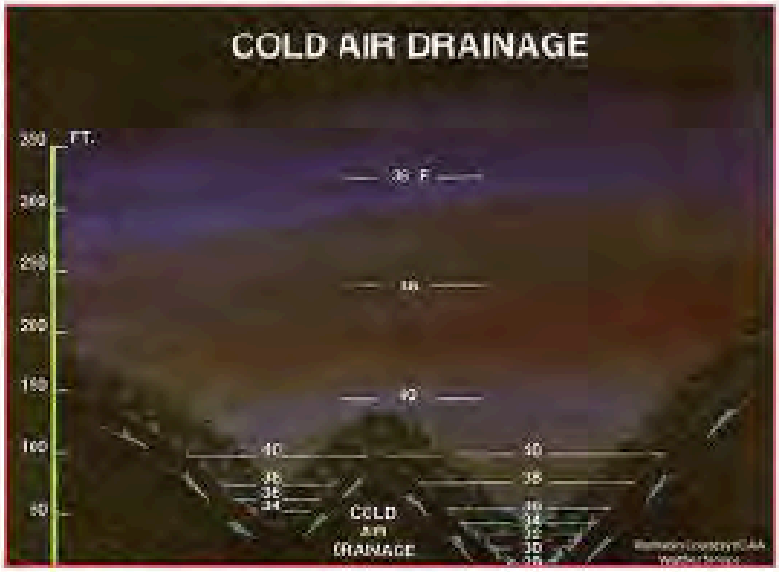

Figure 2. Topography effects on cold air drainage. Temperatures on hilltops may differ from those in valleys by as much as 10°F.

Elevation: To reduce crop losses from spring frost, choose an orchard site that is higher in elevation than that of the surrounding area. Air must move easily out of the orchard to minimize serious damage from spring frosts during bloom and early fruit development. Avoid areas with barriers such as dense treelines to

air drainage. On frosty mornings, temperatures may fluctuate as much as 10°F from hilltop to low-lying areas and can mean the difference in a full crop as compared to a complete crop loss (Fig. 2).

Site history: Because of soil-borne disease problems, do not replant an old orchard site for at least 3 years after it has been cleared. Peach trees perform best on sites where no stone fruit orchards or forests have grown for several years. Also do not plant a site that was recently cleared of standing timber—especially post oaks— because the risk is higher for diseases such as oak root rot *(Armillaria mellea)*.

Market: To determine the size of the orchard and the peach varieties to plant, first decide where you will market the peaches. Pick-your-own or retail sales may not be practical in relatively remote areas. Although prices in wholesale markets are usually somewhat lower, these markets are an important alternative for larger orchards.

Peaches are extremely perishable, and there is little flexibility to explore alternative markets once harvest begins.

Varieties

Select varieties with long-term proven production for your area of Texas. Planting unproven or un-adapted varieties often results in disaster and disappointment.

Peaches require a certain amount of winter chilling—typically, the number of hours at or below 45°F in a location—in order to break dormancy, bloom, and grow normally in the spring:

- Varieties that need fewer chilling hours than are common for the area are more likely to bloom early and be more subject to frost.
- Varieties that need more chilling hours than are available may break dormancy late and fail to set fruit.

Varieties recommended for a given location typically have chilling requirements within 100 hours of the average accumulation for that site (Fig. 3, Table 1).

Figure 3. Average number of hours of winter chilling below 45° F in Texas.

Peach varieties are usually compared to others that have similar chilling requirements and that ripen in a given period. Because bloom and harvest times fluctuate widely across the state and between seasons, a calendar date cannot be

TABLE 1: Recommended peach varieties for Texas.

High-chilling varieties (700–1,000-hour zones)			
Variety	**Chilling requirement**	**Stone freeness**	**Days ripening before *'Elberta'***
'Flavorich'	700	Cling	64
'Regal'	700	Semi-cling	54
'Junegold'	650	Cling	46
'Surecrop'	1,000	Semi-free	42
'Juneprince'	650	Semi- free	35
'Sentinel'	850	Semi-free	34
'GaLa'	750	Semi-free	34
'Harvester'	750	Free	26
'Ranger'	1,000	Free	24
'Fireprince'	850	Free	20
'Cary Mac'	750	Free	20
'Topaz'	850	Free	18
'Majestic'	850	Free	16
'Redglobe'	850	Free	13
Cresthaven	850	Free	3
'Dixiland'	750	Free	3
'Redskin'	750	Free	2
			Days after *'Elberta'*
'Flameprince'	850	Free	14
'Parade'	850	Free	30
'Fairtime'	750	Free	35

Medium-chilling varieties (450–650-hour zones)			
Variety	**Chilling requirement**	**Stone freeness**	**Days ripening before *'Elberta'***
'Flordacrest'	425	Semi-cling	55
'Flordaking'	450	Cling	51
'Junegold'	650	Cling	46
'TexKing'	450	Cling	42
'Juneprince'	650	Semi-free	35
'Texstar'	450	Semi-free	32
'Southern Pearl'	650	Free	28

Continued on page 5

used to estimate when the fruit will mature.

Instead, standard varieties are used as benchmarks for relative ripening dates. Even though 'Elberta' is rarely grown these days, it is still the standard by which the maturity of high- and medium-chilling cultivars are measured. For low-chill varieties, the standards are 'Flordaking' and 'Flordaprince'.

Commercial varieties must be vigorous, consistently bear satisfactory yields, and have acceptable disease resistance. Fruit characteristics need to meet certain minimum quality standards as measured by color, firmness, flavor, shape, and size. As the season progresses, fruit quality typically improves.

For retail or pick-your-own marketed fruit, consider planting several varieties that ripen in sequence to extend the harvest over a 6- to 10-week season. Early peaches often bring premium prices due to a lack of competition from other areas. Late-season varieties typically have greater stone-freeness and higher quality but require more sprays, have significant out-of-state competition, and may ultimately be less profitable.

Rootstock selection

The type of rootstock greatly influences a peach tree's growth, productivity, and longevity. For sites with coarse soils, choose nematode-resistant rootstocks such as Nemaguard. Although peaches perform best on sandy soils, root-knot nematodes may pose problems in those areas.

For heavier, more alkaline soils where nematodes are not an obstacle, Lovell or Halford rootstocks offer fewer problems with iron and zinc uptake and are more cold hardy than Nemaguard.

Guardian rootstock, which was developed to overcome specific tree problems in the southeastern United States, has performed poorly in Texas and is not recommended.

You may need to contract with a commercial nursery to obtain the desired varieties on the correct rootstock. To get the number of rootstock/scion combinations you want, order 12 to 15 months before the anticipated planting date.

Continued from page 4

Medium-chilling varieties (450–650-hour zones)			
'TexRoyal'	600	Free	25
'Suwanee'	650	Free	22
'TexPrince'	550	Free	20
'La Feliciana'	600	Free	18

Low-chilling varieties (150–400-hour zones)			
Variety	**Chilling requirement**	**Stone freeness**	**Days before *'Flordaking'***
'Gulfking'	350	Cling	6
Variety	**Chilling requirement**	**Stone freeness**	**Days after *'Flordaking'***
'Flordacrest'	375	Cling	+4
'Gulfprince'	400	Semi-free	+25
			Days after *'Flordaprince'*
'FlordaPrince'	150	Cling	-0-
'TropicPrince'	150	Cling	+7
'TropicBeauty'	150	Semi-free	+14

Orchard establishment

To prepare the orchard site, clear out the trees and underbrush, remove roots, and disk and smooth the area. If the site has been recently cleared of timber, consider rotating annual cover crops of grasses, legumes, or small grains and delaying planting 1 to 2 years after clearing to reduce the probability of *Armillaria* root rot or other soil-borne pathogens.

If a site has been in native or improved grasses, starting site preparation the year before planting will greatly reduce weed control problems once the orchard is planted. Disking once or twice during the early season should reduce annual weed populations. Applying a non-selective herbicide such as glyphosate will help reduce problems with perennial weeds such as bermudagrass and Johnsongrass.

The trees will perform better and live longer if you plant them on terraces for maximum soil drainage. While this practice is essential on shallow, poorly drained soils, the use of terraces improves tree performance even on the best of soils. Construct the terraces, or beds, to make the tops 12 to 18 inches higher than the row middles.

Figure 4. Healthy nursery stock.

Spacing

Configure the orchard to reduce shading in the future and to make it easier for equipment passage. For irrigated orchards, the optimal spacing appears to be 22 to 24 feet between rows and 18 feet between trees.

For non-irrigated or non-cultivated orchards, spacing rows and trees 24 feet apart will allow for equipment passage through the orchard and give the tree more soil to draw from during drought. Researchers have tested higher-density peach spacing in Texas and in most cases it is not recommended.

Planting

For optimal success, plant the trees following these steps:

1. Buy healthy, vigorous nursery stock (Fig. 4) on appropriate rootstocks from a reputable nursery. Commercial orchards usually buy June-budded trees ranging from 2 to 4 feet tall. Ideal trees are 30 to 36 inches tall. Contact a nursery at least 1 year before planting to ensure the availability of desirable nursery stock.
2. When the nursery stock arrives, keep the roots from freezing or drying out by heeling the trees in soil: Open a trench, lay the trees at a 45° angle, cover the roots with soil, and water in the heeling bed.
3. Plant in December through early March while the trees are dormant. In Texas climates, planting early enables the roots to become established before bud break.
4. One hour before planting, trim the diseased or damaged roots and soak them in water.
5. Dig the planting holes large enough to accommodate the root system. Dig the hole to fit the root system; do not prune healthy roots to fit a smaller hole. You may prune roots that are diseased or damaged and cut back a few that are excessively long.
6. Plant the tree at the same depth as it was planted in the nursery. Firm the soil around the tree and water well to

help settle the soil and eliminate air pockets around the roots.

7. Prune the tree to a single trunk and cut it back to about 24 to 36 inches tall. For 1-year-old nursery stock, remove all the lateral branches flush with the trunk. For older stock, cut back the lateral shoots, leaving stubs to allow new buds to form scaffold limbs. Scaffold limbs are the primary branches arising from the trunk that form the tree's canopy.
8. Place a grow tube or aluminum foil on the lower 18 inches of the trunk, leaving the upper 6 inches of the trunk exposed (Fig. 5). This cover will help reduce sunscald, keep scaffold limb formation at an appropriate height on the trunk, and help in weed-control procedures the year of establishment.

To prevent trunk girdling in later years, remove **all** of the foil after the first growing season.

Figure 5. Cutting back at planting and aluminum foil wrapping of lower trunk.

Training

Within a few weeks after growth begins in the spring, select the strongest four or five shoots arising from the top 6 inches of the main stem. They should be evenly spaced along the trunk with at least one directed into the prevailing wind. Remove all other shoots along the trunks or limbs.

These few branches will grow vigorously for about 10 more weeks and then begin to lignify, or harden and turn brown, near the trunk. Maintain a healthy canopy with sufficient water, nutrients, and weed control throughout the fall to fully harden the new scaffold limbs and to maximize the young tree's winter hardiness.

First-year care

Weed control is critical in the first year; if left unchecked, weeds can drastically reduce the first year's growth. Most weeds remove water and nutrients from the soil more aggressively than can the newly set peach trees. Often these small trees can be seen standing in lush green grass with the telltale red spots of nitrogen deficiency on their leaves (Fig. 6). The trees will grow much bigger if weeds are controlled during the first year.

Figure 6. Lack of weed control causing poor tree survival, reduced growth, and orchard failure.

Figure 7. Early training of young tree to open center design.

Weeds can be controlled by mechanical methods such as tilling or disking and by chemical methods using herbicides.

The advantages of mechanical methods are that the trees will not be harmed by incidental herbicide contact and that cultivation can be performed by unskilled labor when available. Disadvantages include the number of cultivations required for adequate control and the extensive damage to tree roots if cultivation is too deep. To protect the roots, adjust the tillage equipment to cut no more than 3 inches into the soil.

Chemical weed control is more reliable and economical, does a better job of controlling perennial weeds, and usually does not have to be repeated as often.

Do not use glyphosate around first-year trees unless the trunk has been wrapped with aluminum foil as described earlier. Green bark can absorb the herbicide, which will damage the tree extensively. After the first season, the trunk bark will be better able to resist the uptake of herbicides.

Training to open-center system

Because they do not have an erect growth habit, peaches and other stone fruit are traditionally trained to an open center system (Fig. 7). This growth form is shaped like a martini glass and enables the tree interior to receive full sun exposure.

After the first growing season and when the young trees are fully dormant, prune back the tree to a trunk with three or four permanent scaffold limbs. If growth has been excellent in the first season, you can also establish sub-scaffold limbs about 24 inches from the crotch of the tree.

During the second growing season, the sub-scaffold limbs will continue to develop, and the tree will grow much larger. Under ideal conditions, peach trees can grow enough to bear fruit during the third growing season.

Peaches are borne only on 1-year-old wood, so in addition to gaining size and girth, the second-year tree will also be growing fruiting wood that will be responsible for the crop during the third growing season. Prune during the second dormant season to maintain and fully develop the open center form as well as to retain some 1-year-old wood for fruiting the following season.

Pruning

Pruning during the dormant season invigorates the tree, enabling it to develop a healthy canopy to produce the current

season's crop and to improve the potential for production in the following year.

Pruning benefits the trees and the orchard by:

- Keeping the tree center open to enable air to circulate and light to penetrate
- Partially controlling crop size when fruiting wood is thinned selectively
- Lowering the fruiting zone to a height that enables the peaches to be hand-harvested from the ground; if the trees are topped at 7 or 8 feet, the weight of the crop will bring the limbs down where the fruit can be easily reached
- Removing dead or diseased shoots, rootstock suckers, and vegetative water sprouts (excessively vigorous growth) from the center of the tree (Fig. 8).

Figure 8. Winter appearance of open center tree.

When thinning out fruiting wood, remove old, gray, slow-growing shoots that are not fruitful, and leave 1-year-old, red, 18- to 24-inch bearing shoots (Fig. 9).

Peach pruning normally removes about 40 percent of the tree each winter. This practice reduces the number of fruit on the tree and stimulates strong growth of a healthy canopy to ripen the branches that ultimately become fruiting wood for the following year.

Pruning early in the year provides "insurance" against crop loss by removing many of the flower buds. The peach tree will bloom soon after pruning when the chilling requirement is satisfied and warm weather follows.

Growers with only a few trees can wait to prune until the pink bud stage, which is when the flower petals have elongated and start to emerge from the green sepals. Larger orchards are traditionally pruned as late as possible in the spring while still allowing enough time to complete the task before the trees leaf out.

Pruning mature peach trees

A key to a long peach tree life is proper pruning. It often takes 20 to 30 minutes to prune a mature peach tree correctly:

1. Remove all hanger shoots, rootstock suckers, and water sprouts in the lower 3 feet of the tree. This removal allows air to circulate and clears a path for herbicide applications.
2. Remove all shoots above 7 feet high other than the red 18- to 24-inch fruiting shoots. Make the cuts where the scaffold and sub-scaffold limbs extend upward at a 45- to 50-degree angle from the trunk. Avoid cuts that leave limbs

Figure 9. Peach tree pruning.

sideways at a 90-degree angle.

3 Remove all water sprouts that grow toward the inside of the tree. These should be removed anytime they develop. Pruning them immediately after harvest in the summer will reduce shading in the prime fruit-bearing area of the tree.

4 Remove all old gray wood in the 3- to 7-foot production zone.

Fertilization

To the keep trees healthy and productive, maintain nutrient levels in the optimal range. The only accurate way to know what nutrients are needed is to have the soil and foliage tested.

Soil tests determine the initial nutrient needs and can help you maintain the soil pH in the desired range. An easy way to raise soil pH levels is to apply lime; however, it is extremely difficult to lower pH levels in calcareous soils.

Leaf analysis will reveal whether the tree has drawn the needed nutrients from the soil. To correct low micronutrient levels, make foliar and/or chelate applications; to increase macronutrients, apply them to the ground.

Have samples of leaves tested once or twice a year, following these guidelines:

- Collect the samples between July 15 and August 15.
- Select trees randomly across a block and include 50 to 60 leaves per sample.
- To help identify a limiting element, take samples of tree leaves in problem areas separately from those of "normal" trees.
- Take two or three leaves from the middle of the tree.
- Choose current-year shoots that are vigorous, bearing fruit, and well exposed to the sun.
- The leaves should be fully mature, from new growth, and well exposed to sunlight.

Instructions for collecting and submitting samples are available online at http://soiltesting.tamu.edu/ and at county A&M AgriLife Extension offices.

Have the soil tested every 3 to 5 years to monitor soil pH and soil nutrient levels. Soils with a pH above 7.8 usually cause major deficiencies of micronutrients, especially iron and zinc. To help overcome these site limitations, choose appropriate rootstocks and apply chelated nutrients as needed.

Young trees grow best with small, frequent fertilizations. Newly planted fruit trees can be fertilized the first year if they make 8 to 10 inches of growth by May. If so, spread 1 cup of nitrogen fertilizer (ammonium sulfate or nitrate) at least 18 inches away from each tree.

Be extremely careful not to place fertilizers any closer to the trunk. Fertilizers are salts that can burn roots and kill young trees. Because some organic sources of nitrogen also contain high salt levels, know the material you are applying.

Fertilize the second-year trees four times, in March, April, May, and June. If the soil pH is below 7.8, the first application can be a 3-1-2 ratio fertilizer; if above 7.8, use only nitrogen. Apply 1 cup of fertilizer at the first of each month. In the third year, apply 2 cups of fertilizer at the first of each prescribed month.

When following this fertilization pattern, if the trees do not continue growing from month to month, stop fertilizing. Fertilize only if there is active growth.

Once the peach trees are in full production—usually in the fourth growing season—apply phosphorus and potassium according to soil and or leaf tissue test recommendations. Most orchards with mature peach trees require 50 to 60 pounds of actual nitrogen (N) per acre per season. Typically, one half of this application is applied just after fruit set.

Ammonium nitrate is 33 percent nitrogen; ammonium sulfate is 21 percent actual nitrogen; calculate pounds of fertilizer on that basis. Apply fertilizer again in May and June to keep the canopy healthy throughout the summer.

Although nitrogen is traditionally broadcast across the entire floor of a mature orchard, its movement into the root zone will be inhibited in hot, dry weather. Many growers have overcome this problem by making summer nitrogen applications through drip irrigation systems. Using this approach, you can be sure that small, frequent doses will be available to the tree immediately.

Irrigation

Do not plant a peach orchard on a site without suitable water irrigation, in quantity or quality. Before establishing an orchard, have the water analyzed for pH, total soluble salts (EC), sodium absorption ratio (SAR), and bicarbonate and carbonate content.

Design the irrigation system to apply up to 50 gallons of water per tree per day.

Table 2 lists recommendations on the amount of water to

TABLE 2: Gallons of water needed per week for 1- and 2-year-old peach trees

Year	April	May	June	July	Aug	Sept
1	7	7	14	28	28	21*
2	14	14	28	56	56	28*

*Applying supplemental irrigation in September and October may be unnecessary if seasonal rainfall arrives.

drip-irrigate young peach trees. Adjust these amounts for soil type and weather conditions. After the second year, each tree will need the equivalent of 1 inch of water per week if no rain falls.

Fruit thinning

Most peach varieties set far more fruit than can be grown to large size with good quality. Thin to control the number of fruit per tree, to increase fruit size and quality, and to ensure adequate leaf growth in the trees. The prices of large fruit are usually at least twice those of small fruit, and large fruit are more economical to harvest.

The earlier that fruit is thinned from a tree, the bigger the remaining fruit will grow. Although ideally you would thin early-ripening varieties during bloom, the risk of frost generally dictates that you wait until shortly after fruit set. In general, thin the fruit within 4 to 6 weeks after bloom and in order of ripening.

Thin the fruit to 6 to 8 inches apart along the fruiting branches, which generally leaves about 600 fruit per mature tree.

Figure 10. Hand-thinning of developing fruit.

The only fully proven thinning methods available are by hand (Fig. 10) and by machine. The advantages of hand thinning are that it is the most precise method and it enables growers to select the desired fruit position more carefully. However, hand thinning can cost up to $250 per acre, which is more expensive than mechanical thinning.

Mechanical thinning by shakers can be successful if done carefully. The major drawbacks are that the shakers tend to damage the trees if used improperly, and that growers must wait for the fruit to get large enough to be

shaken off. This limits the usefulness of machine thinning on early-ripening varieties.

Researchers are seeking ways to best use mechanical thinners to adjust crop load.

Weed control

Weeds must be controlled, especially for first- and second-year trees. Irrigation and fertilization cannot overcome the ill effects of severe weed competition.

In the past, weeds were controlled by disking and hand hoeing, but this method causes irreplaceable topsoil to be lost to erosion. Another disadvantage is that cultivating orchards makes it more difficult to move equipment through the orchard in wet weather.

For most orchards, the most efficient floor management system is to maintain a weed-free strip under the trees and mown native sod between the rows. In this system, weeds under the trees are controlled with chemicals or mulch. Gradually widen the weed-free strip, from 3 to 4 feet in a first-year orchard to 10 to 12 feet in a mature orchard.

Applied properly, chemicals can manage weeds more effectively, for longer periods, and at lower cost. However, they can damage the trees if used improperly. When applying herbicides, follow all product label instructions carefully

Insects and diseases

Many insects and diseases damage peach trees and fruits in Texas. Major pests include catfacing insects, peach twig borer, plum curculio, San Jose scale, and greater and lesser peach tree borers. In some cases, you can use traps to monitor the presence and damaging levels of insect populations.

Serious diseases are bacterial spot, brown rot, cotton root rot, post-oak root rot, and scab. Although Far West Texas has fewer insect and disease problems, they are enough to warrant control measures.

For commercial and homeowner spray schedules, contact your county A&M AgriLife Extension office.

Harvesting and handling

Peaches will begin bearing a commercial crop in the third or fourth year. Texas-grown peaches are consumed primarily within the state and are harvested by hand. Consumers demand dessert-type peaches that are ready to eat when purchased.

Figure 11. High-quality, tree-ripened fruit.

Growers must therefore harvest fruits that are at a mature stage, and harvest and handle them carefully.

Harvest the fruit when they are firm-ripe and well colored with a red blush over yellow background (Fig. 11). Fruit harvested at this stage ripen properly and have excellent eating quality.

Several types of containers are used for picking and hauling fruit, including half-bushel baskets, drop-bottom picking bags, wooden boxes, and plastic containers.

Plastic containers are about half-bushel size and are especially adapted for handling more mature fruit. They may be stacked several feet high on trailers without damaging the fruit. Pads on the bottom of these containers help reduce fruit damage. Bruising is also lessened because the same container is used for both picking and hauling operations.

Larger operations can use 18-bushel pallet boxes to haul fruit to packing houses.

Methods of handling harvested fruits vary among growers:

- Many growers own or have access to packing house facilities for washing, defuzzing, grading, packing, and storing fruits.
- Hydro-cooling to remove field heat is valuable for fruits that must be transported far or held in cold storage for long periods.
- Cold-storage facilities benefit peach profits tremendously. Harvested fruits can remain in good condition for about 2 weeks if refrigerated at 32° to 35° F. Refrigeration also reduces rots, which permits the grower to accumulate surplus fruits and market them systematically

Marketing

Today's market demands that the peaches be large—preferably 2¼ inches or more in diameter—free of insect and disease blemishes, and attractive, with good shape, color, and maturity.

Texas produces less fruit than is consumed within its borders. Growers near major metropolitan areas can take advantage of these prime markets without having to haul fruit far. Although competition from other states is keen, locally grown fruit bring premium prices.

Most peaches grown in the state are marketed by the individual grower. Outlets can include local supermarkets, packing shed

operators, roadside stands, brokers and wholesalers, and orchards for direct sales (Fig. 12).

Many growers market most of their crop retail because of greater profits. For these sales, many growers use peck, half-peck, or smaller containers. For wholesale markets, the standard containers are half-bushel cardboard boxes.

Figure 12. Selling peaches at the farm gate.

Cost and returns

Production costs and returns depend on the nature and size of the operation. Orchards begin bearing commercial crops by the third season and usually remain profitable for 12 to 15 years. In some well-maintained orchards, 25-year-old trees are still bearing and profitable.

Reasonable average gross returns during this period are $3,000 per acre when fruit is wholesaled. Net income varies by season, attention to cultural management, and marketing. Net returns are considerably higher for growers who market their fruit through retail outlets.

For more information

http://aggie-horticulture.tamu.edu/fruit-nut

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Pears

Jim Kamas, Monte Nesbitt, and Larry Stein
Extension Fruit Specialists, the Texas A&M University System

Pears are among the few fruits that can be grown in every region of Texas. As evidence of the longevity of some pear varieties in the state, old homesteads remain in which the house may be gone, the fireplace only a relic, but the pear trees in the yard are still alive and productive.

There are two distinct types of pears that originate from different parts of the world: European pears and Asian pears. European pears are characterized by their fragrance, melting flesh fruit, and a noticeable sugar/acid balance. Asian pears have crisp flesh, delicate floral aromas, and high sugar content with little or no acid balance in the taste.

Common varieties of true European pears, *Pyrus communis*, include 'Bartlett', 'Bosc', and 'Anjou'. Their success in Texas is limited by the bacterial disease known as fire blight in all but arid Far West Texas. Many of these varieties require more than 1,000 hours of winter chilling (below 45°F), which is more than is received in all but the Davis Mountains and the High Plains in Texas.

Figure 1. European hybrid pears.

Asian pears derived from distinctly different species such as *Pyrus ussuriensis* and *pyrifolia*, which are native to China, Korea, and Manchuria. Varieties include

Figure 2. Pear variety zones of Texas.

'Shinko' and 'Chojuro'. Although Asian pears tolerate fire blight better than do European pears, in high rainfall areas or abnormally wet years it can infect many trees and cause substantial limb loss.

Climate

Asian and European hybrid (Fig. 1) pear cultivars typically have chilling requirements of 200 to 800 hours, making at least some varieties adaptable to most areas of Texas.

Pear production in Texas is divided into three zones (Fig. 2), with extremely low chilling in Zone 3 and high fire blight pressure in Zone 2. Zone 1 affords the lowest fire blight pressure with greater chill hour accumulation.

Soil

Although all fruit trees prefer extremely well-drained soils, pears tolerate heavy, wetter soils better than do many other fruit species. In high-pH soils, some pear rootstock varieties will exhibit substantial iron deficiency.

Varieties

Varieties are recommended for each Texas zone to give the best combination of reliable production and disease management. However, Texas weather can change dramatically, and any variety may perform poorly in years with atypical weather and stresses.

European hybrid pears include many varieties that were bred to increase fire blight resistance. Varieties within this group, such as 'Kieffer' and 'Moonglow', range widely in their disease resistance and eating quality.

Listed below are the recommended varieties for each Texas zone.

Zone 1: Hill Country and West Texas

European hybrids: 'Ayers', 'Warren', 'LeConte', 'Magness', Maxine', 'Moonglow', Orient', and 'Kieffer'

Asian varieties: 'Shinseiki', 'Nijisseiki' ('20th Century'), 'Chojuro', 'Hosui', 'Shinko', and 'Shin Li'

Zone 2: East Texas

European hybrids: 'Kieffer', 'Orient', Moonglow', and 'Magness'
Asian varieties: 'Shinko' and 'Shin Li'

Zone 3: Deep South Texas

European hybrids: 'Baldwin', 'Hood', and 'Floridahome' (not proven, but low chilling and recommended for trial)
Asian varieties: 'Ya Li' and 'Tsu Li' (both require about 300 hours of chilling), have produced well in the southern Hill Country, and they appear to be adaptable much farther south

Rootstocks

In sandy, acidic soils, *Pyrus calleryana* is the best rootstock. It has good nematode tolerance and fire blight resistance. However, it exhibits strong iron deficiency in alkaline soils.

In heavier-textured, high-pH soils, *Pyrus betulifolia* is a more adapted rootstock, but nursery stock may be more difficult to obtain.

In the Pacific Northwest, dwarfing rootstocks are commonly used in pear orchards, but these Old Home X Farmingdale crosses have performed poorly across most of Texas.

Site preparation

Although pears bloom later than some other fruit crops, in some years, spring frost will reduce the crop. Planting on an elevated site or hillside to allow air flow will minimize losses from spring frost. In the year before planting, remove existing vegetation to reduce weed competition.

Planting

Follow these steps to improve your chances of success:

1. Acquire the trees.

Pear trees are typically sold as bare-rooted, budded, or grafted trees that have been grown for 2 to 3 years in the nursery. Order plant material from a reliable nursery and choose trees that are 2 to 4 feet tall and have a trunk diameter of ½ to ¾ inch. Because pears are cross pollinated, you will need to order more than one variety with similar chilling requirements to serve as pollinators.

When the trees arrive, inspect them to make sure that they are not diseased or damaged.

Figure 3a. Third-year dormant pear tree, before pruning.

Figure 3b. The tree after pruning and after weights were added to help spread the limbs.

2. Water the trees.

Keep the root system moist before planting, store them in a moist, cool location, and soak the root system in water for 30 minutes immediately before planting.

3. Plant the trees.

Pear trees are relatively upright in growth habit and can be placed as close as 16 feet between trees. Pollinizer varieties should be planted at least 40 feet from companion varieties.

Before planting, prune back only the roots that are damaged or diseased. Dig the hole to fit the root system instead of pruning the root system to fit the hole.

Plant the tree at the same depth that it was grown in the nursery. The bark will have a distinct change of color where the "nursery line" occurs. Make sure that the graft union is above ground.

Backfill the hole with soil. There is no need to incorporate compost or organic matter unless the soil is very poorly structured or highly calcareous. Do not put fertilizer in the hole at planting.

4. Water the trees well by hand.

Drip irrigation can be used to supply water to trees during the growing season, but after planting, hand water newly planted trees to eliminate air pockets from the planting hole.

Figure 4. Many short lateral spurs that were encouraged by limb spreading.

5. Prune the trunks.

Cut back the trunk by about a third and paint the pruning wound with paint or sealant to help prevent fire blight infection.

Pruning/training

Pears are typically trained in one of two systems:

- **Central leader system:** A single strong dominant trunk is selected, and scaffold limbs are developed every 3 to 4 feet (Figs. 3a, 3b).
- **Modified central leader system:** Three or four leaders are retained instead of only one. Scaffold limbs are developed as in the central leader system.

To increase fruit production, encourage lateral branching and the production of specialized fruiting shoots, called spurs (Fig. 4). Pears bear much of their fruit at the tip of the stem (terminal). For most fruit trees, lateral branching and spur production are encouraged by pruning. However, to reduce the risk of fire blight in pears, it is better to use weights to bend the limbs (Fig. 5).

Figure 5. Weights on a pear tree to help spread the limbs and encourage lateral growth.

Cultivation

To enhance growth, control weeds and give the trees ample water and small, frequent amounts of nitrogen. To reduce the incidence of fire blight, allow the trees to grow with moderate vigor rather than trying to "push" them in the first few years of growth.

Diseases

The most prevalent and damaging disease of pears In Texas is fire blight. Other common diseases are cotton root rot and *Fabraea* leaf spot.

Fire blight: The bacteria that cause fire blight can invade all parts of the pear tree, including the roots, shoots, leaves, flowers, fruits, branches, trunk, and entire trees (Fig. 6).

The symptoms include water-soaked blossoms; wilted, blackened leaves; dark, shriveled fruit; discolored bark; and dead branches. The shoot tips turn black and bend into the shape of a shepherd's crook (Fig. 7). Gummy, amber-colored ooze seeps through cracks and pores. The ooze contains millions of bacteria, which are spread by insects or rain. Left alone, the infection may kill the tree.

The main line of defense against fire blight is to choose the correct varieties for your location. However, some fire blight infection is inevitable because high rainfall, especially during bloom or in the heat of sum-

Figure 6. A pear tree damaged by fire blight.

Figure 7. A shoot tip blackened by fire blight.

mer, can increase disease pressure.

Early in the growing season, you can reduce the potential for fire blight infection by applying low rates of copper fungicides such as copper hydroxide, copper oxychloride, or copper sulfate. Do not apply copper after fruit set, because it can russet some varieties.

During the late dormant season, applying higher rates of copper for *Pseudomonas* control can also help reduce fire blight inoculum (the disease-causing bacteria) in the pear orchard.

When fire blight infection does occur, prune out diseased wood at least 8 to 12 inches below the last sign of infection. Remove infected wood and burn, bury, or haul it away from the orchard.

To prevent spreading the disease to other trees, disinfect the pruning equipment with a 10 percent bleach solution. Immediately afterward, dry and lubricate the tools to prevent severe rusting.

Cotton root rot: Pears are very susceptible to cotton root rot *(Phymatotricopsis omnivora),* a soil-borne pathogen that occurs in alkaline soils. This disease causes the tree to decline slowly in cool weather and suddenly wilt and die in the summer. The roots are rotted, and dead and dying leaves often remain on the tree.

To date, no effective fungicidal treatments for cotton root rot have been developed, and no rootstocks with known tolerance have been identified. Soil tests cannot predict the potential for disease incidence; however, creek bottoms and other sites where sediment is deposited are more prone to this disease than are upland locations.

***Fabraea* leaf spot:** *Fabraea* leaf spot is perhaps the most significant fungal disease of both pear foliage and fruit. In wet years, this pathogen can significantly defoliate susceptible cultivars and cause pitting in the fruit flesh.

Organic particle film barriers such as kaolinitic clays have shown promise in suppressing diseases and insects on a wide variety of fruit crops and may help manage this problem.

While sanitation or the removal of infected tissue can help, commercial fungicides may be needed in some locations, especially in wet years, to reduce severe disease symptoms. For

homeowners, the choices of fungicides may be extremely limited because the commercial products formulated for agricultural producers are extremely expensive.

Fungicide registration and availability vary from year to year. Consult your local Extension agent for current recommendations.

Insects

In most years there are few if any major insect problems although there may be a bit of scarring from stink bugs from time to time. Typically there is no need to spray.

Harvest

Asian pears begin bearing fruit as early as the fourth growing season, but some European hybrids may take as long as 8 to 10 years to produce their first crop. Encouraging lateral budbreak by bending scaffold limbs to a more horizontal position can aid in the formation of fruiting spurs and bring trees into production more early.

Asian pears ripen in late summer; European hybrids ripen from late summer through mid-fall.

For more information

Fruit and Nut Resources, Aggie Horticulture®:
http://aggie-horticulture.tamu.edu/fruit-nut

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Plums, Nectarines, Apricots

Cherries, Almonds and Prunus hybrids

Larry Stein, Jim Kamas, and Monte Nesbitt
Extension Fruit Specialists, The Texas A&M University System

As closely related members of the rose family, plums and apricots typically require similar management. Both fruits have performed much better in Texas than nectarines, almonds, sweet cherries, and *Prunus* hybrids because they are less susceptible to disease, varmints, and crop loss due to premature blooming.

Figure 1. A plum orchard in full bloom.

Figure 2. The dusty white coating associated with plums is known as wax bloom.

Plums

The plum tree has white flowers and sets fruit on buds from previous season's growth (Fig. 1). Usually the fruit has a dusty white coating or wax bloom that is easily rubbed off (Fig. 2). Plums can be sweet to tart; the skin is typically quite tart.

The two main species used in the United States are the European plum, *Prunus domestica*, and the Japanese plum, *Prunus salycina*. The European plum includes varieties such as 'Stanley', which is grown for fresh fruit and often dried for use as prunes. These varieties have produced poorly in Texas because they require cold climates and are susceptible to fungal diseases such as brown rot.

The varieties adapted to Texas are usually hybrids between *P. domestica* and *P. salycina* and are known

Figure 3. A 'Methley' plum tree with upright growth and a heavy fruit load in various stages of development.

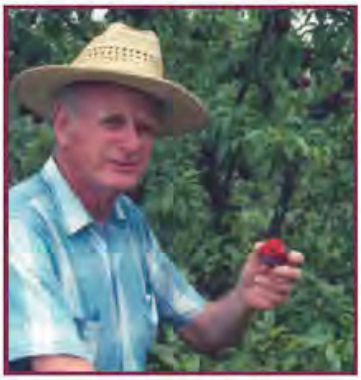

Figure 4. Eating a ripe, juicy 'Methley' plum right off the tree.

Figure 5. 'Bruce' plums.

as Japanese or Japanese hybrid varieties. Most plum varieties are not self-fruitful. You will need to plant two varieties with similar blooming periods for pollination and for fruit to set.

The soil type, site preparation, planting and cultivation of plums is very similar to that of peaches.

Bacterial and fungal pathogens along with the insect and vertebrate pest are also generally the same as for peaches, i.e., brown rot, bacterial leaf spot, plum curculio, and stink bugs.

Plum Varieties

- **'Methley'** ripens from late May to early June. The fruit is small to medium size with a mottled purple peel and juicy red flesh that is sweet and flavorful (Figs. 3 and 4). It is adapted across Texas but is soft and does not store well. It is self-fruitful and readily pollinates other plums.
- **'Santa Rosa'** is a large purplish plum with amber colored flesh. It ripens in late June and is a popular home and market variety across the state.
- **'Bruce'** is a large red plum that must be pollinated to bear fruit; 'Methley' is typically used as the pollinator. It ripens about the first of June (Fig. 5).
- **'Morris'** is adapted only to regions with 800 or more hours below 45°F and performs best when it is planted with another variety that will pollinate it. It ripens in early June and is a large plum with firm red to purple flesh (Fig. 6).

Figure 6. 'Morris' plums.

Figure 7. 'Ozark Premiere'.

- **'Ozark Premiere'** is a cross between 'Methley' and 'Burbank'. It is a large plum with yellow flesh and reddish skin. It is self-fruitful and ripens in late June (Fig. 7).

Nectarines

The nectarine is a mutation of a peach and has no fuzz. It is not a cross between a peach and plum (Fig. 8).

Nectarines are not particularly well adapted to Texas because their smooth skin is especially vulnerable to wind scarring and brown rot. They are also susceptible to fruit splitting and bacterial leaf spot. Nectarine culture is essentially the same as for peaches, only more intensive because of the increased disease and insect issues.

Figure 8. The nectarine is merely a peach without fuzz.

Nectarine varieties

The following varieties are suggested for trial only, given the problems described above.

- **'Karla Rose'** requires 600 hours below 45°F and is a freestone (easily removable pit) variety with deep red skin and white flesh.
- **'Redgold'** is a large, glossy red fruit; the tree requires 850 hours of chill to break dormancy. The fruit is a freestone and ripens in late July.
- **'Rose Princess'** ripens in mid-July and is a freestone that has firm white flesh.
- **'ArmKing'** has medium to large fruit with cling pits and flesh that ripens in late May.

Apricots

The apricot, *Prunus armeniaca*, is closely related to plum botanically and culturally, and is thought to have originated in Armenia.

Apricots are small trees with a spreading canopy. It is not uncommon to find trees that are 25 to 30 feet in height and width. The fruit is similar to a small peach, ranging from yellow to orange and often tinged red on the side most exposed to the sun (Fig. 9). Its skin is smooth but can be covered with very short hairs.

Apricots are self-fruitful; they do not require a pollinator.

Figure 9. Apricots range in color from yellow to orange.

Unfortunately, fruiting is inconsistent on all varieties. Frost damage can cause crop loss, but fruit often fails to set regardless of temperature. Fruit buds can lose cold hardiness if there are wide temperature swings in late winter. Do not expect annual crops.

Rootstocks for apricots

Apricots are generally grafted on peach rootstocks. However, in soils with a pH of about 7.5, it is better to use an apricot root system because they are better adapted to alkaline soils than are peaches. Since apricots are not readily available on native roots, the only practical way is to start them from seed. Use seeds from apricot trees known to produce good fruit consistently.

In October or November, plant the seed outdoors in containers with well-drained potting soil. The seed will be stratified over the winter and should germinate the following spring. The trees can be grown as seedlings, although the fruit quality will be variable. A better alternative is to bud them to a known variety. This does not guarantee better or more consistent production, but will produce greener, healthier trees in areas with highly alkaline soil.

Apricot varieties

Many varieties are grown across the state; some produce well 1 year, only to produce nothing for the next 5. The following varieties are adapted to Texas.

Figure 10. 'Blenheim' apricot.

- **'Blenheim'** is a medium-sized fruit with an orange peel and yellow flesh. This variety has been the most consistent performer across the state and ripens in late June (Fig. 10).
- **'Moorpark'** has medium-sized to large fruit with orange flesh that ripens in mid-June.
- **'Bryan'** produces medium-sized fruit that has orange flesh and ripens from late May to early June.
- **'Chinese' (or 'Mormon')** seems to be more cold hardy in some locations as it has an extended bloom. Fruit is small to medium.

Sweet cherries

Sweet cherries have performed poorly in Texas, because most commercial varieties require extensive chilling and are susceptible to brown rot. Developing fruit is also very prone to bird damage. To protect the ripening fruit from birds, some have built plastic pipe frameworks around the trees and covered them with netting.

New, low-chill sweet cherries are appearing in the market place, though few have been tested thoroughly in Texas. Recently, trees planted in some Texas locations have produced crops in 2 years. However, these varieties' low-chill requirements will likely cause them to break dormancy very early and expose the flower crop to frost injury.

The low-chill cherries are propagated by wholesale nurseries in California and are sold through retailers. Some of these varieties have a chill requirement of 500 to 700 hours. In Texas, they may not perform as well as they do in California. The following are two varieties that have fruited in some areas.

Sweet cherry varieties

- **'Royal Lee'** is a very firm, heart-shaped, red cherry with excellent flavor. It is very productive when planted with another variety for pollination. It needs about 200 hours of winter chill to break dormancy and flower.
- **'Minnie Royal'** is used as a pollinator for 'Royal Lee'. 'Minnie Royal' is a medium-sized, red cherry with good flavor. It only needs about 200 hours of winter temperatures below 45 degrees F, compared with the 700 that standard cherries need.

Sweet cherry rootstocks

Cherries grow upright to over 40 feet tall. However, they can be kept shorter by grafting them onto a dwarfing rootstock. Though largely untested in Texas, 'Colt' is a dwarfing rootstock that can produce shorter trees. 'Lovell' or 'Halford' peach rootstocks with a plum interstem can be used as a cherry rootstock in Texas.

Almonds

Almond fruit looks similar to peaches (Fig. 11). The pit is eaten as a nut. The tree looks similar also and is grown essentially the same as peaches; plant only on well drained soils, and maintain a weed free area around the tree. Almonds generally do not produce well in Texas because they bloom too early in the spring and cold weather injures the developing flowers. Most varieties are susceptible to brown rot and bacterial leaf spot. No variety is highly recommended because they generally fail to set crops. 'All-In-One' is the most common variety being tried today.

Figure 11. Mature almonds.

Figure 12. One of the interspecific *Prunus* hybrids.

Prunus Hybrids

Many *Prunus* hybrids are available, namely plum by apricot and vice versa; commonly known as "plumcots," "pluots," or "apriums," depending on the breeding program that released them (Fig. 12).

In Texas they have been disappointing. So far none are winter hardy, all suffer from bacterial canker infestation, and few have produced adequately. More breeding and development are needed before they can be recommended for cultivation in Texas.

For more information

Fruit and Nut Resources, Aggie Horticulture®:
http://aggie-horticulture.tamu.edu/fruit-nut

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Persimmons

Larry Stein, Monte Nesbitt, and Jim Kamas
Extension Fruit Specialists, The Texas A&M University System

Persimmon trees are small, easy to grow, and adapted to most of Texas. The tree, its leaves, and its fruit don't have to be sprayed because they have no serious insect or disease problems. In the fall, when few fruit crops are ripe, the persimmon produces fruit that is attractive and delicious.

Persimmons are rich in vitamin A and have more vitamin C than citrus fruit. They are considered a delicacy in the Orient. The wood, which is very hard, is prized by woodworkers and is used to make golf clubs.

Mature trees can reach 40 feet high; some remain as shrubs less than 10 feet tall.

Figure 1. Common American persimmon growing in the wild; note how livestock has consumed the very low hanging fruit.

Wild varieties

- The common **American persimmon,** *Diospyros virginiana,* grows wild in the South and reaches as far west as the Colorado River in Texas. American persimmon groves are common in abandoned pastures and along fence rows (Fig. 1).

Unlike the cultivated persimmon, the wild persimmon varieties are small and very astringent until completely ripe. They are usually ripe after the first frost and all the leaves have fallen from the tree, though even then some fruit can still be very astringent.

The common American persimmon makes excellent rootstock and is graft compatible for cultivated Oriental persimmons in the southern United States and Texas.

Figure 2. One of the Oriental persimmons; note the fruit load and dark green foliage.

- **Texas persimmon,** *Diospyros texana,* is found in northern Mexico and Central and West Texas; it is especially abundant in the Edwards Plateau area.

The tree has small, purple fruit and is known for its peeling bark, which reveals shades of white, gray, and even pink on the trunk. It is not graft compatible with American or Oriental persimmons.

- **Oriental persimmon,** *Diospyrus kaki,* was introduced into the United States in the mid-1800s from its native China and Japan (Fig. 2). It is has been an important fruit crop in each of those countries for hundreds of years. The fruit is eaten fresh, dried or cooked. In northern China, some valleys grow only Oriental persimmons. On the main island of Japan, persimmon trees are found in every village, along the roadsides, and around farmers' cottages.

Soil adaption

The common American persimmon, used as the rootstock for Oriental persimmon trees, is widely adapted in Texas. It thrives in sands to bottomland as long as the soils do not stand in water.

The Texas persimmon resists root rot; the common American persimmon is moderately susceptible, and the Oriental persimmon is highly susceptible. It is critical that all Oriental trees be grafted or budded onto the common persimmon because root rot is prevalent where the tree can grow.

Site preparation and planning

Prepare the orchard site before the planting. Kill perennial weeds with glyphosate, then rip the soil to break up any hard pans.

To ensure that the varieties you want are available, order plants well in advance of the planting season. Persimmon trees are usually purchased in early winter as bare root plants. Retail

nurseries also sell container plants; the planting date on these is more flexible.

Plant the trees every 15 to 18 feet in rows that are 20 feet apart. Plant the tree to the same depth it grew in the nursery and water it thoroughly. Even if the soil is wet at planting, the tree needs to be watered to settle the soil around the root system.

Pruning

If you plant bare-root stock, remove at least half the top. Shape young plants by pruning the shoots during the first few seasons. This pruning forces growth into framework branches off a central leader. The goal is to develop a pyramid shape with three to five main limbs at about 1-foot intervals on the trunk, beginning at about 3 feet above ground level.

Prune mature plants during the winter. Remove crossover, shaded, diseased, and broken branches. Open the canopy to prevent self shading, reduce excessively vigorous shoot growth, and regulate crop load. Remove limbs with narrow crotches because they create dead areas on the limbs; preserve limbs that grow off the leader at wide angles.

Persimmon fruit develops on branches that have grown in the current season. To keep the limbs from drooping, prune secondary branches so that the bearing shoots remain close to the main branches.

Cultivation

Supplement rainfall with irrigation during the spring growth flush and during summer, especially if the soils are shallow.

If needed, apply fertilizer as the new shoots emerge in early spring. A general recommendation is 40 pounds of actual nitrogen per acre per year. If shoots grow more than 3 feet, fertilize less.

Persimmons typically produce seedless fruit, which tend to drop before full maturity, reducing crop yield in some years. Although fruit drop may reduce the overall yield, this fruit thinning can enable fruit to grow bigger. Seedless fruit are very finicky and will drop if the tree experiences growth problems from too much fertilizer, excessive heat, cold, water or drought. Hence, heavy mulch and appropriate water are essential to reduce fruit drop. While these practices may reduce fruit loss, this problem cannot be eliminated.

Diseases

Figure 3. Several fungi cause leaf spot on Persimmons and can also affect the fruit; but only severe cases require treatment.

Persimmons are largely free of serious diseases; however, crown gall and anthracnose have occasionally caused problems. Trees infected with crown gall *(Agrobacterium tumefaciens)* develop tumors or galls on their branches and roots, which eventually become hard and rough.

Because the infection can spread to open wounds on trees, treat existing cuts and bruises on mature trees carefully to stop the disease from spreading. Tree losses in Texas from crown gall have been minimal.

Although not deadly to adult trees, several fungi cause leaf spot and sometimes affect the fruit as well. Leaf spot can lead to early defoliation, but only severe cases warrant treatment.

Insects and vertebrate pest

Few insect pests attack persimmons. In some summers, caterpillars may defoliate persimmon trees, and cases of mealy bugs, thrips, mites, ants, and fruit flies have been reported.

Many wild animals are attracted to the fruit including opossums, raccoons, birds, deer, and rats. Watch fruit nearing maturity closely, because these predators may eat the fruit before it is fully ripe.

Rootstocks

The best rootstock for Texas is the common American persimmon. The rootstock buds easily and produces a vigorous, productive tree. *Diospyros lotus* ('Lotus') is used as a rootstock in California. Trees have been planted in Texas on Lotus rootstock, but their long-term performance is unknown.

Harvest

The fruit should be allowed to hang on the tree as long as possible unless varmints are an issue; then remove the fruit with a gentle pull when they develop a vibrant orange color. Still, knowing when to eat persimmons is the key to enjoying them. Most persimmons, except 'Fuyu' and 'Izu', are astringent and must be fully ripe and soft or the astringency will really pucker your mouth. The astringency is caused by tannins in the peel. The fruit usually ripens around the first fall frost. However, frost is not necessary for reducing the tannins, softening, or ripening

the persimmon. Eventually the tannins will disappear and the fruit will ripen and sweeten naturally. This usually happens when fruit of astringent varieties become soft; non-astringent fruit can be eaten as soon as they develop a deep rich orange color.

Persimmon fruit ripen equally on or off the tree. Persimmons will store on the tree for a considerable period into the winter, making the tree and its decorative fruit very attractive in the landscape. The sweet, jelly-like flesh is usually eaten fresh, although it can be dried.

Varieties

Most Oriental persimmons, except 'Eureka', produce seedless fruit. Seedless fruit tends to have better eye appeal because seeded fruit that result from cross pollination, often have darker flesh. Since 'Eureka' and 'Fuyu' will pollinate other varieties, do plant these two with other varieties that you wish to be seedless.

- **'Eureka'** is heavy producing, medium-sized, flat-shaped, red persimmon of extremely high fruit quality. The tree is relatively small and self-fruitful. Fruit typically contain seeds. 'Eureka' has proven to be the best commercial variety in Texas (Fig. 4).
- **'Hachiya'** is a productive, very large, cone-shaped, seedless persimmon with bright orange skin. The tree is vigorous and upright. 'Hachiya' has been an outstanding Texas variety and makes an excellent dual purpose fruit and ornamental specimen (Fig. 5).
- **'Tane-nashi'** is a moderately productive, cone-shaped, orange persimmon. The tree is vigorous and upright. The fruit stores extremely well on the tree and is seedless. 'Tane-nashi' makes an excellent landscape ornamental (Fig 6).

Figure 4. 'Eureka' persimmon.

Figure 5. 'Hachiya' persimmon.

Figure 6. 'Tane-nashi' persimmon.

Figure 7. 'Tamopan' persimmon.

Figure 10. 'Fankio' persimmon.

Figure 8. 'Fuyu' persimmon.

Figure 9. 'Izu' persimmon.

- '**Tamopan**' is a moderately productive, very large, flat, orange, persimmon with a distinctive ring constriction near the middle of the fruit. The tree is the most vigorous and upright of the varieties grown in Texas (Fig. 7).
- '**Fuyu**' is a medium-sized, non-astringent, self-fruitful persimmon. The fruit is rather flattened, orange-colored, and of high quality. It is best planted in the southern, milder areas of the state as it is susceptible to freeze damage (Fig. 8).
- '**Izu**' bears medium-sized, non-astringent fruit. It seems to be more cold hardy than 'Fuyu 'and ripens in September (Fig. 9).
- '**Fankio**' produces large, conical, with vivid gold fruit. It is one of the prettiest persimmons; the leaves turn bright red as the gold fruit ripens in the fall (Fig. 10).

For more information

Fruit and Nut Resources, Aggie Horticulture®:
http://aggie-horticulture.tamu.edu/fruit-nut

Texas A&M AgriLife Extension Service

AgriLifeExtension.tamu.edu

More Extension publications can be found at AgriLifeBookstore.org

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New

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Pomegranates

Larry Stein, Jim Kamas, and Monte Nesbitt,
Extension Fruit Specialists, The Texas A&M University System

Interest in growing pomegranates has increased in recent years because their pulp and juice contain high levels of antioxidants, which are thought to improve health. The shrub also has orange-red flowers and colorful fruit that make it an attractive ornamental.

In ancient days, pomegranates were carried in desert caravans for their thirst-quenching juice. The plant has been grown for thousands of years throughout the Mediterranean regions of Africa, Asia, and Europe. Spanish missionaries introduced it to the Americas in the 1500s.

Like crape myrtles, the pomegranate *(Punica granatum)* is a member of the Lythraceae family, which includes about 620 species. Although the plant can be trained as a small tree, it is more commonly grown as a bushy shrub (Fig. 1).

Figure 1. A pomegranate shrub.

The fruit is yellow to bright red and up to about 4 inches in diameter, about the size of a large orange (Fig. 2). On the blossom end, it has a cuplike organ called a *calyx*. The rind is smooth and leathery.

Pomegranates have many seeds that are surrounded by crimson, pink, purplish, or white covers called *arils*. The arils are the edible parts of the fruit (Fig. 3). They are sweet, juicy, and variable in acidity; some varieties can be quite tart.

The leaves are deciduous, dark green, and usually glossy. The plant often has thorns along its branches.

Pomegranates grow well in areas with hot, dry summers. Some varieties can tolerate temperatures as low

Figure 2. Bright red pomegranates and the sweet, red, juicy, edible arils.

Figure 3. Fruit and arils of the 'Wonderful' pomegranate variety.

as 10°F; others are damaged at 18°F. They are grown as far north as Zone 7b of the U.S. Department of Agriculture Hardiness Zone Map (Fig. 4).

Many fruiting types should survive most winters throughout the central, southern, and southeastern parts of Texas. Studies are under way on varieties that survive typical winters in north central Texas and produce fruit; these include Al-sirin-nar, Salavatski, and Russian 18.

Soil

Pomegranates can grow in almost any soil that has good internal drainage. They grow very well on the moderately alkaline soils of South Texas and northern Mexico, as well as the slightly acidic soils in East Texas.

Some pomegranates tolerate salt better than do other commercial fruit crops. On new sites, have the soil tested for nutrients and salinity to help determine how much to water and fertilize.

Varieties

Because pomegranates are not quarantined, named varieties (Table 1) can be ordered from out-of-state nurseries if they are unavailable locally.

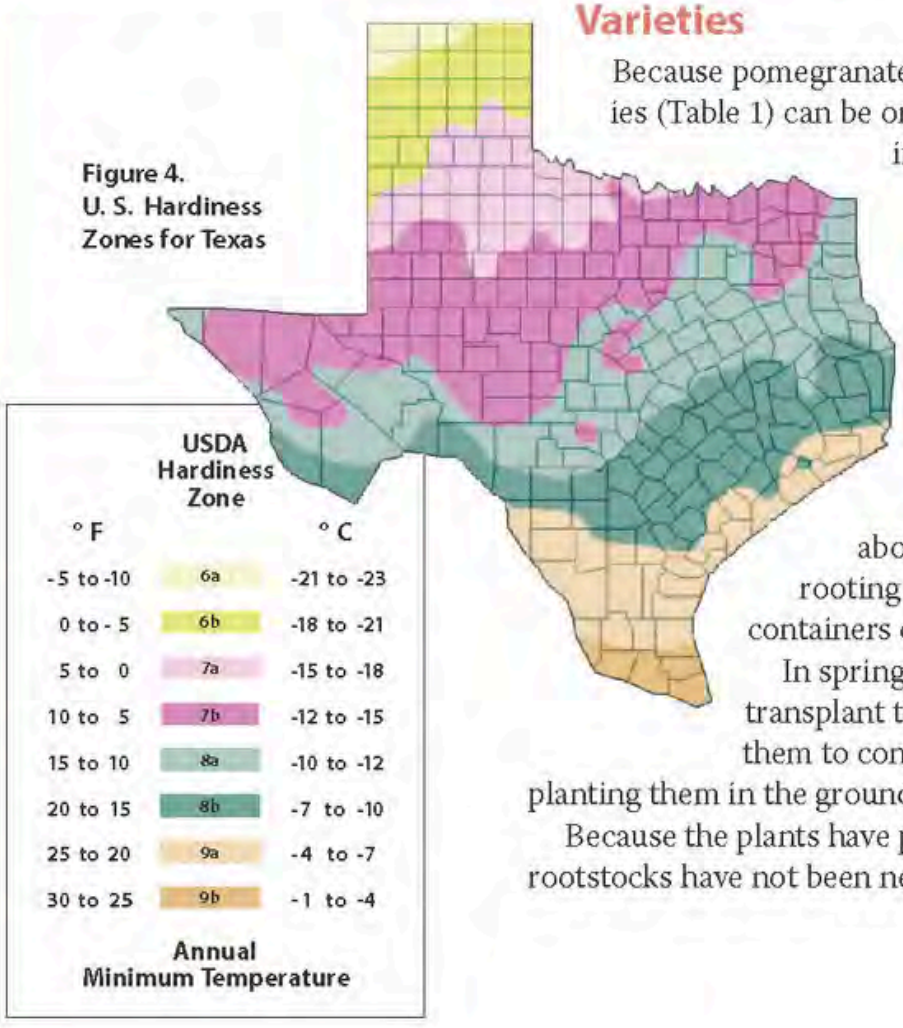

Figure 4. U. S. Hardiness Zones for Texas

Propagation

Pomegranates root readily from hardwood cuttings taken in winter during pruning. Although the size of the wood does not seem to affect rooting, pencil-sized cuttings are easiest to work with. Cut sections about 6 to 14 inches long, dip them in rooting hormone, and stick them upright in containers of well-drained potting soil.

In spring after the cuttings begin growing, transplant them into gallon containers and allow them to continue growing for 4 to 6 weeks before planting them in the ground.

Because the plants have performed well on their own roots, rootstocks have not been needed.

Table 1. Pomegranate varieties suitable for growing in Texas

Variety	Description	Notes
Al-sirin-nar	A vigorous plant; fruit are glossy red with rosy-pink arils; sweet-tart taste	Has produced some of the best yields to date; ripens in late October
Russian 18	Medium to large fruit with bright red skin; very good sweet-tart taste	Cold hardy; adapted over a wide area of Texas; bears at an early age
Salavatski	Large red fruit with reddish arils; tastes typically sweet with a hint of tartness	Good cold hardiness; ripens in mid-October
Spanish Sweet	Produces large red fruit and arils with hard seeds; tastes sweet but very tart	Cold tolerant; very productive; ripens in mid-October
Sumbar	Sweet fruit; soft seeds	Ripens early; has survived very cold winters in Fredericksburg area; potential cold injury problems if planted too far north
Surh Anor	Large fruit with high sugar content; arils are usually alternately clear and red speckled	Consistently productive; ripens in mid-October
Wonderful	Vigorous plant; consistently produces many large fruit	The main commercial variety to date; fruit process well; splitting of the fruit near maturity and lack of cold hardiness have been ongoing problems in Texas

Site preparation

Well before planting, prepare the ground by killing perennial weeds and grasses and breaking up the soil to reduce compaction.

To enable the plant to establish quickly, remove all other vegetation within a 1- to 2-foot circle of the young tree. Turfgrass can be killed initially with a systemic contact herbicide

Planting

For best flower and fruit formation, plant pomegranates where they can receive full sun (Fig. 5). Space the plants 12 to 15 feet apart in rows that are 15 to 20 feet apart. Do not overcrowd the plants because the lack of light will reduce growth and production.

If the plants are sold in potting media without soil, rinse most of the media from the root ball so the roots can contact the soil.

Organic mulch or weed barrier fabric can be used to conserve soil moisture and to prevent weed and grass competition.

Figure 5. A pomegranate planted in full sun.

Irrigation

Thoroughly water the plants at planting and again 2 to 4 weeks after planting. Begin a once-a-week schedule when the plants leaf out.

Once the trees are established, water them about every 7 to 10 days. To make watering easier, build up a ring of soil several inches thick and high, a couple of feet in diameter, around the newly planted tree. Then just fill the ring with water as necessary. The ring will settle into the surrounding soil within a few months, by which time the young plant will have become established.

If you use drip irrigation, use one 1-gallon-per-hour emitter per tree for the first year or two; gradually increase to at least four emitters per tree when the plants are 4 to 5 years old.

Figure 6. Heart rot.

Fertilization

After the plant begins growing, fertilize it lightly with nitrogen. Generally, 1 to 2 cups of ammonium sulfate should provide enough nitrogen, especially if it is split into three to four applications.

Use about twice as much fertilizer in the second year and three times as much in the third year. The applications can be split among February, May, and September.

Fertilize established plants as needed to maintain 12 to 18 inches of terminal (end of the stem) growth. For most plantings, the only nutrient you'll need to apply every year is nitrogen. If the plant does not respond to fertilizer and good management—such as watering regularly and controlling weeds well—have the soil tested.

Pruning

Pomegranates are best grown as bushes. As the plant begins growing, choose three to five suckers or trunks, and remove all the other shoots. You'll need to remove suckers often.

Once the pomegranate tree begins bearing, prune it annually to maintain the major branches, thin out the growth, and remove dead or damaged shoots. Concentrate on removing interior shoots to maintain the major scaffold limbs, which are the primary branches growing from the trunk.

Weed control

Prevent weeds and grasses from competing with pomegranates by adding mulch made of fabrics or organic material.

Insects and other pests

Pomegranate leaves can be damaged by whiteflies, thrips, mealybugs, stink bugs, and scale insects. The tree can be defoliated by moth larvae *Euproctis* spp. and *Archyophora dentula*. Termites may infest the trunk.

In some countries, the fruit are covered with paper or plastic bags to protect them from birds, borers, and rodents.

Diseases

The most serious problem with pomegranate is a fungus that affects the leaves and the fruit, causing the fruit to split and the leaves to drop prematurely. Although the leaf loss may be tolerated, fruit splitting cannot, because it usually occurs just as the fruit begins to mature.

To alleviate the problem, you might try applying copper fungicide in late spring through summer. However, control of the disease is not fully understood.

Another disease, soft rot or heart rot (Fig. 6), is caused by the fungus *Rhizopus arrhizus* and induced by too much rain during bloom and the ripening season. Minor problems are leaf spot and fruit spot, which are also caused by fungi.

Sun damage

Appearance is important for pomegranates, especially if they are bought primarily for fall decorations such as table arrangements. If the fruit receives too much sun, it can develop sunscald (Fig. 7), roughened rinds, and brown, russeted blemishes. To prevent sun damage, you may need to apply a sunburn material such as kaolinite clay.

Figure 7. Pomegranate fruit discolored by sunscald.

Harvest

The trees produce fruit 3 to 4 years after planting. The fruit ripens about 6 months after bloom, with the best fruit development during hot weather. The fruits mature

in September for early-ripening varieties and continue through October for later ripening ones.

Because the fruit does not ripen after being picked, harvest it only after it has reached full maturity. Fruit that is ready to pick may make a metallic sound when tapped lightly.

To harvest, cut—don't pull—off the fruit as close as possible to the branch to avoid leaving a stem, which could rub and injure other fruit.

As the plant matures, it should produce more fruit. About the fourth year, each tree may produce a crop of 20 to 25 fruits (10 pounds). In the tenth year, production rises to 100 to 150 fruits (50 pounds). In well-managed orchards, the average annual yield may be as much as 200 to 250 fruits, or about 75 pounds, per tree.

Pomegranates are commonly eaten fresh. Some of the new varieties have soft seeds that can be eaten with the fleshy pulp. The fruit juice can be made into a beverage or syrup and can be blended with other juices. An emerging trend in the commercial industry is to sell bags of arils to be eaten fresh.

Pomegranates store best at 40 to 45°F with a relative humidity of 85 percent. They can be stored for up to 3 months.

For more information

- *Fruit and Nut Disease Control Products for Use in Texas*, Texas A&M AgriLife Extension Bookstore: https://agrilifebookstore.org/
- Fruit and Nut Resources, Aggie Horticulture®: http://aggie-horticulture.tamu.edu/fruit-nut
- Insect Answers, Texas A&M AgriLife Extension Service: http://insects.tamu.edu/extension/insctans/
- *Texas Plant Disease Handbook*, Texas A&M AgriLife Extension Service: http://plantdiseasehandbook.tamu.edu/

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New

Low Tunnel Strawberry Guide for Home Gardeners on the Texas High Plains

Russell W. Wallace and C. Joel Webb

Extension Vegetable Specialist and Research Technician

Texas A & M AgriLife Research & Extension Center at Lubbock

Strawberries (*Fragaria ananassa)* are a very popular small fruit for home gardeners. On the High Plains of Texas and in surrounding regions, strawberries can be difficult to grow, often leaving home gardeners feeling very frustrated. However, with proper growing techniques, transplant timing, and tender loving care, high yielding and quality strawberries can be achieved (see Figure 1).

Figure 1. Strawberries ready to be harvested on March 2, 2012 in high tunnels located at the Texas A & M AgriLife Research and Extension Center at Lubbock. Photo credit: Russ Wallace.

GARDEN AND SOIL PREPARATION

Strawberries prefer a sunny location with good quality soil that is protected from high winds. Certain strawberry cultivars can be very sensitive to high winds, blowing dust and plant damage can reduce berry number and development. Research has shown that when provided with wind protection, strawberry yields and quality increase significantly (Wallace, 2012). For more information on wind protection and low tunnels see section titled '*Constructing a low tunnel for strawberry home gardens.*

Strawberries grow best on well-drained soils. Adequate drainage can be improved by planting strawberries on beds raised 6 to 12 inches. Strawberries also prefer soils with a pH range of 6.5 – 7.0. However, soils on the Texas High Plains generally have soil pH from 7.5 – 8.3. Iron deficiency may cause leaf yellowing, and thus iron chelates may be sprayed to improve growth. Soil tests should be considered prior planting, and every few years to evaluate the soil.

Recent strawberry evaluations at the Texas A & M AgriLife Research & Extension Center at Lubbock have shown excellent yields even on soils with a pH of 8.1. Soil pH can be lowered temporarily using organic materials including compost, peat moss, pine needles, humic acid, or sulfur. Some fertilizers including forms of

urea, ammonium sulfate or ammonium nitrate can also help. Strawberries should be fertilized with at least 1.0 lb/100 sq. ft. of a balanced fertilizer (e.g. 13-13-13) at transplanting and periodically during strawberry growth.

Strawberries perform best when given uniform irrigation. Low humidity and windy conditions found on the Texas High Plains throughout late winter and spring can quickly deplete soil moisture resulting in poor growth and development. Use of drip irrigation or a soaker hose placed beneath black plastic mulch is recommended, and when regularly irrigated, this will reduce soil moisture evaporation. In addition, use of black plastic mulch can help raise soil temperatures during cooler temperatures improving crop growth.

TRANSPLANTING STRAWBERRIES

Strawberries can be purchased as bare rooted plants or as rooted plugs. Most local nurseries sell rooted plugs which can be easily transplanted into the garden. If transplanting bare root plants, be sure to not let the roots dry out. Prune any dead or dying roots and spread the roots out to increase rooting. When using rooted plugs, transplant the entire plant, including the soil around the roots.

Using black plastic mulch to grow strawberries is encouraged, and will help increase strawberry growth, reduce soil moisture evaporation, and control weeds. Holes should be punched into the black plastic mulch at regular intervals, generally with an in-row spacing of 12-inches. Strawberries can also be transplanted in multiple rows spaced 12-inches apart, though it is best to stagger the plants 6-inches in alternate rows to improve uniformity of plant growth and development.

When transplanting bare root plants or rooted plugs be sure and use the proper planting depth. All roots should be covered with soil, but do not cover the plant's growing point (also called the crown). When roots are left exposed, transplants may dry out and die. If planted too deep and the crown is buried, the plant may rot, or emerging stems and leaves may be damaged. Do not transplant any plants that are diseased as they may infect other plants. After placing the plant in the transplant hole, pack the soil firmly around the crown. At transplanting, it is a good idea to use a diluted fertilizer transplant solution to increase rooting and early growth, and prevent the plants from drying out.

In Texas, strawberries are best transplanted in the fall, generally between mid-September and late October. Unfortunately, most local nurseries sell strawberry plants in the spring. Trials at the Texas A & M AgriLife Research & Extension Center at Lubbock showed that when transplanted in the spring (March or April), that air temperatures quickly become too hot for strawberries, limiting growth and development (Wallace, 2012). As a result, it may be necessary to order strawberries from producers online, or discuss growing plants for fall transplanting with your local retail nursery.

STRAWBERRY GROWTH

Plants will begin to grow by sending out new roots, shoots and leaves from the crown area, as well as runners (or stolons). Runners are stems that have growing points the strawberry plants use to reproduce, generally forming a new plantlet which will root on exposed soil. During early growth, runners should be removed to allow the nutrients to be used for overall growth. If runners are not removed, they will try and spread out too early thereby reducing yields.

Fall-transplanted strawberries should be protected using low tunnels covered with clear polyethylene plastic and/or inside hoops covered with Spunbond row cover cloth. Unprotected plants may become stunted, or killed by freezing temperatures and high winds. Trials on the Texas High Plains showed that strawberry plants grown inside tunnels and covered with row covers were protected from colder outside temperatures (see Figure 2).

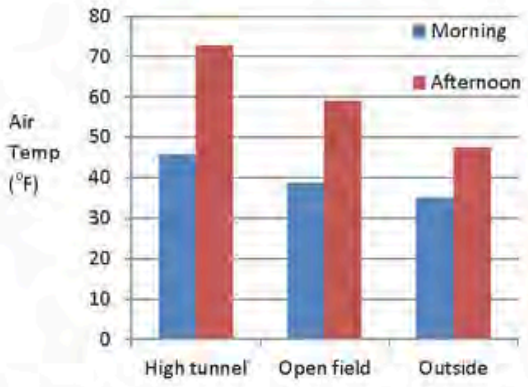

Figure 2. Difference in temperatures measured beneath Spunbond row covers for strawberries grown under high tunnels or in the open field at the Texas A & M AgriLife Research and Extension Center at Lubbock in 2012.

Strawberries are self-pollinating; however, honey bees are important to increase fruit quality and yields. On the Texas High Plains, the winds can aid in the self-pollination process. Poorly-shaped berries may occur when winds and bees are absent resulting in cat-faced or irregularly-shaped fruit. Cold temperatures during the off- season (December through early March) may also result in misshapen and abnormal berries (see Figure 3).

Figure 3. Misshapen berries photographed March 22, 2012 resulting from poor pollination due to excessively cold temperatures. Photo credit: Pat Porter, Extension Entomologist; Texas A & M AgriLife Extension.

Periodically strawberries may need additional fertilizer throughout the season to improve plant health. Dilute fertilizers can be added to the soil through the drip system. Because strawberries are shallow-rooted, frequent irrigations are needed. Watch out for water that has high amounts of salts as these may burn the roots and plug drip system emitters. If salts do become a problem, flooding the entire garden with water may help push salts down below the root system.

Following peak yields (late March through May), strawberry runners may be allowed to grow and root, and if desired, plants may spread out in the garden area. In the system using black plastic mulch, it is

generally best to replant strawberries annually, though this adds more expense. However, strawberries on the Texas High Plains usually have difficulty spreading and growing from year to year given the low humidity and rainfall, higher soil pH, as well as the typical high winds.

There are many strawberry cultivars available for home gardeners. Strawberries generally fall into two fruit bearing categories: June-bearers primarily develop flowers in the early spring from buds that were developed during the previous fall, or under short-day conditions. June-bearing cultivars usually produce more fruit per plant than other types. Cultivars that showed excellent yields include 'Chandler', 'Strawberry Festival' and 'Radiance'. Other cultivars that may be available at local nurseries include 'Allstar', 'Surecrop', 'Cardinal', and 'Sequoia', among others.

Ever-bearing strawberries usually produce fruit under long-day conditions. However, they do not produce a lot of runners, and therefore will not spread easily. Ever-bearers will produce a fall crop if they survive the summer heat. Day-neutral cultivars will produce under any day-length though temperatures above 70 °F will usually decrease flowering. Ever-bearing and day-neutral cultivars that showed a good response in the High Plains' trials included 'Albion', 'Seascape', and 'San Andreas'. Other cultivars to try include 'Ogallala', 'Ozark Beauty', 'Tribute', and 'Tristar'. Much will depend on what your local nursery has available for sale.

HARVESTING STRAWBERRIES

When transplanting in mid-September, and when using tunnels plus row covers for cold weather protection, research has shown that strawberries can be harvested at least once weekly beginning as early as late November (Wallace, 2012). However, during those colder months, berry pollination may be poor and quality reduced. Fruit taste and firmness may also be affected by the colder temperatures.

During peak harvest (March through May), it may be necessary to pick strawberries two to three times weekly, depending on temperatures and plant growth (Figure 4). Harvested berries should be fully ripe, as they will not not ripen once picked. Pull berries off the plant and immediately place into containers. Be careful not to place berries too deep or bruising may increase berry rot. Also, refrigerate unwashed berries immediately, or wash and freeze for storage.

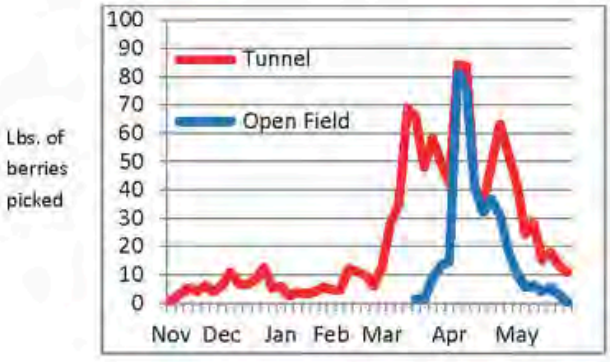

Figure 4. Typical harvest trend for strawberries grown inside tunnels or in the open field at the Texas A & M AgriLife Research and Extension Center at Lubbock, TX (2011 - 2012).

PESTS AND THEIR CONTROL

Major pests of strawberries include birds, mice, spider mites, slugs and snails, and white grubs. Birds can be easily controlled by covering the tunnel with bird netting. Be sure to secure the bottom of the netting to the ground with stakes or bricks to keep birds from entering underneath.

Mice can be difficult to control, and are often found beneath the black plastic mulch. Mouse traps or bait placed safely throughout the garden area is generally their only means of control. Slugs and snails feed during the night, and baits should be used. Spider mites can be difficult to prevent, and due to warmer environments inside tunnels, they may appear on the leaves of strawberries much earlier than those grown outside. Predatory mites and insecticidal soaps may be the only options for their control. When applying insecticides, remember that it is best to spray in the evenings when bee activity is minimal.

Root and fruit diseases are common problems with strawberries. Nematodes may also stunt or reduce plant growth. Fortunately, the low humidity and rainfall found on the High Plains aids in reducing diseases, though using low tunnels may exacerbate any potential problems. Root rots including black crown rot, Red stele and Verticillium wilt can be increased by over-watering, especially if well-drained soils are not available. Adding compost and pine needles will help with drainage. Rotating strawberry beds with other annual crops will also help reduce disease potential. Nematodes are more of a problem with sandy soils, and rotation with a grass species will aid in suppression, or using clear plastic mulch for several months prior to planting to solarize the soil may be beneficial.

The major fruit disease of strawberries is *Botrytis* gray mold, which attacks the fruit before and/or after harvest. It can be recognized by a gray, powdery mass that covers the ripening fruit. Heavy plant foliage and dead leaves may increase this disease. Increasing air movement around plants may help to reduce its spread. For additional pest management strategies, contact your local county extension office.

USEFUL REFERENCES

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Pace, M., J. Goodspeed, A. Hinton, and S. Olsen. 2001. *Strawberries for the home garden.* HG-515. Utah State University Extension, Electronic Publising. 8 pages. Available online at: http://www.hort.usu.edu/pdf/fruit/strawberries.pdf.

Wallace, R.W. 2012. *Strawberries in protected cultivated systems.* Oral presentation given at Amer. Soc. Hort. Sci. Available online at: http://ashs.org/db/horttalks/detail.lasso?id=10368.

Cantaloupe/Muskmelon

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties
Ambrosia, Caravelle, Hales Best, Israeli, Magnum 45, Mainstream, Mission, Perlita, TAM Uvalde

Soil Preferences
Adaptable to wide range of soils. Optimum soil is well-drained, medium textured, soil with pH 6.0 - 8.0. Will tolerate heavier soils than most other cucurbits.

Optimum Growing Conditions
Hot days and warm nights. Low soil and air temperatures can stunt growth. Fruit maturing with temperatures below 70°F are usually poor quality.

Establishment Methods

Planting Method	Direct seeded or transplanted
Optimum Time	Spring - when soil temperature is >70°F Fall - 80-90 days prior to average first frost date
Seeding rate	3/4 - 2 lbs/acre
Approx seed/oz	1,300
Seeding depth	0.5-1"
Seedling spacing	8-12" in-row on 78-80" bed, or 12-24" with 2 lines on 78-80" bed

Fertility/Fertilization
Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results).

Generalized rate. 120 - 70 - 70 lb/acre	
N*	40-50 lbs pre-plant + 20-30 lbs/acre; side-dress at 2-4 true-leaf stage and at vining
P	60-100 lbs banded approximately 2" below seed at planting
K	60-100 lbs (most Texas soils contain adequate potassium)

* Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation
Moderate water demand: 15-20" per season (may be significantly reduced with drip irrigation). Critical need periods are at establishment and vining through fruit netting.

Pest Management

Cantaloupe Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Alternaria		Clove, Rosemary And Thyme Oil, Hydrogen Dioxide, Neem Oil, *Streptomyces lydicus*
Downy mildew	Acibenzolar-S-Methyl, Chlorothalonil, Copper Sulfate, Cymoxanil, Dimethomorph, Fenamidone, Fluopicolide, Fosetyl-Al, Hydrogen Dioxide, Mancozeb, Mandpropamid, Maneb, Potassium Phosphite, Azoxystrobin, Propamocarb Hydrochloride, Cyazofamid, Pyraclostrobin, Sodium Tetraborohydrate Decahydrate, Trifloxystrobin	*Bacillus pumilus*, *Bacillus subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria sachalinensis*, Hydrogen Peroxide, Neem Oil, *Streptomyces lydicus*
Gummy stem blight	Potassium Phosphite, Azoxystrobin, Chlorothalonil, Copper Sulfate, Kresoxim-Methyl, Mancozeb, Maneb, Paraffinic Oil, Polyoxin D Zinc Salt, Pyraclostrobin, Tebuconazole, Thiophanate-Methyl	Copper Hydroxide, *Bacillus subtilis*, Cuprous Oxide, Extract of *Reynoutria Sachalinensis*, Hydrogen Dioxide
Powdery mildew	Acibenzolar-S-Methyl, Azoxystrobin, Copper Sulfate, Hydrogen Dioxide, Kaolin, Myclobutanil, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Phosphite, Potassium Salts of Fatty Acids, Kresoxim-Methyl, Pyraclostrobin, Quinoxyfen, Sodium Tetraborohydrate Decahydrate, Sulfur, Tebuconazole, Thiophanate-Methyl, Trifloxystrobin, Triflumizole	*Streptomyces lydicus*, Potassium Bicarbonate, *Bacillus subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria Sachalinensis*, Hydrogen Peroxide, Neem Oil
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin

Vine decline	Chlorothalonil, Fludioxonil, Thiophanate-Methyl	
Viruses	Paraffinic Oil	

Cantaloupe Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Aphid	Acetamiprid, Bifenthrin, Diazinon, Dimethoate, Endosulfan, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Malathion, Naled, Oxydemeton-Methyl, Permethrin, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins
Cutworm	Beta-Cyfluthrin, Bifenthrin, Carbaryl, Cyfluthrin, Deltamethrin, Diazinon, Esfenvalerate, Flubendiamide, Lambdacyhalothrin, Permethrin, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*
Leafminer	Abamectin, Cyromazine, Deltamethrin, Dimethoate, Lambdacyhalothrin, Naled, Paraffinic Oil, Permethrin, Petroleum Oil, Spinetoram, Thiamethoxam, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Spinosad
Looper	Methomyl, Naled	Azadirachtin, *Bacillus thuringiensis*, Garlic Juice Extracts, Pyrethrins
Melonworm	Acetamiprid, Beta-Cyfluthrin, Bifenthrin, Carbaryl, Chlorantraniliprole, Cryolite, Cyfluthrin, Deltamethrin, Diazinon, Endosulfan, Flubendiamide, Indoxacarb, Lambda-Cyhalothrin, Methomyl, Methoxyfenozide, Permethrin, Spinetoram, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*, Spinosad
Mite	Oxydemeton-Methyl, Paraffinic Oil, Petroleum Oil, Sodium Tetraborohydrate Decahydrate,	Azadirachtin, Garlic Juice Extracts, Neem Oil

	Soybean Oil	
Thrips	Diazinon, Dimethoate, Dinotefuran, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Spinetoram, Thiamethoxam	Azadirachtin, Garlic Juice Extracts, Pyrethrins, Spinosad
Whitefly	Beta-Cyfluthrin, Bifenthrin, Cyfluthrin, Deltamethrin, Dinotefuran, Endosulfan, Fenpyroximate, Fosetyl-Al, Imidacloprid, Lambdacyhalothrin, Paraffinic Oil, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Spiromesifen, Thiamethoxam	Azadirachtin, Neem Oil, Pyrethrins

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	Clomazone, Ethalfluralin, DCPA, Bensulide, Trifluralin	Corn Gluten Meal
Preemergence	Ethalfluralin, DCPA	
Postemergence	Carfentrazone, Oxyfluorfen, Paraquat, Halosulfuron, Sethoxydim, Glyphosate, Pelargonic Acid, Clethodim	D-Limonene, Clove Oil, Cinnamon and Clove Oil

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.

** As stated in §205.206 of the National Organic Standards, pest management decisions should follow a hierarchical approach, which should be defined in a farm's organic systems plan. Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

Days after planting	Usually harvested at the 3/4 slip stage. Fields may be harvested 5-10 times over 3-week period. Direct seeded - 85-95 Transplanted - 70-80
Normal method	Hand harvested using harvest aid machinery
Containers	Bulk wagons
Grades	Based on fruit diameter and freedom from defects
Packaging/Handling	9, 12, 18, or 23 fruit/half carton (approximately 38-41 lbs) Sometimes bulk loaded Usually hydro-cooled to remove field heat and chlorine-treated prior to packing
Anticipated yield/acre	7-9 tons

Transit Conditions

32-41°F at 95% RH (freeze injury 30°F). Shelf-life - 1-2 weeks.

Comments/Production Keys

- Avoid heavy clay soils having poor aeration and drainage
- Plants extremely cold sensitive (night temperature < 50°F stunts growth)
- Crop well adapted to plastic mulch/drip irrigation culture; results in increased earliness, quality and percent packed out
- Plastic mulched and drip irrigated crop responds well to fertigation
- Extreme care required during harvesting and handling to avoid bruising and increased decay during transit
- Chlorine-treat fruit prior to packing and/or direct sales to avoid potential of salmonella and cholera contamination
- Excessive nitrogen delays maturity and reduces fruit quality
- Moisture received after netting can reduce soluble solids and subsequent fruit quality
- Bright sunshine during fruit maturity enhances soluble solids and quality. Conversely, cloudy overcast skies reduce soluble solids, sweetness, in fruit.

Honeydew

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties

Honey Girl, Honey Star, Sweet Delight, TAM Dew

Soil Preferences

Adaptable to wide range of soils, Optimum soil is well-drained, medium textured, soil with 6.0 - 8.0 pH. Will tolerate heavier soils than most other cucurbits.

Optimum Growing Conditions

Hot days and warm nights. Low soil and air temperatures can stunt growth. Fruit maturing with temperatures below 70°F are usually poor quality.

Establishment Methods

Planting Method	Direct seeded or transplanted
Optimum Time	Spring - when soil temperature is >70°F Fall - 80-90 days prior to average first frost date
Seeding rate	3/4 - 2 lbs/acre
Approx seed/oz	1,300
Seeding depth	0.5 - 1"
Seedling spacing	In-row 8-12" in single line on 78-80" bed, or 12-24" with 2 lines on 78-80" bed

Fertility/Fertilization

Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results).

Generalized rate: 120 - 70 - 70 lb/acre	
N*	50-100 lbs; 40-50 lbs pre-plant + 20-30 lbs/acre side-dress at 2-4 true-leaf stage, and at vining
P	60-100 lbs; banded approximately 2" below seed at planting
K	60-100 lbs (most Texas soils contain adequate potassium)

* Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation
Moderate water demand; 15-20"/season (may be significantly reduced with drip irrigation). Critical need periods are at establishment, and vining through fruit netting.

Pest Management

Honeydew Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Anthracnose	Azoxystrobin, Chlorothalonil, Copper Sulfate, Mancozeb, Maneb, Potassium Phosphite, Thiophanate-Methyl, Pyraclostrobin	*Bacillus subtilis*, Copper Hydroxide, Cuprous Oxide, Neem Oil, Potassium Bicarbonate
Downy mildew	Dimethomorph, Acibenzolar-S-Methyl, Chlorothalonil, Copper Sulfate, Cymoxanil, Fenamidone, Fluopicolide, Fosetyl-Al, Mancozeb, Mandpropamid, Maneb, Potassium Phosphite, Azoxystrobin, Propamocarb Hydrochloride, Cyazofamid, Pyraclostrobin, Sodium Tetraborohydrate Decahydrate, Trifloxystrobin	*Bacillus pumilus*, *Bacillus subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Streptomyces lydicus*
Gummy stem blight	Azoxystrobin, Chlorothalonil, Chlorothalonil, Copper Sulfate, Kresoxim-Methyl, Mancozeb, Maneb, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Phosphite, Pyraclostrobin, Tebuconazole, Thiophanate-Methyl	*Bacillus subtilis*, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria Sachalinensis*, Hydrogen Dioxide
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin
Powdery mildew	Acibenzolar-S-Methyl, Azoxystrobin, Copper Sulfate, Kaolin, Myclobutanil, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Phosphite, Potassium Salts of Fatty Acids, Kresoxim-Methyl, Pyraclostrobin, Quinoxyfen, Sodium Tetraborohydrate Decahydrate, Sulfur, Tebuconazole, Thiophanate-Methyl,	*Bacillus pumilus*, *Bacillus subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria Sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Streptomyces lydicus*

	Trifloxystrobin, Triflumizole	
Vine decline	Chlorothalonil, Fludioxonil, Thiophanate-Methyl	
Viruses	Paraffinic Oil	

Honeydew Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Aphid	Acetamiprid, Bifenthrin, Diazinon, Dimethoate, Endosulfan, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Malathion, Oxamyl, Oxydemeton-Methyl, Permethrin, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Neem Oil,
Cutworm	Beta-Cyfluthrin, Bifenthrin, Carbaryl, Cyfluthrin, Deltamethrin, Diazinon, Esfenvalerate, Flubendiamide, Lambdacyhalothrin, Permethrin, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*
Leafminer	Abamectin, Cyromazine, Deltamethrin, Dimethoate, Lambdacyhalothrin, Paraffinic Oil, Permethrin, Petroleum Oil, Soybean Oil, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Spinosad
Looper	Methomyl	Azadirachtin, *Bacillus thuringiensis*, Garlic Juice Extracts, Pyrethrins
Melonworm	Acetamiprid, Beta-Cyfluthrin, Bifenthrin, Carbaryl, Chlorantraniliprole, Cryolite, Cyfluthrin, Deltamethrin, Diazinon, Endosulfan, Flubendiamide, Indoxacarb, Lambdacyhalothrin, Methomyl, Permethrin, Spinetoram, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*, Spinosad
Mite	Malathion, Paraffinic Oil, Petroleum Oil, Sodium Tetraborohydrate Decahydrate, Soybean Oil	Azadirachtin, Garlic Juice Extracts
Thrips	Dimethoate, Dinotefuran, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Oxamyl, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate,	Azadirachtin, Garlic Juice Extract, Neem Oil, Peppermint and Rosemary Oil,

	Soybean Oil, Spinetoram, Thiamethoxam	Pyrethrins, Spinosad
Whitefly	Beta-Cyfluthrin, Bifenthrin, Cyfluthrin, Deltamethrin, Dinotefuran, Endosulfan, Fenpyroximate, Fosetyl-Al, Imidacloprid, Lambdacyhalothrin, Paraffinic Oil, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Spiromesifen, Thiamethoxam	Azadirachtin, Garlic Juice Extracts, Pyrethrins

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	Clomazone, Ethalfluralin, DCPA, Bensulide, Trifluralin	Corn Gluten Meal
Preemergence	Ethalfluralin, DCPA	
Postemergence	Carfentrazone, Oxyfluorfen, Paraquat, Halosulfuron, Sethoxydim, Glyphosate, Pelargonic Acid, Clethodim	D-Limonene, Clove Oil, Cinnamon and Clove Oil

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.

** As stated in §205.206 of the National Organic Standards, pest management decisions should follow a hierarchical approach, which should be defined in a farm's organic systems plan. Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

Days after planting	Usually harvested at 3/4 slip stage of maturity Fields may be harvested 5-10 times over 3 week period Direct seeded - 85-95 days Transplant - 70-80 days
Normal method	Hand harvested using harvest aid machinery
Containers	Bulk wagon
Grades	Based on fruit diameter and freedom from defects
Packaging/Handling	9, 12, 18, or 23 fruit/half carton (approximately 38-41 lbs) Sometimes bulk loaded Usually hydrocooled to remove field heat and chlorine-treated

	prior to packing
Anticipated yield/acre	10 tons (210 cwt)/acre

Transit Conditions
32-41°F at 95% RH (freeze injury at 30°F); 1-2 weeks shelf life.

Comments/Production Keys

- Avoid heavy clay soils having poor aeration and drainage
- Plants are extremely cold sensitive (night temperatures < 50°F stunt growth), and easily injured by frost
- Crop well adapted to plastic mulch/drip irrigation culture; results in increased earliness, quality and percent packed out
- Extreme care required during harvesting and handling to avoid bruising and increased decay during transit
- Chlorine-treat fruit prior to packing and/or direct sales to avoid potential of salmonella and cholera contamination
- Excessive nitrogen delays maturity and reduces fruit quality
- Moisture received after netting can reduce soluble solids and subsequent fruit quality
- Bright sunshine during fruit maturity enhances soluble solids and quality. Conversely, cloudy overcast skies reduce soluble solids, sweetness, in fruit.

Seedless Watermelon

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties
Gem Dandy, Matrix, Summersweet 5244, Tiffany, Tri-X 313

Soil Preferences
Deep, well-drained, light textured soil having a pH range of 5.5 - 8.0. Does not tolerate heavy soils.

Optimum Growing Conditions
Hot days (80-95°F) and warm nights (60-70°F). Cooler temperatures slow growth and maturity. Cloudy days and frequent rainfall reduces fruit quality.

Establishment Methods

Planting Method	Transplants
Optimum Time	When all danger of frost has passed
Approx seed/oz	500
Seeding depth	0.5"
Seedling spacing	2-3' in-row on 80" (center to center) beds

Transplant Production Suggestions:

- Use fungicide treated seed
- Prior soaking of pellets or potting media suggested
- Sow 2-3 seeds/pellet, pot or cell
- Sow seeds approximately 0.5" deep with pointed end up (reduces seed coat clamping around emerging seedlings)
- Cover seeded flats with clear plastic and maintain greenhouse temperature at 85°F for 48 hours
- Keep flats moist but not wet
- Remove plastic cover at 10% seedling emergence and reduce greenhouse temperature to 75°F
- Carefully remove seed coats from cotyledons
- Thin to one plant/pot, pinching off extra seedlings

Fertility/Fertilization
Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results)

Generalized rate: 80 - 80 - 80 lb/acre	
N*	40-90 lbs 0-50 lbs pre-plant 0-30 lbs side-dressed 3 weeks after emergence Under high rainfall, an additional 20 lbs may be required at vining
P	40-80 lbs applied at planting
K	40-80 lbs (if needed, apply with pre-plant N)
Starter solution (transplants)	Approximately 8 oz of high phosphate starter solution/plant at field setting

* Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation
10-15"/season. Steady moisture supply (1-2" every 7-14 days).

Pest Management

Watermelon Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Alternaria		Clove, Rosemary and Thyme Oil, Hydrogen Dioxide, Neem Oil, *Streptomyces lydicus*
Downy mildew	Acibenzolar-S-Methyl, Azoxystrobin, Chlorothalonil, Copper Sulfate, Cyazofamid, Cymoxanil, Mancozeb, Dimethomorph, Fenamidone, Fenamidone, Fosetyl-Al, Mandpropamid, Potassium Phosphite, Propamocarb Hydrochloride, Pyraclostrobin, Sodium Tetraborohydrate Decahydrate, Trifloxystrobin, Maneb, Fluopicolide	*Bacillus pumilus*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Bacillus subtilis*, *Streptomyces lydicus*
Fusarium wilt	1,3-Dichloropropene, Chloropicrin, Fludioxonil, Potassium Phosphite	*Bacillus subtilis*, *Gliocladium virens* GI-21, *Streptomyces lydicus*
Gummy stem	Azoxystrobin, Chlorothalonil, Copper Sulfate, Kresoxim-Methyl, Mancozeb,	*Bacillus subtilis*, Copper Hydroxide, Cuprous Oxide,

blight	Maneb, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Phosphite, Pyraclostrobin, Tebuconazole, Thiophanate-Methyl	Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin
Powdery mildew	Acibenzolar-S-Methyl, Azoxystrobin, Copper Sulfate, Kaolin, Kresoxim-Methyl, Myclobutanil, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Salts of Fatty Acids, Pyraclostrobin, Quinoxyfen, Sodium Tetraborohydrate Decahydrate, Tebuconazole, Thiophanate-Methyl, Trifloxystrobin, Triflumizole	*Bacillus Pumilus, Bacillus Subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of Reynoutria sachalinensis, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, Streptomyces lydicus, Sulfur
Virus	Paraffinic Oil	

Watermelon Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Aphid	Acetamiprid, Bifenthrin, Diazinon, Dimethoate, Endosulfan, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Malathion, Oxamyl, Oxydemeton-Methyl, Permethrin, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins
Armyworm	Beta-Cyfluthrin, Bifenthrin, Cyfluthrin, Deltamethrin, Flubendiamide, Lambdacyhalothrin, Spinetoram	Azadirachtin, *Bacillus thuringiensis*, Pyrethrins,
Cabbage Looper	Methomyl	Azadirachtin, *Bacillus thuringiensis*, Garlic Juice Extracts, Pyrethrins
Cutworm	Beta-Cyfluthrin, Bifenthrin, Carbaryl, Cyfluthrin, Deltamethrin, Diazinon, Esfenvalerate, Flubendiamide, Lambdacyhalothrin, Permethrin, Zeta-Cypermethrin	Azadirachtin *Bacillus thuringiensis*
Leafminer	Abamectin, Deltamethrin, Dimethoate, Dinotefuran, Lambdacyhalothrin, Paraffinic Oil, Permethrin,	Azadirachtin, Garlic Juice Extracts,

	Petroleum Oil, Soybean Oil, Spinetoram, Thiamethoxam, Zeta-Cypermethrin	Spinosad,
Mite	Oxydemeton-Methyl, Paraffinic Oil, Petroleum Oil, Sodium Tetraborohydrate Decahydrate, Soybean Oil	Azadirachtin, Garlic Juice Extracts, Neem Oil,
Thrips	Diazinon, Dimethoate, Dinotefuran, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Oxamyl, Petroleum Oil, Potassium Salts of Fatty Acids, Soybean Oil, Spinetoram, Thiamethoxam	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins, Spinosad,
Webworm	Lambdacyhalothrin, Soybean Oil	Pyrethrins,
Whitefly	Beta-Cyfluthrin, Bifenthrin, Cyfluthrin, Deltamethrin, Dinotefuran, Endosulfan, Fenpyroximate, Fosetyl-Al, Imidacloprid, Lambdacyhalothrin, Paraffinic Oil, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Spiromesifen, Thiamethoxam	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins,

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	Clomazone, Ethalfluralin, DCPA, Bensulide, Trifluralin	Corn Gluten Meal
Preemergence	Ethalfluralin, DCPA, Terbacil	
Postemergence	Carfentrazone, Oxyfluorfen, Paraquat, Halosulfuron, Sethoxydim, Glyphosate, Pelargonic Acid, Clethodim, Terbacil	D-Limonene, Clove Oil, Cinnamon and Clove Oil

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.

** As stated in §205.206 of the National Organic Standards, pest management decisions should follow a hierarchical approach, which should be defined in a farm's organic systems plan. Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

Days after planting	65-75 days
Normal method	Hand
Containers	Bulk wagons or pallet boxes
Grades	Based on diameter size and freedom from blemishes
Packaging/Handling	4-8 watermelon per 50-60 lb cardboard carton(depending upon fruit size) Shipped in pallet bin boxes
Anticipated yield/acre	5-15 tons/acre

Transit Conditions

50-60°F at 80-85% RH (chilling injury at 40°F); Shelf-life 3-4 weeks.

Comments/Production Keys

- Production of seedless watermelon may not be an option for everyone as it requires a high levels of input, management and grower sophistication
- A production systems approach should be followed:
  - Transplant establishment
  - Plastic mulch
  - Drip irrigation
  - Precise water and nutrient application
  - Windbreaks
  - Bees
- Direct seeded establishment not economically feasible at this time due to seed cost and germination problems
- To ensure sufficient pollination, plant every third bed to a standard diploid melon variety (of a different color or shape than the seedless triploid variety) to serve as the pollinator. Make certain that the outer two beds of the field are planted to the pollinator variety.
- The first fruit set/vine will often contain a few true seeds and many immature edible (white) seed

Watermelon

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties
Allsweet, Black Diamond, Bush Sugar Baby, Calhoun Grey, Charleston Gray, Crimson Sweet, Crimson Tide, Dixielee, Golden Crown, Jubilee, Mickylee, Minilee, Mirage, OrangeGlo, Prince Charles, Royal Jubilee, Tendersweet, Yellow Doll

Soil Preferences
Deep, well-drained, light textured soil having a pH range of 5.5 - 8.0 (optimum pH 6.5 - 7.0). Does not tolerate heavy soils.

Optimum Growing Conditions
Bright, hot days (80-95°F) and warm nights (60-70°F). Cooler temperatures and excessive rainfall slows growth and maturity. Overcast and cloudy weather conditions reduce soluble solids (fruit quality).

Establishment Methods

Planting Method	Transplant (preferred) or direct seeded
Optimum Time	When all danger of frost has passed and/or soil seed zone temperature exceeds 70°F
Seeding rate	1-3 lbs/acre
Approx seed/oz	300-600
Seeding depth	0.75 - 1.0"
Seedling spacing	Irrigated - 3' in-row on 80" wide raised beds Dry land - 5' in-row on 8-10' wide raised beds

Fertility/Fertilization
Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results).

Generalized rate: 80 - 80 - 80 lb/acre	
N*	40-90 lbs 0-50 lbs pre-plant 0-30 lbs side-dressed 3 weeks after emergence Under high rainfall, an additional 20 lbs may be required at vining

P	40-80 lbs applied at planting
K	40-80 lbs (if needed, apply with pre-plant N)
Starter solution (transplants)	Approximately 8 oz of high phosphate starter solution/plant at field setting

* Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation

10-15"/season. Steady moisture supply (1-2" every 10-14 days) required. Key stages are establishment, blooming, fruit set, and enlargement.

Pest Management

Watermelon Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Alternaria		Clove, Rosemary and Thyme Oil, Hydrogen Dioxide, Neem Oil, *Streptomyces lydicus*
Downy mildew	Acibenzolar-S-Methyl, Azoxystrobin, Chlorothalonil, Copper Sulfate, Cyazofamid, Cymoxanil, Mancozeb, Dimethomorph, Fenamidone, Fenamidone, Fosetyl-Al, Mandpropamid, Potassium Phosphite, Propamocarb Hydrochloride, Pyraclostrobin, Sodium Tetraborohydrate Decahydrate, Trifloxystrobin, Maneb, Fluopicolide	*Bacillus pumilus*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Bacillus subtilis*, *Streptomyces lydicus*
Fusarium wilt	1,3-Dichloropropene, Chloropicrin, Fludioxonil, Potassium Phosphite	*Bacillus subtilis*, *Gliocladium virens* GI-21, *Streptomyces lydicus*
Gummy stem blight	Azoxystrobin, Chlorothalonil, Copper Sulfate, Kresoxim-Methyl, Mancozeb, Maneb, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Phosphite, Pyraclostrobin, Tebuconazole, Thiophanate-Methyl	*Bacillus subtilis*, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin
Powdery	Acibenzolar-S-Methyl, Azoxystrobin,	*Bacillus pumilus*, *Bacillus*

mildew	Copper Sulfate, Kaolin, Kresoxim-Methyl, Myclobutanil, Paraffinic Oil, Polyoxin D Zinc Salt, Potassium Salts of Fatty Acids, Pyraclostrobin, Quinoxyfen, Sodium Tetraborohydrate Decahydrate, Tebuconazole, Thiophanate-Methyl, Trifloxystrobin, Triflumizole	*subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Cuprous Oxide, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Streptomyces lydicus*, Sulfur
Virus	Paraffinic Oil	

Watermelon Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Aphid	Acetamiprid, Bifenthrin, Diazinon, Dimethoate, Endosulfan, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Malathion, Oxamyl, Oxydemeton-Methyl, Permethrin, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins
Armyworm	Beta-Cyfluthrin, Bifenthrin, Cyfluthrin, Deltamethrin, Flubendiamide, Lambdacyhalothrin, Spinetoram	Azadirachtin, *Bacillus thuringiensis*, Pyrethrins
Cabbage Looper	Methomyl	Azadirachtin, *Bacillus thuringiensis*, Garlic Juice Extracts, Pyrethrins
Cutworm	Beta-Cyfluthrin, Bifenthrin, Carbaryl, Cyfluthrin, Deltamethrin, Diazinon, Esfenvalerate, Flubendiamide, Lambdacyhalothrin, Permethrin, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*
Leafminer	Abamectin, Deltamethrin, Dimethoate, Dinotefuran, Lambdacyhalothrin, Paraffinic Oil, Permethrin, Petroleum Oil, Soybean Oil, Spinetoram, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts, Spinosad
Mite	Oxydemeton-Methyl, Paraffinic Oil, Petroleum Oil, Sodium Tetraborohydrate Decahydrate, Soybean Oil	Azadirachtin, Garlic Juice Extracts, Neem Oil
Thrips	Diazinon, Dimethoate, Dinotefuran, Fenpropathrin, Imidacloprid, Lambdacyhalothrin, Oxamyl, Petroleum Oil, Potassium Salts of Fatty Acids,	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins,

	Soybean Oil, Spinetoram, Thiamethoxam	Spinosad
Webworm	Lambdacyhalothrin, Soybean Oil	Pyrethrins
Whitefly	Beta-Cyfluthrin, Bifenthrin, Cyfluthrin, Deltamethrin, Dinotefuran, Endosulfan, Fenpyroximate, Fosetyl-Al, Imidacloprid, Lambdacyhalothrin, Paraffinic Oil, Petroleum Oil, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Soybean Oil, Spiromesifen, Thiamethoxam	Azadirachtin, Garlic Juice Extracts, Neem Oil, Pyrethrins

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	Clomazone, Ethalfluralin, DCPA, Bensulide, Trifluralin	Corn Gluten Meal
Preemergence	Ethalfluralin, DCPA, Terbacil	
Postemergence	Carfentrazone, Oxyfluorfen, Paraquat, Halosulfuron, Sethoxydim, Glyphosate, Pelargonic Acid, Clethodim, Terbacil	D-Limonene, Clove Oil, Cinnamon and Clove Oil

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.

** As stated in §205.206 of the National Organic Standards, pest management decisions should follow a hierarchical approach, which should be defined in a farm's organic systems plan. Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

Days after planting	Direct seeded - 85-95 days Transplanted - 65-75 days
Normal method	Hand
Containers	Bulk wagons or pallet boxes
Grades	Normally field graded during loading; based on diameter size and freedom from blemishes
Packaging/Handling	4-5 watermelon/fiberboard carton depending upon size Shipped in pallet boxes or bulk lots

	Straw between melon layers suggested for bulk loads
Anticipated yield/acre	5-15 tons

Transit Conditions
50-60°F at 80-85% RH (chilling injury at 40°F); Shelf-life 3-4 weeks.

Comments/Production Keys

- Can be produced under low input dry land systems
- Open pollinated varieties better suited to dry land conditions
- Transplant establishment may or may not be economically feasible with open pollinated varieties or with hybrids. If used, best suited to plastic mulch (6' width) and drip irrigation.
- Responds well to high levels of inputs and management; transplant establishment + plastic mulch + drip irrigation
- In areas with high winds, wind breaks planted every 4 - 6 beds is advisable. Windbreaks should be established in the fall in order to provide protection to spring planted crop.
- Excessive nitrogen fertilization and irrigation delays maturity and reduces fruit quality
- Requires the addition of bees to obtain maximum yield and quality (one strong hive/acre)
- Maintain good foliage coverage of fruit to avoid sunburn
- Straw layers should be placed between melon layers to reduce fruit injury during bulk shipment
- Palletizable bin boxes becoming popular for bulk shipment

Fruit & Nut Resources

Banana

Julian W. Sauls
Extension Horticulturist

Broad, long, graceful leaves and rapid growth-commonly reaching full size in just a few weeks-make banana a favorite plant for providing a tropical look to pool and patio areas. The development of bananas following a frost-free winter is a source of both pride and amazement to those unfamiliar with banana culture.

Banana is a tropical herbaceous plant consisting of an underground corm and a trunk (pseudostem) comprised of concentric layers of leaf sheaths. At 10 to 15 months after the emergence of a new plant, its true stem rapidly grows up through the center and emerges as a terminal inflorescence which bears fruit.

The flowers appear in groups (hands) along the stem and are covered by purplish bracts which roll back and shed as the fruit stem develops. The first hands to appear contain female flowers which will develop into bananas (usually seedless in edible types). The number of hands of female flowers varies from a few to more than 10, after which numerous hands of sterile flowers appear and shed in succession, followed by numerous hands of male flowers which also shed. Generally, a bract rolls up and sheds to expose a new hand of flowers almost daily.

Climate

Banana is a tropical plant which grows best under warm conditions. Frost will kill the leaves; temperatures in the high 20s can kill the plant to the ground. In the lower Rio Grande Valley and other protected areas, the plant will regrow from below ground buds. In colder areas where banana is used mostly as an ornamental, new plants are obtained and planted each spring.

The leaves are tattered badly by strong winds, rendering the plant less attractive. Strong winds, in conjunction with saturated soil and the weight of a stem of fruit, can result in significant blow down unless guying or other protection is provided.

Soil and Site Selection

Banana grows in a wide variety of soils, as long as the soil is deep and has good internal and surface drainage. The effect of poorly drained soils can be partly overcome by planting in raised beds, as the plant does not tolerate poor drainage or flooding.

The planting site should be chosen for protection from wind and cold weather, if possible. The warmest location in the home landscape is near the south or southeast side of the house.

Varieties

There are numerous named varieties and several unnamed types. For purely ornamental use, both unnamed seedy types and named varieties will suffice. Most are tall-growing and have green leaves, but 'Dwarf Cavendish' only reaches about 6 feet in height, and there is a mottled or splotchy red-leafed ornamental which can sometimes be located in the nursery trade.

From the standpoint of fruit production, 'Orinoco' or 'Horse' banana has a coarse-looking fruit about 6 inches long by 2 inches in diameter that is primarily used in cooking. 'Dwarf Cavendish' is a short, compact variety that produces fruit typical of those in the supermarket. Because of its size, wind damage is less severe.

'Lady Finger' is a standard-size plant which bears thin-skinned fruit about 1 inch in diameter and 4 inches in length. Its flavor is superior to supermarket bananas.

'Apple' or 'Manzana' is very similar to 'Lady Finger' in all respects except that its fruit imparts an aftertaste very much like the taste of a fresh apple.

Plantains are cooking bananas, but they apparently are not available in South Texas. Other varieties which may be found in the nursery trade include 'Cavendish', 'Ice Cream' and others.

Propagation and Planting

Suckers are used for propagation, being taken when they have a stem diameter of 2 to 6 inches. The leaves are commonly cut off in nursery trade, but decapitation at 2 to 3 feet is satisfactory. The sucker should be dug carefully, using a sharpshooter or spade to cut the underground base of the sucker from the side of its mother rhizome. Large suckers can be decapitated at ground level and halved or quartered (vertically) to increase planting material.

Nurserymen transplant from the field into containers for retail use, so planting these bananas is much the same as planting any container-grown plant. Sucker transplanting should be at the same depth as the sucker was growing originally.

For ornamental purposes, bananas may be planted as close as 2 to 3 feet apart, but those planted for fruit production should be spaced about 8 to 10 feet apart.

Culture

Weed and grass competition should be eliminated prior to planting. Mulching is useful to prevent weed regrowth, but turfgrass may need to be controlled by hoeing or with herbicides.

Irrigation should be applied periodically to thoroughly wet the soil. Avoid standing water, as bananas do not tolerate overly wet conditions.

Fertilization requirements under Texas conditions have not been researched. However, it is reasonable to presume that nitrogen will be the only limiting nutrient in most situations. For new plants, one quarter cup of ammonium sulfate (21-0-0), watered in, after the plant commences regrowth should be applied monthly for the first three to four months. The rate can be increased over time to two cups per month when fruiting begins.

Established plantings of several plants together should receive about two cups of ammonium sulfate every couple of months throughout the year.

Cold protection of the top is possible by use of coverings and heat sources, but such is not often practical. However, in colder locations, soil can be banked around the trunk just before a projected cold spell to better protect the underground buds, which will allow the plant to regenerate in the coming spring. Unprotected but well-established bananas across South Texas, with some exceptions, regenerated after both the '83 and '89 freezes.

Some people dig the entire plant, rhizome and all, remove the leaves and store the plant, dry, in a heated area over winter. To assure survival, it is easier to dig small suckers, severed very close to the parent rhizome, and pot them for overwintering indoors.

Pruning is normally practiced only to provide suckers for propagation, as most banana plantings are allowed to grow freely in mats of several plants of varying age and size. For fruit production, some pruning would be desirable to limit the number of plants per mat to 5 or 6. Suckers can be quickly dispatched with a sharpshooter or machete when they are only a few inches tall; however, the sucker must be severed from its mother plant underground.

After fruiting, the mother plant which bore should be cut off near ground level, as it can never produce again. The old trunk will quickly decompose if cut into three or four pieces, with each piece then being split lengthwise. Use the remains in a mulch bed or compost heap.

After a major cold period in which there is no doubt that bananas were killed to the ground, cut the plants off at ground level within a couple of weeks of the freeze. Dead bananas are not very attractive and they are much easier to cut off before decomposition starts.

Tattered older leaves can be removed after they break and hang down along the trunk.

Production, Maturity and Use

Most bananas will produce the flower bud within 10 to 15 months of emergence as a new sucker, depending mostly on variety and extent of cool/cold weather. Most production north of the lower Rio Grande Valley occurs in the spring and summer following a particularly mild winter.

The reddish purple bracts of the flower roll back and split to expose a hand of bananas, usually at the rate of one per day. After all hands with viable fruit are exposed, the bracts continue to roll back and split for several weeks, leaving a bare stem between the fruit and the bud. There is no advantage to leaving the bud longer then necessary; it may be broken off a few inches below the last viable hand of fruit.

Well-tended bananas in commerce produce fruit stems approaching 100 pounds, but such yields are rare under Texas conditions. The more delicately flavored, small-fruited varieties may attain stem weights of 35 to 40 pounds. Most Texas producers readily accept production of stems having only two or three hands, although six to eight hands per stem is common for well-tended plants.

Bananas do not always attain best eating quality on the tree. The entire stem (bunch) should be cut off when the individual bananas are plump (full) and rounded. Although green in color, the fruit is mature and will ripen to good eating quality. The stem of fruit should be hung in a cool, shaded place to ripen. Ripening will proceed naturally in a few days (if properly harvested), but can be hastened by enclosing the bunch in a plastic bag with a sliced apple for about a day. Once ripening starts on the oldest hand, the entire bunch will ripen within a couple of days.

Ripe bananas are consumed fresh out-of-hand, in salads, compotes, ice-cream dishes and pudding. Overripe fruit can be pureed in the blender for use in ice cream and baking. Both dessert and cooking bananas may be fried or baked, but the cooking bananas are generally more starchy until nearly spoiled ripe, and their fresh flavor is not so good. Green (mature but not ripe) bananas and plaintains can also be sliced thinly and fried for a starchy treat.

Disease and Insect Pests

Bananas in commerce are subject to a number of serious diseases and pests, but few problems have been documented in South Texas. An unidentified fungal leaf spot has been observed, but no serious damage has resulted. Leaf tattering by wind is the most common problem.

Fruit & Nut Resources

Jujube

George Ray McEachern
Extension Horticulturist
Texas A & M University

January 27, 1997

Jujubes are one of the easiest to grow of the fruit crops, with few pests or problems ever reported. Jujube (Ziziphus jujube) was introduced into Texas in approximately 1875. The tree can grow to a height of 30-50 ft if soil and climatic conditions permit. The leaves are dark green and attractive with a shiny waxlike appearance above and a layer of fuzz on the lower side. The tree loses its leaves in the winter to make an ornate specimen with upright trunks, short angled shoots, and rough bark.

Fruit from seedlings can be quite small, while improved varieties can be as large as 2 inches long and 1 1/2 inches in diameter. The fruit usually ripens in July and August. As it matures on the tree, it will gradually turn from a light green to a dark brown and become wrinkled. A single seed is inside the fruit and the dark brown appearance and this seed gives rise to the common name, Chinese Date. The texture and flavor more closely resemble that of an apple than a date.

Varieties of jujube trees in Texas are propagated either by seed or root sprouts from stands of trees scattered around the state. The fruit from these seedlings will usually be of inferior quality; however, they are readily available, inexpensive, and easy to maintain. There are two commonly known varieties in the state: Li is the largest fruit grown in Texas, and also the best flavored. It has edible flesh when picked from the tree and is somewhat later than the other varieties. Texture is crisp when harvested at the proper time. At maturity, skin color is mahogany and the fruit should be harvested before the skin becomes wrinkled. Lang is the most widely grown named variety in Texas. It produces heavy crops of large pear shaped fruit that matures ahead of the Li variety. Lang produces a more spreading tree than other jujube trees. The fruit is red skinned at maturity. Both the Li and the Lang varieties should be grafted as they do not come true to seed.

Soils for jujubes can range widely, but they do require fair to good drainage. They will perform well at a wide range of soil pH. Plants grown in soils with a pH above 7.8 may exhibit minor element deficiencies. With this notable exception, jujubes will survive on soils where most other trees would perish.

Climate for jujubes should be hot and dry. They are grown primarily in Texas and the southwestern United States. Jujubes have survived drought and excess moisture better than any other fruit plant in trials at College Station, Texas. Though plants will survive in all areas of the state, they are better adapted to the more arid areas rather than the Gulf Coast. Winter injury does not seem to be a problem with jujubes in Texas and they usually bloom late enough to escape spring frosts.

Pests are rarely a problem in jujubes though cotton root rot can be a major limiting factor on those sites where it is present. If plant loss is contributed to this disease, do not replant in the same area as additional losses are a certainty.

Root sprouting is a problem under mature plantings and can lead to the formation of a thicket if control measures are not undertaken. As soon as sprouts form, they should be cut off at or under the ground. Any root injury will encourage root sprouting, so cultivation should be avoided where possible. Plants produced from these sprouts will not produce the same type of fruit as the mother plant if the tops are grafted onto a rootstock. Young plants should not be used as a source of new plants unless they are grafted.

Propagation of jujubes is a whip-graft of root sprouts to the variety desired.

Fertilization required to produce excellent plant growth in Texas is only nitrogen. A rule of thumb would be to use 0.2 lb N per inch of trunk diameter up to a maximum of 1.0 lb. A single application just prior to growth in the spring is usually adequate. First and second year plants will respond to applying the material in three applications at monthly intervals usually April, May, and June. If split applications are used, use 1/3 of the total in each application.

Aggie Horticulture®

Mango

Julian W. Sauls
Extension Horticulturist

Mango is regarded as the queen of fruits in tropical areas of the world. Prior to the severe freezes of the 1980s, numerous mango trees were in production in yards across the lower Rio Grande Valley, including a small orchard near Mercedes. Grown for its large, colorful and delicious fruit, the medium to large evergreen mango tree is also attractive in the home landscape. Its rounded canopy may be low and dense to upright and open, with dark green foliage that is long and narrow.

Climate

Mango is adapted to lowland tropical and subtropical areas. Winter temperature is a major consideration, as leaves and twigs, especially on younger trees, can be damaged at temperatures below 30 degrees. Flowering and fruiting are seriously affected at temperatures below 40 degrees during bloom. There is no apparent difference in cold hardiness among varieties.

Soil and Site Selection

Mango requires soil having good internal drainage, but is not particular as to soil type. Trees can tolerate minor flooding, but have low tolerance for salts, boron and lawn herbicides. Because of its extreme sensitivity to cold, mango should be planted in the most protected site in the yard–within 8 to 12 feet of the south or east side of the house. The tree must receive full sun for optimum growth and fruiting.

Varieties

There are two principal types of mangos: Indian and Indochinese. Varieties of the Indian type typically have monoembryonic (single embryo) seeds, highly colored fruit and are subject to anthracnose disease. Those of the Indochinese type have polyembryonic seeds (multiple embryos), and fruit usually lacking in coloration, but they may have some resistance to anthracnose. There are some varieties, however, that do not fit clearly into either group.

Varietal choices in Texas are limited. More common commercial varieties include 'Haden', a red and yellow fruit of about a pound and quarter that matures in June; 'Irwin', a red mango of just under a pound that matures in June; 'Tommy Atkins', a red and yellow fruit comparable to 'Haden' in size and maturity; 'Kent', a green, red and yellow mango of about a pound and a half in size that matures in July; and 'Keitt', a green and pink mango of a pound and half that matures in August.

Other varieties may be equally acceptable; for example, 'Julie' and 'Manila' are probably of better eating quality than the more brightly-colored commercial types.

Propagation

Polyembryonic types generally come true from seed, which is the common method of propagation in the tropics. Monoembryonic types do not come true from seed, so they must be grafted onto seedling rootstocks, using almost any available mango seeds.

The fibrous stone or pit should be removed from the seed. The seed should be planted concave edge down and about 1 inch deep in any good potting soil. Germination may take two to three weeks; graftable seedlings of a quarter inch diameter take about six months.

Veneer or side veneer grafting and chip budding are the most successful methods of propagation. Most propagation occurs in winter, using rootstocks grown from the previous summer's production. Cleft grafting is also practiced.

Planting

Because of frequent freezes, mango trees may not achieve maximum size, so they can be spaced 12 to 15 feet from each other or other trees.

Because trees are normally grown in containers of soilless media, much of the outer layer of media should be washed off the sides and top of the root ball immediately prior to setting the tree in the ground. This practice exposes the outer part of the root system to the actual soil in which the tree must grow, thereby enhancing tree establishment. Newly planted trees should be staked for support for the first year.

Build a water ring several inches high and thick atop the soil around the tree. The ring should be a little wider than the planting hole–take soil from elsewhere in the yard if there's not enough left over from planting. Fill the basin with water–after it soaks in, a little soil may be needed to fill in holes made as the soil settles around the root system.

Young Tree Establishment

Newly planted trees should be watered two or three times the first week, then once or twice per week for several weeks. Simply fill the water basin and let the water soak in. The water ring will gradually erode away over four to six months, at which time the tree can be considered established.

Delay fertilization until new growth occurs after planting, then apply monthly into September. Scatter the fertilizer on the ground under the tree and promptly water thoroughly. Using ammonium sulfate (21-0-0), use one half cup monthly in the first year, one cup per month in the second and two cups monthly in the third year. For other fertilizer analyses, adjust the rate accordingly.

All lawn grass and weeds should be eliminated for several feet around the young mango, as the tree cannot compete for water and nutrients until it is much larger. As the tree grows, widen the grass-free area beyond the canopy. Organic mulches are excellent for mango trees.

No pruning or training should be necessary except to remove deadwood.

Winter frost protection is essential. Soil banks around the young tree trunk provide excellent protection–they should be put up in early December and removed in early March. Young trees can also be draped with a blanket or similar covering just prior to a predicted cold spell–pull the corners outward and anchor them to the ground. It is not necessary that the cover reach the ground. Any additional, practical heat source under the tented tree will probably save even the foliage. Incandescent lights, electric heaters, camp lanterns or stoves are good heat sources.

Mature Tree Care

Cultural practices are designed to maintain good growth and production. Irrigation, nutrition, and weed and grass control are the major practices in mature mango tree care.

Irrigation is the same as for other established fruit and nut trees–water slowly, deeply and thoroughly. Repeat as needed, based on soil type and prevailing weather. Weekly soakings during the summer are more than adequate.

Fertilization, using 21-0-0, should be at the rate of one to two cups per inch of trunk diameter per year, split into equal applications in February, May and August. Simply scatter the fertilizer on the soil surface under the tree, then water thoroughly.

Weed and grass control under the tree is desirable to reduce competition and can be easily maintained by use of organic mulch replenished as necessary.

The only pruning necessary is to remove dead or damaged branches, which will occur following major freezes unless excellent cold protection methods are practiced. Then, pruning should be delayed until the extent of freeze damage can be ascertained.

Production, Maturity and Use

Grafted trees will begin to produce in the third year after establishment, with mature trees capable of producing three to five bushels.

The mango fruit develops rapidly, as the time from flowering to maturity is only 100 to 150 days, depending upon variety. Mangoes will ripen to best quality on the tree. Mangoes can be harvested at color break and ripened in the kitchen. Color break is the change from pure green to yellow, usually on the blossom end of the fruit. Another indicator of maturity is a change in color of the flesh around the seed from white to yellow.

Fresh consumption is the most important use of mango, but the fruit can be frozen, dried or canned Mango can be used in jams, jellies, preserves, pies, chutney and ice cream. Green mangoes are sometimes eaten raw in the tropics.

Problems

The largest problem of mango is anthracnose because it attacks all parts of the tree and is probably most damaging to the flower panicles. On maturing fruit, the fungus causes irregular black spots that may be sunken slightly and show surface cracks. A grouping of spots forms a large, damaged area. Tear streaking is common, resulting from fungal spores that wash down the fruit from infected twigs or flower stalks. The disease can be controlled with fungicides.

Powdery mildew can be a serious problem under conditions of high humidity and rainfall during bloom because the disease would limit fruit set. Serious defoliation would not be expected under Texas conditions.

Mites and scale insects can attack mango trees, but they rarely limit growth or production unless populations build to high levels.

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Fruit & Nut Resources

Mayhaw

Marty Baker and George Ray McEachern
Extension Horticulturists
Texas A&M University

January 27, 1997

Mayhaws (Crataegus aestivalis, C. rufula, or C. opaca) are very common south of the 1,000 hour chill line. They grow under hardwood timber in the wet floodplain soils along creeks and rivers. These small trees are of the Hawthorne family. The fruit is small and apple-like and ripens during the late April and early May in East Texas. They have beautiful white blossoms in the Spring and are desirable as ornamentals as well as for wildlife cover and forage.

Varieties

Information and observations are very limited on some varieties. Most ripen over a 10 to 30 day harvest period, but some varieties may have 80% of the fruit ripe at one time. 'Super Spur' and 'Super Berry' seem to have the best yield and tree form. These varieties bloom early so they are best grown in central East Texas and Southeast Texas. The 'Super Spur' has chilling problems during mild winters in the Beaumont area. 'Big Red,' 'Winnie Yellow,' 'Highway Red,' 'Highway Yellow,' 'T.O. Warren Superberry,' Angelina, Harrison, Big Mama, and the #1 Big varieties usually bloom later and are better adapted to Northeast Texas. A potential grower in Northeast Texas should still plant 'Super Spur' and 'Super Berry' mayhaws due to the potential of these two selections when late freezes do not damage the crop.

Soil Requirements

Mayhaws are found in swampy areas and are tolerant of wet soils, but grow best in moist, well-drained soils. Soil should have a pH 6.0 to 6.5 prior to planting.

Propagation

Mayhaws can be propagated by the seed of ripe fruits, by rooted cuttings, or by grafting the mayhaw onto a rootstock. Seed viability varies greatly between mayhaw trees. Many of the seedlings will be true to type. This is very unusual when propagating by seed. Cuttings may be rooted under mist systems or in a humidity chamber in the summer. A root-promoting hormone dip may help rooting. Of course, cuttings will produce fruit exactly like the fruit of the mother tree. Mayhaws appear to be initially graft-compatible with any hawthorne. In East Texas, the parsley hawthorne is considered an excellent rootstock. Mayhaws can be grafted onto Washington hawthorne seedlings which are available commercially, but their performance at maturity has not been determined. Mayhaw seedlings are probably the best choice as a rootstock, especially in damp soils.

Fertilizer Requirements

Established trees should receive one pound of 5-10-10 slow release fertilizer per inch of trunk diameter in February or early March. Repeat the application in late August or early September if the trees are not vigorous and if adequate water is available to prevent scorching. One year-old trees should receive 1/2 pound of 5-10-10 in February and 1/4 pound in March and May. Broadcast the fertilizer evenly under the tree to avoid burning the roots. Do not apply fertilizer within eight inches of the trunk. Mayhaw trees are long-lived and may have a 30-foot diameter canopy after 17 years and grow to 30 feet tall. With this in mind, plant the trees 15 to 20 feet apart in the row with 18 to 20 feet between the rows.

Training

Train mayhaws to a single trunk at the base. The first branches should start at 18 inches or more if equipment will be operated under the tree. Mayhaws have a tendency to produce an open canopy at maturity. Occasional pruning is necessary to open the tree up for greater light penetration. The trees will adapt to a modified central leader training system when one main

trunk is promoted by pruning. This is a common method of training apple trees. Mayhaws will also adapt to a multiple leader training system utilized by southern pear and apple growers to combat fire blight infections and weather damage. Fire blight occurs on mayhaws, but is usually not devastating to the crop.

Harvesting

Since mayhaws are grown in the wet floodplains along rivers the traditional harvesting procedure takes advantage of the water as a mode of transportation. Fruit ripens in early May, falls into the nearby water, and moves downstream. It can be harvested by someone shaking the tree so that the fruit falls into the water, and someone else trapping the floating fruit downstream. Commercially, the fruit is harvested by placing a tarp or canvas under the tree and shaking it to collect the fruit.

Insects, Pests, and Diseases

The plum curculio, aphids, flat-headed apple borers, white flies, and foliage feeders are known to attack mayhaws. Plum curculio has caused extensive damage to fruit in some locations and requires a spray program as part of an integrated pest management program in most areas. Deer and rabbits can destroy a containerized plot of nursery grown mayhaws or an orchard in a short period of time. Quince rust is the most common disease of mayhaws, and was severe in East Texas in 1990. Cedar-apple rust and juniper rust also attack mayhaws. The best way to control rust is to make selections from rust-free plants in a heavy rust year. Several fungicides are used to control rust diseases in apple orchards. Registration is being sought under special use laws for several chemicals to prevent rust disease on mayhaws.

Uses

Mayhaw fruit can be made into jams and jellies, and even wine. Traditional Southern rural families still make a big batch of mayhaw jelly every year.

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Fruit & Nut Resources

Papaya

Julian W. Sauls
Extension Horticulturist

Papaya is native to Central America and is grown in tropical and warmer subtropical areas worldwide. It is a large herbaceous plant, usually with a single, straight trunk which can reach to 30 feet. The leaves are large (up to 3 feet in diameter) and deeply lobed, borne on hollow petioles 2 feet or more in length. The older leaves abscise as new leaves emerge, producing a palm-like form to the plant. The flowers and fruit arise from buds on the trunk at the base of the leaves.

Because of its tropical appearance and abundant fruit, papaya is in considerable demand for use in protected landscape settings throughout coastal and southern Texas.

Climate

Papaya thrives best under warm, humid conditions. It is generally intolerant of strong winds and cold weather. Temperatures just below freezing can kill small plants to the ground–larger plants that are not killed outright will normally produce suckers to regenerate the plant and bear fruit within a year.

Limited commercial plantings in the lower Rio Grande Valley rarely survive more than a few years because of freezing temperatures.

Soil and Site Selection

Papayas are adapted to practically any well drained soil. The plant is shallow rooted and will not tolerate excessive wetness or standing water. Raised beds can partly overcome drainage problems.

Although papayas thrive best in full sun, some concession can be made to protection from wind or cold weather. Close to the south or southeast side of the house is the warmest location in most residential sites. Some wind protection provided by other plantings or structures is helpful.

Varieties

Papayas are generally grown from seed so there are few true varieties. The Hawaiian Solo, Blue Solo and more recent types are fairly uniform and are closest to varietal status. Consequently, most papayas are types rather than varieties, so fruiting characteristics are better considered in groups.

Papaya is polygamous, with three primary sex types: female, male and bisexual. There are some cases where plants produce more than one kind of flower at the same time. Bisexuals are usually preferred for home plantings, but most types available in Texas are male or female. Because sex determination prior to flowering is practically impossible, two to four seedling plants are grown together until flowering to assure females for fruit production and males for pollination.

Fruit types range from small to medium round and medium to large oblong. Flesh color is mostly yellow, although there are some orange to red types.

Female flowers are borne along the trunk and can be identified by that location and the presence of a miniature papaya fruit inside the base of the flower petals. Male flowers are borne in long sprays that originate along the trunk. Each spray is much-branched with inch-long, trumpet-shaped, male flowers. Bisexual types are practically identical to the females, but have male stamens surrounding the miniature fruit inside the flower petals.

Propagation and Planting

Most papayas are grown from seed because of the impracticality of vegetative propagation methods in nursery production. Seeds are extracted from fully ripe fruit, washed to remove gelatinous material and planted several per pot of soil or potting

medium.

Germination is accomplished in approximately two weeks under full sunlight. The plants can be set out as soon as they are large enough (about 1 foot tall) to survive with minimal care. The pots of plants should be spaced 8 to 10 feet apart.

Papaya seedlings should begin flowering in five to six months, at which time they can be thinned to a single female or bisexual plant at each site. In the absence of bisexual plants, one male plant is needed for every eight to ten females.

Cuttings may be rooted to preserve a particularly desirable selection. However, branching must be induced by girdling or decapitation in order to provide the suckers for rooting.

Seed can be obtained from papaya fruit purchased at the local supermarket. If the fruit is from Hawaii, the chances are good that the resulting seedlings will be mostly bisexual. For nursery production of papaya seedlings with a high percentage of female or bisexual flowers, controlled pollination between desirable parents is essential. The expected distribution of the various flower types for different crosses is presented below:

		Progeny Distribution		
Fruit	**Pollen**	**Percentage**		
Parent	**Parent**	**Male**	**Female**	**Bisexual**
Female	Male	50	50	—
Female	Bisexual	—	50	50
Bisexual	Bisexual	—	33	67
Bisexual	Male	33	33	33

Obviously, the most desirable combinations are female or bisexual flowers pollinated by bisexuals, because no males are produced in these combinations.

Pollination is accomplished by covering an unopened flower (female or bisexual) with a small paper bag until it opens, then transferring pollen from a bisexual (or male) flower onto the protected stigma, and re-covering the pollinated flower for several days. The resultant fruit should be marked so that its seed can be collected at maturity.

In colder areas where overwinter survival is questionable, seedlings can be developed in late fall and carried through the winter in greenhouses. After frost danger passes in spring, these seedlings can be planted outdoors to provide fruit until the next killing frost.

Culture

Weed and grass control within 3 to 4 feet of the papaya is essential for optimum growth and fruiting. Cultivation for weed control should be quite shallow, as the papaya's roots are concentrated near the soil surface. The use of organic mulches is highly recommended.

Fertilizer at the rate of one-quarter pound of ammonium sulfate (21-0-0) per plant should be applied monthly after planting, increasing to one half pound six months after establishment.

Irrigation should be applied to thoroughly wet the soil periodically as needed through the year. Avoid standing water following irrigation. A fluctuating irrigation regime may retard growth and cause poor fruit set.

Because papayas rapidly reach 10 to 15 feet or more, cold protection of the top is difficult. Protection of the lower portion of the trunk may permit the plant to regrow from sprouts in the event of freeze damage.

Production, Maturity and Use

Well-tended papayas should produce fruit within a year of planting, with mature plants capable of producing 100 to 200 pounds of papayas per year. Fruit can be ripened off the plant after appearance of a yellow tinge at the apical end, but the fruit attains best quality if harvest is delayed until the fruit is completely yellow.

The most common use of papaya is fresh in slices or chunks and in fruit compotes. A thick juice can be prepared by blending diced papaya with a little water. Papaya can also be sliced and dried. Green papaya is sometimes cooked and eaten like squash. Papaya is a prime source of papain enzyme (meat tenderizer), so green fruit chunks and leaves can be wrapped around meat or fowl before cooking to enhance tenderness and flavor.

Disease and Insect Pests

Root rots can cause rapid death of papaya plants. The only solution is to set new plants in a better location with better drainage or use raised beds. Watering must be done with care.

Virus diseases are quite common and uncontrollable. They normally cause vein-clearing and yellow mottling of the leaves. Other symptoms include distortion of leaf growth accompanied by stunting, poor set and the presence of various greasy-appearing or yellow rings on leaves and fruit. Infected plants should be removed and destroyed.

Anthracnose appears on the fruit as irregular, water-soaked spots that later enlarge, darken and become sunken in the rind. Copper sprays have been of limited effect in severe situations, but would not be expected to be of much use under normal conditions in Texas.

Common whitefly is about the only insect pest which has affected papaya in Texas, leading to sooty mold on the foliage and fruit. Sweetpotato whitefly also is reported to favor papaya. The safest control is through spraying with a soapy water solution.

Tip burn and marginal necrosis (browning) of the leaves is caused by saline soil and water conditions common in much of Texas. Symptoms are usually more severe on older leaves and during the summer.

Fruit & Nut Resources

Muscadine

George Ray McEachern and Marvin L. Baker
Extension Horticulturists
Texas A&M University

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Muscadine grapes (Vitis rotundifolia) are native to East Texas. They thrive in slightly acid soils and have good disease resistance which makes them particularly suited to the humid climates of East Texas. There are less than 50 acres of commercial vineyards, but muscadines are very popular in gardens, on arbors, and as screens and borders.

The highly flavorful fruits of muscadines are particularly popular for jams, jellies, and juices and are also excellent as fresh fruit, though the skin is tough. There is also some interest in muscadines for home and commercial winemaking.

Varieties

The most recently named varieties of muscadines are perfect flowered or self-fruiting. These will also serve as pollinators for the female varieties. When planting a vineyard, a pollinator variety should be set a minimum of every third vine in every third row.

Most varieties ripen from mid-August through September in East Texas.

1. **Regale** is a very productive purple variety with medium-sized fruits borne on loose, uniform-ripening clusters of 10 to 20 berries each. It has very good quality berries with a wet stem scar and is self-fruitful. It begins ripening in early August.
2. **Summit** is one of the most productive varieties grown in East Texas. It is a very large-fruited bronze grape with exceptionally sweet flavor. It has a dry stem scar and good keeping quality. It requires a pollinator.
3. **Higgins** is a large-fruited, productive bronze grape. It has very good flavor, requires a pollinator, and begins ripening in late August or early September.
4. **Doreen** is a recent release with green, medium-sized berries that dislodge easily from the vine. Doreen was the top producer among varieties in Texas Agricultural Experiment Station tests at Overton in 1981. It has a football shaped berry with a dry stem scar and has excellent keeping quality. It is self-fruitful and ripens from mid-September through early October.
5. **Cowart** is a large-fruited purple variety. It produces well, has good quality, and is self-fruitful.
6. **Carlos** is a medium-sized bronze grape. It is very productive and vigorous and has good quality. It is self-fruitful.
7. **Fry** is a very large bronze grape with exceptional quality. It requires a pollinator. It begins ripening in late August or early September.

Soil

Muscadines are best suited to the fertile, loamy soils of East Texas that are acid with a soil pH of 6.0. Problems with chlorosis are usually encountered in soils that have a pH 7.0 or above.

Deep, well-drained, sandy soil is optimum. Muscadines will not tolerate "wet feet" and should not be planted on soils with poor drainage. If adequate drainage is doubtful, plant the vines on a raised row that will allow adequate drainage in all directions.

Climate

Muscadines are a southern crop requiring warm winters–they will freeze to the ground if grown in areas receiving winter temperatures less than 5 degrees to 10 degrees F. Muscadines cannot be grown north of climatic zone 7A. When grown on well-drained soils, they can withstand exceedingly high levels of annual precipitation. Unlike bunch grapes, complications from Black Rot and high relative humidity are not major limiting factors.

Establishing the Vineyard

Establish the vineyard by setting the posts 10 feet apart in 10-foot rows. The plants will be set at the same spacing as the posts. Posts should be wood or metal fence posts. Posts in the row should be a minimum of 7 feet long with at least 2-inch tops. They should be set at least 2 feet deep in the soil. End posts should be 8 feet long with 5-inch tops. These should be set at least 3 feet deep in the soil.

Propagation

Muscadines are propagated by layering. Layering is done by taking a lower cane and placing it under the soil during the dormant season. During the second dormant season, the rooted cane is removed from the soil and a new plant is obtained.

Planting

Set vines in late winter after the danger of hard freezes is past. Care should be taken to keep the roots moist while planting by keeping the plants in a container of water or by wrapping the roots with wet burlap.

Dig the planting hole wide enough to allow the roots to be spread and set the plants 1 or 2 inches deeper than they grew in the nursery. Set the plants immediately against the posts so that they may be used for training. Fill the planting hole with loose topsoil, pack firmly, and thoroughly water the newly set plant. Never add fertilizer to the planting hole.

Cut the tops of the dormant plant back to approximately two buds. Growth from these buds should be allowed to develop freely during the first year to develop a strong root system.

Trellising

Use one 10-gauge wire 66 inches high from the soil surface and connected to 7-foot posts which are set every 10 feet. Vines are planted every 20 feet.

Training

Train two trunks up the fence posts the second year. Loosely tie the shoot to the post every 6 inches in order to develop a straight trunk. Remove any extra shoots once the shoot being trained appears safe from accidental breakage. Also, pinch off any side shoots, but not leaves, from the shoot being trained. Train each of the shoots in opposite directions down the wire.

Pruning

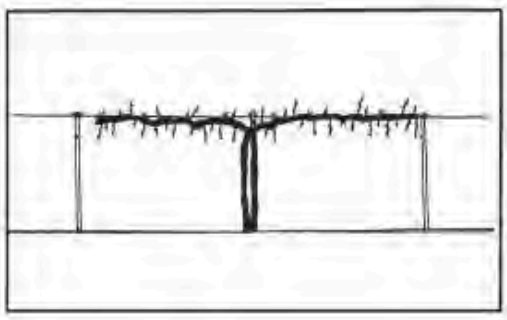

Figure 1. Single curtain pruning systems for muscadine grapes.

Prune in the months between November and February. If pruned after December, the vines will bleed water profusely. This is common and not a problem. On mature vines, spurs are selected along the horizontal trunk or cordon every 6 inches. The spurs should be pruned to 2 or 3 buds on 3- and 4-year-old vines and lengthened to 4 or 5 buds as the vine matures and vigor increases. Remove shoots not needed for spurs or fruiting arms. Remove vigorous shoots as they develop at the bend near the top of the posts. The single curtain pruning system is illustrated in Figure 1.

Fertilization

Muscadines respond well to applications of balanced N-P-K fertilizers such as 4-1-2 or 3-1-2. Unless specific deficiency symptoms are found, no other fertilizer mineral is necessary in Texas.

Apply approximately one pound of fertilizer per year of vine age up to a maximum of four pounds. Applications in year one and year two are best applied in small 1/4 pound increments every two weeks in April, May, and June. A single application in February or March is usually adequate on mature vines. Keep fertilizer at least 18 inches from the trunk of vines. Avoid applying fertilizer in sod middles.

Weed Control

Muscadine roots are very shallow and should not be mechanically cultivated. Disking or other forms of tillage damages roots and reduces vine vigor.

Weeds in first year vines should be controlled by hoeing out about a 3-foot circle around each vine. Kill weeds with ROUNDUP or RELY after the second year. Protect the trunks with growth tubes, aluminum foil, or paper.

Control weed growth in row middles with mowing. This will avoid danger of root pruning from disking and will help keep soil erosion in check.

Water Requirements

Muscadines are commonly grown in East Texas without irrigation, but low summer rainfall often limits fruit size and production of dryland vines. Irrigation is essential for establishment of vines in years one, two, and three.

Irrigation requirements will vary depending upon the soil, vine vigor, and weather conditions. General guidelines that can be used as a basis for applying water with a drip irrigation system are given below.

	Water Applied to Each Vine (Gallons Per Week)	
	April-June	**July-Sept.**
Year 1	7	14
Year 2	14	28
Year 3	28	56

Adjust irrigation rates as necessary to compensate for extremes in soil drainage or weather. Reduce irrigation in September or after harvest in order to harden the vines for winter. Serious freeze injury can result if irrigation and fertilization are continued too late into the fall.

Harvesting

Muscadine varieties ripen from early August through September. Mature fruit are easily dislodged from the vine. Ripe berries can be harvested rapidly by placing a canvas or catching frame under the vine and shaking the vine or wire very hard. Vines should be harvested every two to five days.

Varieties with a wet stem-end scar, such as Regale, will not store well and should be processed soon after harvest. Varieties with a dry stem scar, such as Summit and Doreen, will keep well for at least a week if refrigerated at 35 degrees to 45 degrees F.

Marketing and Processing

Market outlets for muscadines in Texas are limited. Pick-your-own and direct consumer sales are possible. There are some limited sales to commercial wineries. Commercial marketing through grocery store chains and similar outlets for fresh produce has not been developed. Large muscadine plantings are not advisable unless larger outlets can be developed.

HOME FRUIT PRODUCTION-MISCELLANEOUS CITRUS

Julian W. Sauls, Ph. D.
Professor & Extension Horticulturist
Texas Cooperative Extension

December, 1998

There are a number of citrus fruits which do not fit into the usual categories, so they are described here. Some are edible, some are strictly ornamental and some are grown for both purposes. These citrus fruits can be readily grown in the Valley and some have sufficient cold hardiness to be grown throughout south and southeast Texas. All require full sun for optimal growth and all require deep, well-drained soils. All will ultimately require some means of cold protection to avoid damage. Generally, these citrus should be planted and grown just like other citrus in terms of cultural practices and pest control.

Pummelo

Pummelo, which produces the largest fruit of all citrus, is also known as shaddock after the name of a ship's captain who is believed to have introduced its seeds to the West Indies near the start of the eighteenth century. Its similarity to grapefruit leaves little doubt that pummelo was the progenitor of grapefruit. Pummelos are characterized by very large, thick-skinned fruits having coarse flesh with a distinctively musky aroma and flavor. Both pink fleshed and white fleshed types exist, varying from mildly sweet to very acid.

Unlike other citrus, the juice sacs do not rupture easily and they readily separate from the segment membrane. The juice sacs can thus be consumed separately, with or without sugar, or as a salad base.

'Chandler' is a pink-fleshed variety developed by the University of California. It is sweet, with seediness depending upon proximity to pollinizers. 'Reinking' is a white-fleshed, seedy pummelo developed by the U.S.D.A. Both mature in November, with fruit holding well until February. Numerous other varieties exist, especially in the Orient where pummelos are quite popular.

Pummelo is a little less cold hardy than grapefruit. While marcot (air layer) is a common means of propagation in Asian countries, trees in Texas are commonly budded onto sour orange seedling rootstocks. Cultural practices are the same as for grapefruit.

Kumquat

Kumquats are native to China and are the most cold hardy of all edible citrus. The tree is usually small and shrubby, mostly thornless and adapts well to container culture. Fruit are small and showy, bright yellow to orange in color, few-seeded and not very juicy. The peel is fleshy, thick, aromatic, spicy and edible. The fruit matures in late November and can be eaten whole; it is also candied and used for marmalade.

Kumquat trees become semidormant from fall into spring, with growth occurring only at relatively warm temperatures. Consequently, kumquats bloom much later than other citrus.

Fruit of 'Nagami' is oval to oblong and acid, although its rind is sweet. Fruit of 'Meiwa' is round, with sweet rind and flesh. Fruit of 'Marumi' is round, but smaller than that of 'Meiwa', and acid.

Kumquats have been hybridized with limes to produce limequats and citranges to produce citrangequats--the former being described in Home Fruit Production-Limes, the later being described later in this manuscript.

While kumquats can be grown from seed, seedlings are considered weak and inferior. Both marcots and rooting cuttings can be used, but kumquats are often budded onto 'Cleopatra' mandarin, calamondin or trifoliate orange seedlings. Cultural requirements are the same as for other citrus.

Citron

Citron probably originated in northeastern India and is undoubtedly the first citrus fruit known in Europe inasmuch as it has been cultivated in the Mediterranean basin for over three millennia. The fruit is large, usually oblong with a pronounced nipple, with yellow, very thick, fleshy peel. The fruit is essentially inedible, as there is little flesh or juice. The peel is brined and candied for use in fruit cakes and other confections. The peel oils are intensely aromatic and pleasantly so--the odor of a single fruit can permeate an entire house for days. The fruit has long been an important part of some religious functions.

The tree is straggly, thorny and small. Citron is the most cold sensitive of all citrus, more so even than lemons and limes. 'Etrog' and 'Diamante' are acid forms, 'Corsican' is sweet. 'Buddha's hand' is unique among fruits in that the fruit is split from the blossom end into numerous, finger-like projections.

Cultural requirements of citrons are the same as for lemons or limes. Propagation is by seed, cuttings and budding.

Calamondin

Calamondin is primarily grown as a house plant and is often called 'miniature orange". It originated in China and its fruit closely resemble mandarins, although they are fairly small and quite acid, with few seeds. The juice is sometimes used as a lemon or lime substitute. The plant is bushy, normally dwarfed and nearly thornless.

Calamondin bears year round, which increases its appeal as an ornamental. The tree is more cold hardy than oranges. A variegated form exists, having green and white to yellow leaves.

Propagation is from seed and cuttings rooted under mist. It is commonly used as a rootstock for kumquats, but its greatest use is for ornament. Cultural requirements are the same as for other citrus.

Citrangequat

Citrangequats are trigeneric hybrids involving kumquat and citrange, the latter of which is a hybrid of trifoliate and sweet orange. One objective of the breeding program of U.S.D.A. in the early twentieth century was to combine the cold hardiness of kumquat and trifoliate orange with the quality of sweet orange. Only three citrangequats were ever named; they do have good cold hardiness, though eating quality is very poor to nonexistent.

'Sinton' is the result of a 'Nagami' kumquat X 'Rusk' citrange cross that has small, obovate fruit of good reddish color, acid flavor and few seeds. The tree is upright, nearly thornless, with mainly unifoliolate leaves. It was named in 1923 for Sinton, TX, where it first fruited. As an ornamental, it is hardy and attractive.

'Telfair' resulted from a cross between 'Nagami' kumquat and 'Willits' citrange and was named for Telfair County, GA. Its fruit and tree are similar to 'Sinton' except that it is thorny and has mainly trifoliolate leaves.

'Thomasville' is a sibling of 'Telfair' that first fruited in Thomasville, GA. Its fruit are a little larger than the other two citrangequats; it is somewhat seedy. The tree is similar to 'Telfair'. 'Thomasville' is considered edible at full maturity, but "edibility" is relative, as few people can be convinced to taste it a second time.

All in all, the citrangequats are very ornamental and cold hardy and should succeed wherever kumquat or trifoliate orange can be grown. Propagation is primarily by budding. Cultural requirements are the same as for other citrus.

Trifoliate Orange

Trifoliate orange is the most cold hardy of all citrus. It is deciduous, unlike other citrus, and very thorny. The author saw mature trifoliate hedges growing in Fort Worth, TX, in the early 1970's. Its fruit are completely inedible, containing an acrid oil that is very unpleasant to the taste. It matures in late summer.

There are small-flowered and large-flowered types, with the former said to impart greater cold resistance while the latter is believed to be more dwarfing. There are literally dozens of trifoliates but only a few have been named in the United States. 'Rubidoux' is a California selection of the small-flowered group that has been used in California. 'Flying Dragon' is a dwarfed ornamental type from Japan that has large, downward curving spines (thorns) and very small, linear leaves. Both are widely used as rootstocks for mandarins in Southeast Texas, as are other, local, selections from seemingly feral trifoliate trees.

Propagation is from seed. Cultural requirements are about the same as for other citrus.

Sour Orange

The sour oranges were among the first citrus to be introduced to the Americas, where they became feral in areas of warm, humid tropical and subtropical climates. The sour oranges are principally used for marmalade, with specialty use in liqueurs and perfumes. In Texas, sour orange is the rootstock on which more than 99 percent of the industry is planted.

The tree is vigorous, usually armed with long spines (thorns) and hardier than sweet orange. The fruit is large, commonly rough skinned and yellow, with white, very acid flesh and juice. The fruit are very seedy.

'Chinotto' is a myrtle-leaf orange closely related to the sour oranges that makes a very attractive ornamental. The tree is densely foliated, compact and nearly thornless with the same cold hardiness as sour orange. The fruit resembles a small orange with yellowish peel. It is acidic in flavor and seedy; the fruit stores very well on-tree and is used in preserves.

Sour oranges are primarily grown from seed, though 'Chinotto' may be budded onto sour orange seedlings. Culture is the same as that for other citrus.

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HOME FRUIT PRODUCTION-GUAVA

Julian W. Sauls
Professor & Extension Horticulturist
December, 1998

Guava is a small tree with a spreading, broad top that develops from a short trunk. It is native to the American tropics but has become naturalized in practically all tropical and subtropical climates of the world. Despite severe freezes of the 1980's, guavas continue to thrive in yards across the Lower Rio Grande Valley. While it has little commercial potential, a small planting is being tried in Cameron County it can be successfully grown, with adequate cold protection, in other areas of South Texas.

CLIMATE

Because it is of tropical origin, guava grows best in tropical and subtropical areas that are frost-free. While young trees can be killed by temperatures in the middle to upper 20's, older trees can tolerate slightly colder temperatures without much damage. Even if killed to the ground by freezing weather, the tree will usually regrow from underground portions.

Although of primary interest in the Valley, guava should grow nearly everywhere in Texas that oranges or grapefruit thrive, provided that the trees receive adequate cold protection for their size.

SOIL AND SITE SELECTION

Guava is adapted to a wide variety of soils and should thrive in any soil that has good internal and surface drainage. Soil salinity is not a major concern, although the leaves will commonly exhibit tipburn and perhaps marginal necrosis during the summer months because of salt accumulation in the affected tissue.

The planting site should be chosen with cold protection in mind. Generally, the south side of the house is the warmest location in a residential site.

VARIETIES

Probably all of the guavas grown locally are unnamed seedlings, although there are superior varieties being grown in Florida . 'Supreme' is white-fleshed, 'Blitch' and 'Patillo' are pink-fleshed and 'Ruby' is red-fleshed. Other varieties and unnamed hybrids also exist and most are probably superior to the local seedlings. Yellow-fleshed types also exist.

Guava fruit shape ranges from round or ovoid to pear-shaped. Size varies from little more than an ounce to nearly a pound. The skin is usually pale yellow at maturity and may range from thin to thick. Seediness varies from few to many. Flavor may be sweet to highly acid, with a very distinctive aroma which ranges from strong and penetrating to mild and pleasant. While some fruit may be borne almost year-round, especially following very warm winters, most fruit matures in the summer.

PROPAGATION

Although guava does not reproduce true-to-type from seed, seedlings are commonly used. Seeds should be planted immediately upon extraction from mature fruit.

Air layering is probably the easiest way to propagate a limited number of plants. Both veneer grafting and chip budding are successful, given young, vigorous, seedling rootstocks and scion wood that comes from terminal growth which is still green and quadrangular (in cross-section). Leafy cuttings will root well under mist propagation.

PLANTING AND ESTABLISHMENT

Guava trees may not achieve maximum potential size in Texas, so a spacing of 10 to 12 feet from adjacent trees should be adequate. Newly planted guavas should be watered at planting and once or twice weekly as needed for several weeks. Watering is most easily accomplished by constructing a water ring several inches high and thick atop the soil around the tree. The water ring will gradually erode away over the next several months, at which time the tree can be considered established.

Delay fertilization until new growth commences, then apply monthly into September. Simply scatter the fertilizer on the ground and water thoroughly. With ammonium sulfate (21-0-0), use one-half cup monthly in the first year, one cup monthly in the second year and two cups monthly in the third year. For other fertilizer analyses, adjust the rate accordingly based upon the relative content of nitrogen.

The soil underneath and around the young tree should be maintained completely free of all weeds and grasses, since the young tree cannot compete well for water and nutrients until it is much larger. Organic mulches are excellent for use under guava trees to eliminate weeds and to conserve moisture.

Cold protection is essential for survival of young guava trees. Soil banks are excellent for freeze protection for several years--put them up in late November and remove them in early March. Protection of the top can be achieved using covers such as blankets or tarps--just drape the cover over the tree, pull the corners outward and anchor them to the ground. It is neither necessary nor desirable that the cover reach the ground. In very severe cold, any additional, practical heat source under the tented tree will provide almost complete freeze protection.

MATURE TREE CARE

Cultural practices are conducted to maintain good growth and production. Irrigation, nutrition, weed/grass control and cold protection are the major cultural practices. Essentially, these practices are the same as for other established fruit trees.

Irrigate slowly and deeply as needed based on soil type and prevailing weather. Weekly to biweekly soakings during the summer should be adequate.

Fertilization should be at the rate of one to two cups of 21-0-0 per inch of trunk diameter annually, split into equal applications in February, May and August. Simply scatter the fertilizer on the ground and water thoroughly. Other nutrient elements are rarely necessary under Texas conditions.

Maintain weed and grass control with a systemic herbicide or with organic mulches that should be replenished as necessary. Cold protection may also be necessary as described above.

Pruning should be unnecessary except to remove dead or damaged branches or to thin out branches that overlap with others. Pruning of freeze damage should be delayed until the extent of the damage can be ascertained in the spring following the damage.

PRODUCTION, MATURITY AND USE

Vegetatively propagated trees will bear within three years, seedlings shouldn't take any longer. Larger fruit are primarily produced on vigorous shoots of two to three years of age. The primary season of maturity is summer, although some fruit may mature at other times of the year. Since fruit maturity is variable during the summer, mature fruit will be available every couple of days. Maturity is characterized by a change of the skin color from greenish to yellow and a concomitant softening of the fruit.

Vigorously growing young guava trees can produce half a bushel of fruit in the third season, increasing to several bushels on mature trees.

Guava is an outstanding source of Vitamin C, which probably exceeds that of orange juice. Fruit can be readily frozen and it is well suited to processing. The sweeter selections are more commonly eaten fresh, while the stronger flavored selections are more commonly used in jam, jelly, paste and other products.

PROBLEMS

While a number of pests affect guavas in Florida, none have been documented in the Valley. Root-knot nematodes can cause serious damage to the roots of young guava trees, but their effect can be lessened by good cultural care and heavy organic mulching.

Tip burn and marginal necrosis (browning) of the leaves are caused by saline soil and water conditions common in South Texas, even though guava trees are generally considered to be salt tolerant. Symptoms are more severe on older leaves and during the summer months.

The Mexican fruit fly could infest the fruit, but the overall suppression program in the Valley should help to keep this pest to a minimum.

OTHER GUAVAS

In addition to the common guava (Psidium guajava L.) there are other species which produce edible fruit, the most notable of which is the Cattley or strawberry guava (Psidium cattleianum Sabine). The plant is more of a large, bushy shrub and it is slightly more cold hardy than common guava. The fruit of Cattley guava is round, rarely longer than 1.5 inches, with a red to reddish purple color and contains numerous small, hard seeds. The yellow Cattley guava is considered to be slightly sweeter than the red types. Both kinds have whitish, juicy pulp that is mildly sub-acid and slightly aromatic.

There are no apparent varieties of either of the Cattley guavas, but selections of either type come fairly true from seed. Production usually commences in the second or third year, with heavy fruiting occurring in five or six years. Aside from the differences noted here, Cattley or strawberry guava should be treated the same as common guava.

Other species include the Brazilian guava, (Psidium guineense Sw.) the Costa Rican guava [Psidium friedrichsthalianum (Beng.) Nied.] and Psidium araca Raddi, but they have not achieved any prominence outside their place of origin except in arboretums and private collections.

It should be noted that the feijoa or pineapple guava (Feijoa sellowiana Berg) is not a guava at all, despite the similarity of its fruit to those of the various species of guavas.

Texas Citrus and Subtropical Fruits is maintained by Julian W. Sauls.
Web design by Gretchen Chaffin.

Fruit & Nut Resources

Citrus

Julian W. Sauls
Extension Horticulturist

Commercial citrus production in Texas is mostly limited to the Lower Rio Grande Valley. Small plantings that formerly existed near Beaumont, Orange, Houston, Beeville, Falfurrias and Carrizo Springs have mostly disappeared because of economics and recurring freezes. Nonetheless, many Texas residents want citrus trees in the home landscape to enjoy their dark, evergreen foliage, fragrant blossoms and colorful, delicious fruit.

Climate

Citrus trees growing outside the Valley are at a distinct disadvantage with regard to climate, i.e., winter almost always will be accompanied by one or more freezes. Citrus trees are subtropical to tropical in nature; thus, they may suffer severe damage or even death because of freezing temperatures. However, several types of citrus have sufficient cold-hardiness to sustain some freezing conditions, particularly as mature trees. The resident of coastal and southern Texas who is willing to put forth the effort to provide cold protection for young trees, and sometimes even mature trees, can successfully produce citrus fruits.

Soil Requirements

All citrus trees require deep soil having both good surface and internal drainage. Surface drainage refers to runoff to prevent water standing around the tree. Internal drainage is the ability for water to percolate downward through the soil to preclude saturation of the root zone.

The presence of vigorous, healthy landscape trees is a good indication that the soil is sufficiently deep and well-drained for citrus trees. Should uncertainty about internal drainage exist, dig a posthole 3 to 4 feet deep and fill it with water. All water should drain from the hole within 24 to 36 hours. Soils requiring more than 48 hours to drain completely should be avoided unless raised planting beds are used.

Most citrus grows well in a soil pH range from 6 to 8. Avoid soils that have a high caliche content or are excessively salty, as citrus trees will not grow well in such soils.

Site Selection

Most residential lots do not offer much choice in terms of planting sites for citrus trees. Nonetheless, several factors require consideration.

Avoid planting near septic tank lines to preclude future problems with tree roots clogging the lines. In cold-sensitive areas, plant citrus trees on the south and southeast sides of the house to provide some protection from northwesterly cold fronts. The house will lose considerable heat, providing some additional protection to trees planted nearby.

Planting under large, overhanging trees offers some cold protection, but growth and production of citrus under other trees is not entirely satisfactory. Citrus requires full sunlight for optimum growth and production. Plant most citrus trees 6 to 8 feet from buildings, driveways, walkways and fences, and twice that far from each other, to preclude later problems with pruning and tree size control. The natural form of citrus is for the ends of the lower branches to almost touch the ground when fruit is present, so allow for this natural growth at planting.

Varieties

Characteristics of the most common citrus varieties are shown in Table 1. Not all of these are readily available in nurseries, but they are varieties which have been grown in Texas prior to the 1983 freeze. Consequently, a renewed demand for some of these citrus varieties should stimulate nursery interest in propagating them.

Seedling citrus trees are those grown from seed. Some productive seedlings do exist in Texas, but very few have the quality of named varieties. Although the seed of some types of citrus come true-to-type, seedlings which do not usually are thorny, slow to come into production and frequently produce seedy fruit. Seedling trees are more cold-hardy than budded trees, an advantage they lose upon being budded, but most seedlings are more susceptible to foot rot.

Many current citrus varieties originated as chance seedlings or bud sports of other citrus. To achieve varietal significance, the attributes of such a tree must equal or exceed those of existing varieties.

Citrus Rootstocks

Most citrus types and varieties do not perform well on their own root system so they are commonly budded onto rootstocks which are better adapted to certain soil conditions. Most citrus trees are of a desirable scion variety T-budded onto a seedling rootstock several inches above the soil line. The rootstock of a budded tree includes all roots and the lower few inches of the trunk, whereas the scion is the trunk and all branches, leaves and fruit.

Sour orange, the most common rootstock in Texas, is well-adapted to most soil conditions in which citrus is grown. Trifoliate orange is more cold-hardy than sour orange and produces a smaller tree, but it is not well adapted to saline or highly alkaline soils. Consequently, trifoliate orange is preferred for the upper Gulf Coast and colder areas where soil conditions are suitable, but sour orange is recommended for the lower coast and most of southern Texas.

Selection and Planting

Most citrus nursery stock available at retail is containerized, either having been grown entirely in containers or field-grown and transplanted to containers prior to sale. Normally, the bud union will be readily discernible as a cut area at a dogleg bend in the trunk. The cut area is where the top of the rootstock was cut off to allow the budded top to grow erect. This area should be healing over with bark at the time of purchase. The crook in the trunk will disappear within a couple of years, but the bud union will remain discernible for years as a distinct line of contrast between bark textures of the stock and scion. Container trees are available year-round and can be planted anytime. Best results come from planting during fall to late winter as the tree can become better established before the onset of hot, dry weather of late spring and summer.

Most container citrus trees are grown in a soilless medium that usually contains a fair proportion of peat moss. The roots of such trees tend to remain within the growing medium long after planting; thereby, resulting in poor establishment and growth. To avoid this problem, wash off an inch or more of the growing medium all around the root ball, including the top, immediately before setting the tree in the ground. Thus, the peripheral roots will be placed into intimate contact with the soil in which they must survive and grow, resulting in better tree establishment.

Figure 1. Dig the planting hole 1 inch less than the root ball depth.

Planting depth is critical to the survival of citrus trees. The rootstock is somewhat resistant to foot rot disease, but the top is quite susceptible. If the bud union is too low with respect to surrounding ground, the tree could contract foot rot and die. The practice of scooping out grass and soil to form a large depression for ease of watering almost guarantees the death of a citrus tree.

Remove lawn grass in a circle 3 to 5 feet in diameter, centered on the planting hole. Dig the planting hole half again wider than the root ball. In a bare ground situation, dig the hole exactly the same depth as the root ball, but in lawn grass, dig it 1 inch less than the root ball depth. The best way to determine proper depth is to lay a shovel handle or similar object across the hole, with both ends laying on undisturbed ground or the lawn grass.

Figure 2. Build a watering ring
slightly wider than the planting hole.

Mixing topsoil, compost, peat or other materials with the backfill soil is unnecessary in good citrus soils. Set the tree in the hole, backfill about halfway, then water sufficiently to wet the backfill and settle it around the roots. Finish filling the hole and tamp the soil lightly into place. Cover the root ball with 1/2 to 1 inch of soil to seal the growing medium from direct contact with the air and prevent rapid drying of the root ball.

Build a watering ring atop the ground around the tree, about 5 to 6 inches high and 6 to 8 inches thick. The ring should be slightly wider than the planting hole. If adequate soil isn't left over from planting, borrow some from the garden. Fill the water basin with water. When the water soaks in, it may be necessary to add a little soil to the holes made as the soil settled around the root system.

Young Tree Care

Water

Newly-planted citrus trees require thorough watering two to three times the first week and one to two times per week for the next few weeks, depending upon soil type, rainfall and time of year. Then, apply water when the soil begins to get dry an inch or so down. Simply fill the water ring each time. The watering ring should erode away over time (4 to 6 months), at which time the tree can be considered established and watered as needed by soaker hose or sprinkler system.

Nutrition

Do not apply fertilizer until the tree begins new growth after planting. Fertilize monthly through October. Scatter fertilizer on the ground at least a foot from the tree trunk and promptly water it in thoroughly.

Nitrogen is usually the only fertilizer element required in most Texas soils, but additional elements should not do any harm. Consult your local county Extension agent. Available fertilizers may vary in terms of the percentage of nitrogen, but the following is a general rule regarding the quantity to apply:

	Amount of fertilizer/tree, applied monthly, February-October	
	Nitrogen content	
	8-13 percent	**17-21 percent**
First year	1 cup	1/2 cup
Second year	2 cups	1 cup
Third year	4 cups	2 cups

Weed Control

Good weed control is essential for rapid establishment and vigorous growth of young citrus trees. Eliminate all existing lawn grass and weeds for several feet around the tree. As the spread of the tree increases, widen the grass-free area beyond the tree canopy or drip-line.

Weed control can be accomplished by mechanical means such as hoeing. Organic mulches are not recommended for citrus trees because of the potential for inducing foot rot disease. If mulches are used, keep at least 12 inches of bare ground between the tree trunk and the mulch. Herbicides such as Roundup(TM) and Kleenup(TM) are excellent for control of existing weeds and pre-emergent herbicides may be used to prevent weed seeds from germinating.

Pruning/Training

Citrus trees are sold already properly shaped and pruned to develop naturally, so pruning and training of a citrus tree is not necessary. The only exception is that shoots from below the head (scaffold limbs), whether on the rootstock or the scion, should be removed as soon as they are noted.

Cold Protection

Figure 3. A soil bank around a young citrus tree for cold protection.

Several kinds of wraps are used on the trunk of young citrus in the belief that they will provide significant cold protection. With one exception, none provide more than a few degrees of protection to a young tree trunk. The wraps do prevent rodent damage and sprouts on the trunk, but they also may harbor insects, particularly ants, which can cause problems. The best cold protection possible for young citrus is a soil bank, which can be used for the first two to four winters.

Soil banks are put up around Thanksgiving and taken down about the first of March. A soil bank is a mound of soil piled as high as feasible around the trunk and lower scaffold limbs. Thus, the trunk and lower scaffolds will be protected from even the worst freeze, although the unprotected top may be killed completely. The tree will regrow from the trunk and scaffolds without going back to the rootstock.

Before banking, treat the bark to be covered with a suitable insecticide and a copper-based fungicide to preclude problems while the bank is up. Exercise extreme care in removing the banks to prevent damaging the bark, as it will be quite tender from spending the winter underground. Use the garden hose to wash off the last of the soil. If there is not enough soil from around the tree to build a good bank, borrow from the garden or use potting soil. The extra soil should be taken away upon bank removal.

Other cold protection means are discussed in the following section on care of established citrus trees.

Care of Established Citrus Trees

Cultural practices for established citrus trees are designed to maintain good growth and vigor to maximize the production of quality fruit. The common components of all cultural programs are irrigation, fertilization and weed and grass control. Pruning is rarely necessary. Pest control may be necessary to produce bright, clean fruit, and occasionally to maintain tree health and vigor.

Water

Irrigation in the home landscape, probably the most expensive and time-consuming production practice, is poorly understood. Water commonly is applied too frequently and in inadequate amounts, resulting in inefficiency, waste and less than optimum growth and production.

Most soils in southern Texas hold between 3 and 7 inches of water in the upper 3 feet of depth, with sandy soils at the low level and heavier clay soils at the upper level. This is the reservoir of soil moisture available to plants.

The soil moisture reservoir is depleted by plant use and evaporation from the soil surface, both of which are dependent on season and prevailing weather. Most plants do not use much water in the cooler months because weather conditions are not too favorable for their growth and do not favor evaporation. Irrigation with too little water does not completely replenish the soil reservoir, but excess water percolates down through the soil and is lost. Because it is not practical to replace soil moisture at the same time and rate as it is being used, watering is scheduled periodically to refill the soil reservoir.

A good irrigation schedule for established trees is simple to develop. You need a couple of pet food or tuna fish cans about 2 inches tall. Set them up somewhere in the middle of the yard so they will be exposed to wind, rain, sun, etc., and cover with wire mesh to prevent birds from drinking from them. Fill with water immediately after a thorough irrigation or good soaking rain.

Assume the cans will hold 2 inches of water. From mid-April through mid-September, irrigate with 1 1/2 inches of water when the cans are completely dry, then refill the cans and wait for the water to evaporate again. The rest of the year, irrigate with 1 inch of water when the cans are dry. The difference is that growth in the cooler months uses only about half as much water as evaporates, while growth in the warmer months uses about three-fourths as much water as evaporates.

Sandy soils usually can absorb water as fast as you can apply it, but water penetrates very slowly in clay soils. Adjust the application rate to prevent water runoff.

Nutrition

The soil must provide 13 nutrient elements essential to all plant growth. Southern Texas soils generally are quite fertile and contain more than adequate quantities of all essential elements except nitrogen. The other elements rarely need to be applied to mature, established citrus. However, the exceptions are important.

Clay soils usually contain plenty of iron, but citrus trees may exhibit iron deficiency in the early spring. Usually, the deficiency clears up as the soil warms up. If it does not, soil application of iron chelates is necessary. Where iron deficiency does occur, do not use fertilizers which contain phosphorous because high phosphorous aggravates iron and zinc deficiency in high pH (alkaline) soils. Red, sandy soils may need supplemental potassium and sandy soils in general may need additional zinc.

Mature, bearing citrus trees should receive enough nitrogen to provide for good but not excessive growth. If the percentage of nitrogen in the fertilizer is less than 15 percent, apply about 1 pound per inch of trunk diameter per year. If the percentage is above 20, use 0.75 pound or less per inch of trunk diameter per year. One pound of dry fertilizer is approximately 2 cups.

The fertilizer may be applied at one time for the year, usually in February, or it may be split into two or three applications. Two applications are recommended, with two-thirds of the fertilizer applied in February and the balance in May. However, equal applications in February, May and September are effective, also.

The most expedient application is to spread the fertilizer uniformly on the soil surface under the tree canopy and slightly beyond and water it in thoroughly. It is not necessary to drill holes in the soil for fertilizer as a thorough watering will carry surface-applied fertilizer throughout the soil profile.

Weed and Grass Control

Control weeds and grass beneath citrus trees to reduce competition for fertilizer and water. Also, weeds and grass may harbor pests which can affect the fruit or trees. It is easier to control weeds or grass than to mow under citrus trees and perhaps cause bark or fruit damage from lawnmowers.

Mulches are commonly used to conserve moisture and control weeds and grass. Because of the incidence of foot rot disease in citrus, organic mulches are not recommended. If used, keep mulches at least a foot away from the tree trunk.

Pruning

Citrus trees are pruned primarily to control tree size and to remove dead, diseased or damaged wood. Citrus trees should be allowed to grow naturally without pruning.

See the section on freeze rehabilitation for proper pruning of freeze-damaged citrus trees.

Pest Control
Citrus pests in Texas include insects, mites and diseases which may affect the health and vigor of the trees or the appearance of the fruit. Few pests actually kill citrus trees, but those that do are noteworthy because prevention is the only control.

Tristeza is a virus disease that kills citrus trees quickly, particularly those growing on sour orange rootstock. Tristeza is present in Louisiana, Florida and other areas, but not in Texas. For that reason, it is illegal to import citrus trees, budwood or other tree parts from other states or countries.

Foot rot is a fungal disease present in many Texas soils. Both sour orange and trifoliate orange rootstocks have some resistance to the disease, so it is not a problem unless the tree is planted too low and the bud union is exposed to soil or standing water.

Monitor and control outbreaks of pests or diseases which affect tree vigor, as reduced vigor results in reduced production. Aphids, mites, scales and whiteflies are good examples. Mites, particularly the citrus rust mite, can badly blemish the rind. However, rind appearance does not adversely affect eating quality of the fruit.

Where pest control is necessary or desirable, contact your county Extension agent for confirmation and recommendations. In using any pesticide, read fully and follow completely all label directions.

Cold Protection

Citrus trees anywhere in Texas ultimately will be threatened by a severe freeze. Consequently, cold protection practices must be implemented to minimize the damage. The duration of freezing temperatures can be more critical than the minimum temperature, i.e., a brief drop to 24 degrees F may not cause as much damage as several hours at 26 degrees F. Moreover, exposure to cold weather increases the ability of citrus trees to withstand cold, as short days and cool weather condition the tree to stop growing and acquire greater cold-hardiness. For example, satsuma may withstand 18 degrees F in early February when it is completely dormant and most cold-hardy, but may be seriously damaged at 24 degrees F in early December.

Citrus trees in colder areas of southern Texas usually will attain greater cold-hardiness than those in the Valley. However, residents of freeze-prone areas should grow only cold-hardy types of citrus such as kumquats, satsuma mandarin, tangerines, calamondin and some tangelos.

The soil under and around the citrus tree should be bare and firm insofar as possible in a landscape setting. Remove mulches before winter. Thoroughly irrigate the citrus tree and surrounding areas several days before a hard freeze is anticipated. Bare ground can absorb more heat from the sun than can soil covered by weeds, grass or mulch. Moist soil can absorb more heat and conduct heat better than dry soil. Consequently, pre-freeze irrigated bare ground can absorb, store, conduct and release more heat to the tree during a freeze.

The tops of citrus trees may be draped with blankets, quilts or plastic for further protection. It is not necessary to encase the tree completely. Put such coverings on and anchor them securely the afternoon before the freeze. Remove plastic coverings during sunny days to prevent cooking the trees. Permeable covers can be left in place until freeze danger has ended.

Additional heat can be provided and is very effective in combination with covers, particularly if the cover does not completely encase the tree. Incandescent lights (such as trouble-shooter lights) in the tree or small electric heaters under the tree generate considerable heat. Exercise extreme caution with electrical equipment outdoors, as many freezes begin with strong winds and often include precipitation.

A gas lantern or camp stove will burn for 10 to 12 hours on a tank of fuel, but will require pumping up once during the night. The propane types do not require pumping. These can be placed on the ground beneath the tree. A portable gas grill works fine on low heat if there is room to place it under the tree, but leave the lid closed.

A water sprinkler placed over the tree (without the other methods) can prevent freezing by covering the tree with ice. But, the sprinkler must be started before the temperature drops to the critical level – 28 degrees F on calm nights, 30 degrees F on windy nights – and must run continuously until the temperature is sufficiently above freezing that ice in the shade begins to melt. However, the ice load can cause significant limb breakage and a freeze lasting several days can result in excessive waterlogging of the soil.

Freeze Rehabilitation

Despite your best efforts, freeze damage does occur to citrus trees. The immediate urge is to begin cutting off the deadwood, but there is no effective way to determine the extent of deadwood immediately. While it may be unsightly in the residential landscape, delay pruning until May.

Citrus trees lose their leaves (and fruit) after a severe freeze, but they send out new growth in March. Much of this lush spring growth dies back in April because of underlying damage to the wood and bark. Consequently, delay pruning until after the dieback has occurred.

Dead bark seems to shrink tightly around the limb while live bark keeps growing outward, creating a distinct ridge between the two. The ridge will be irregular around the limb. Scrape lightly across the ridge with a knife blade to delineate the green, live bark. Cut off the limb below the lowest limit of the dead bark so that live bark completely encircles the limb stub. Treatment of cut-off limb stubs with wound dressing or pruning paint is not necessary for proper healing.

A soil-banked, young tree may be killed to the bank. After removing the bank, a new top will grow from the undamaged trunk. Such new trees are commonly multi-trunked because several shoots arise.

In the worst case, an unbanked citrus tree may be killed to the ground. However, the rootstock usually will send up new shoots which ultimately will bear fruit. Unfortunately, these are rootstock fruits, not what you had before the freeze. It is possible to propagate desirable budwood onto these root sprouts, but it is simpler to plant a new tree of the desired variety and start over properly.

Productivity and Maturity

Most budded citrus trees can produce a few fruit in the second year after planting, but usually do not produce until the third year. Thereafter, production increases annually as tree size increases. Seedling trees may not bear for several years.

There usually are four or five flushes of new growth on a citrus tree each year. Each flush is capable of producing flowers and setting fruit, but most citrus in Texas rarely produces any flowers or fruit after the spring growth flush. The exceptions are lemons and limes which can flower and set almost year-round, as do kumquats and calamondin. Offbloom (i.e., non-spring flush) fruit of oranges, tangelos, grapefruit and others are puffy, having a very thick peel, and sheepnosed in shape. Rarely is juice quality comparable to normal.

Typical citrus trees go through three distinct periods of fruit drop. First is the drop of about 70 to 80 percent of the flowers during and immediately following bloom. The second drop occurs a couple of weeks later, involving small fruit of pea-size to marble-size. The third drop occurs in late May, involving larger fruit, almost golf ball in size. Navels will drop again in mid-summer and in late summer. A few fruit on all citrus will continue to drop through final harvest, but that is normal and cannot be prevented.

Excluding the semi-everbearing citrus, most other types mature in the fall, including mandarins, tangelos, grapefruit and most oranges. The juice quality of all citrus fruits improves during the season, i.e., the longer it stays on the tree, the better it gets. Citrus fruits generally store well on the tree; some fruit drop does occur but usually is compensated by increased size of the remaining fruit. Even so, citrus fruits will ultimately begin to dry out on the tree, so they should be harvested and used during their season (as indicated in Table 1).

Growing Citrus in Containers

Citrus trees generally do not perform well as houseplants, but several kinds can be adapted to container culture. However, none will be as attractive or grow and fruit as well as trees grown under optimal conditions in the soil.

The smaller citrus types (calamondin, limes, kumquats, lemons and limequats) are best suited to container culture, but all will grow for a limited time.

Containers may be of any suitable material, but must have adequate holes at the bottom to drain excess water. Size of the container is the most limiting factor. The size should be large enough to permit maximum growth, yet small enough to be readily moved indoors during freezing weather.

Potting

Cover the drainage holes with screen mesh to prevent soil from washing out. Potting soil is suitable, but an adequate mix can be made of one part sand, one part peat moss and one part composted bark. Partially fill the container and set the plant to its

correct depth, which is the level at which it was grown previously. The final soil surface should be 1 to 4 inches below the container rim to allow for easy watering. Complete filling the container, firm the soil or media around the plant and water thoroughly. An attractive mulch of bark, gravel or other material can be added to improve the appearance of the container.

Light

Citrus grows best in full sunlight, but place container-grown citrus to receive partial shade to reduce growth and to provide better acclimation to the occasional trips indoors during winter. Avoid extremely low light for prolonged periods as the trees will become leggy and unattractive.

Avoid extremely rapid changes in light exposure to prevent excessive leaf drop. Acclimate plants that will be moved indoors for the entire winter by gradually reducing the existing light, possibly by partial shading, for 2 to 4 weeks before moving them inside. Reverse the process for moving outdoors. Such acclimation is not necessary for trees that are to be indoors for only a few days during freezes.

Freezes

The root system is more susceptible to cold damage because it is not so well insulated in containers as in the ground. Container-grown citrus will require some form of cold protection to survive most freezing temperatures. Moving them indoors during freezes may be the simplest solution.

Water

Overwatering is the most common cause of poor performance of container citrus trees. Water only as needed. Generally, allow the upper inch of the medium to become dry before watering. Then apply water slowly to fill the container, permitting the excess to drain out the bottom.

Soils generally stay wet longer in plastic, metal and ceramic containers than in wood or clay containers which permit water evaporation through the sides. Cool weather slows growth, so reduce watering frequency during winter.

Nutrition

Good nutrition is essential, but overfertilization and low light can result in leggy growth. Numerous water-soluble fertilizers are available and should be used according to label directions. Generally, a deep green color of mature foliage indicates adequate nutrition.

Salt accumulation from water and fertilizer salts can cause a white crust on the soil or container, as well as leaf burn and twig dieback. Periodically leach salts by slowly running water into the container for several minutes to carry soluble salts through the soil and out the drainage holes.

Pruning

Trees will become leggy when grown indoors in poor light for too long. To overcome this, cut back the entire top by about one-third to induce more branching and bushiness. (Note: more adequate light is still necessary.) Such heavy pruning is best done during February so that flowering and fruiting are least affected.

Twig dieback and leaf drop may occur if the top gets too large for the capability of the root system. Such plants require moderate pruning to balance the top with the roots and rejuvenate the plant.

Fruitfulness

Citrus will produce fruit when grown in containers, given time, good care, adequate size and age. Do not expect large yields as the amount of fruit produced is proportional to tree size, which will be limited by the size of the container in which it is grown.

Diagnosing Citrus Problems

Citrus normally grows and produces well without undue attention or difficulty but occasional problems do occur. Unfortunately, few problems are noted in time to apply preventive or corrective measures for that particular situation. Most problems are not serious and can be ignored completely or alleviated by minor adjustments in cultural practices. Few citrus problems warrant the use of pesticides. Contact your county Extension agent for confirmation and recommendations.

Table 2 lists many common citrus problems by category of the affected part of the tree, i.e., fruit, leaves and twigs and branches, trunk or entire tree.

Aggie Horticulture®

HOME FRUIT PRODUCTION-PINEAPPLE

Julian W. Sauls
Professor & Extension Horticulturist
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Pineapple is probably native to Brazil but was present throughout the American tropics when Columbus encountered the fruit on the island of Guadeloupe in 1493 on his second voyage. Called "anana" by the natives who grew it, "Pina de Indes" by Spanish explorers and King Pine by European elite who could afford it, the pineapple is today one of the best-known of all tropical fruits.

At the turn of the last century, Florida was the leading producer of pineapples until the industry was decimated by a presumed disease, which later was found to be mealybugs, at which time Hawaii became the leading producer.

Unlike many fruit plants, pineapple is very well adapted to container culture--and the fresh pineapples in the local supermarket have everything you need to get started.

CLIMATE AND SOILS

Pineapple grows best under uniformly warm temperatures year-round. While plants might survive 28 degrees, significant leaf damage would severely weaken the plant. Because of the likelihood of winter cold, pineapple would not be recommended for outdoor planting in Texas except in the Lower Rio Grande Valley.

SOIL AND SITE SELECTION

Pineapple plants absolutely require soils with good internal drainage. Because they grow and fruit best in soils which are mildly acidic, pineapples can be problematic in the moderately alkaline soils in the Valley.

Given the small size of the plant, its sensitively to frost and its preference for well-drained, acidic soils, pineapples can be grown in 4- or 5-gallon planters or containers anywhere in Texas--moving the plants indoors next to a sunny window during the colder winter months.

Any good potting medium should be adequate for pineapple culture, as should any container having drainage holes at the bottom.

VARIETIES

Smooth Cayenne is a major processing variety that is also found fresh in Texas supermarkets. Its lack of spines on the leaves is advantageous for a container plant that must be moved indoors during cold weather. Fruit of Smooth Cayenne will weigh 5 to 6 pounds under good culture.

Red Spanish is a major fresh market pineapple that is a little hardier than the others. Its fruit will weigh 2 to 4 pounds and its leaves are spiny.

There are varieties of pineapple with much better eating quality than Smooth Cayenne or Red Spanish. However, those with better eating quality do not ship very well, so they are not likely to be encountered in local markets. Among the better pineapples, however, are Natal Queen, weighing 2 to 3 pounds; Pernambuco (Eleuthera), weighing 2 to 4 pounds and Abakka, weighing 3 to 6 pounds. All three of these have spiny leaves. Having eaten all of these varieties at the peak of their maturity, the sweet, melting flesh of Pernambuco is a personal favorite. Sugarloaf is a name that is used for various varieties in Mexico.

PROPAGATION

There are four kinds of propagation material on pineapple plants: ratoon suckers arise below ground, suckers originate in the leaf axils, slips grow from the fruit itself or along the stalk below the fruit and crowns are the leafy tops of the fruit. All four types work, although slips and suckers are preferred in commerce. Fortunately, each pineapple fruit in the supermarket comes with a crown which can be used to start the plant which will develop slips and suckers for subsequent use.

Propagules should be cut from the mother plant and set aside for a week or two to cure. In the case of crowns, any adhering flesh should be cut away.

PLANTING AND CARE

For initial planting, one-gallon pots are more than adequate, with transfer to a larger container as the need arises. After curing, the lowest leaves should be pulled off so that the base of the propagule can be planted deeply enough that it won't topple over. Water thoroughly at planting and then lightly a couple of times a week. For best results, the plant should be in full sun and best establishment will occur during the warmer months of the year.

Once the propagule begins to put out new leaves, a complete, soluble fertilizer should be applied monthly, according to directions which come with the fertilizer. General houseplant fertilizer is sufficient. Because the propagule will require several months to develop its root system, the water and the soluble fertilizer should be poured or sprayed over the plant so that some of it will collect in the leaf axils. After about six months, however, the fertilizer solution should be poured into the soil and not over the plant as the latter can result in damage to the developing bud.

FRUITING

The time from planting to fruiting is dependent upon temperature, source and size of propagation material. For example, plantings in early spring will fruit in less time than those planted in early fall. Moreover, suckers require less time than slips which require less time than crowns. While part of this difference is because of differences in the propagation material, a major difference is in the size of the propagule, as larger propagation material generally becomes established more readily, which reduces the time to fruiting.

While precise times for fruiting in containers in Texas cannot be given, you can get an idea from the time required under conditions in Hawaii. After early spring planting, a sucker will take about 16 months, a slip about 24 months and a crown may take 28 months to flower. After flowering, the developing fruit will require another 6 months, more or less, to mature. Thus, you should expect to wait 21 to 34 months from planting to enjoy your own home-grown pineapple.

Flowering will last about two weeks, as the basal flowers on the small conelike fruit open first. At flowering, a support stake and loose ties should be installed to prevent the young fruit from being knocked over accidentally.

Fruit quality is best when the fruit is allowed to develop its yellowish orange rind color on the plant, as there is no improvement in quality after the pineapple is harvested. Obviously, those in the supermarket had to be harvested before they had achieved the best eating quality, just like tomatoes, peaches and some other produce.

FORCING

Pineapple can be "forced" to flower in order to produce fruit sooner than it would under natural conditions. If the plant is large and vigorous, the fruit produced will be about as large as if it had flowered normally; otherwise, fruit size and quality will be reduced by forcing.

If you can find calcium carbide, perhaps in a hobby store, drop three or four small pellets into a cup of ice water. When the solution stops fizzing, pour it into the center of the rosette whorl of leaves.

Naphthaleneacetic acid (about 7 mg per cup of water) poured into the rosette will also induce flowering. B-hydroxyethyl hydrazine (BOH) (5 ml per gallon) also works, as do other products that generate either acetylene or ethylene gas. The forcing treatment should be reapplied one week later.

Because pieces of apple fruit generate ethylene gas and can be used to hasten ripening of bananas, it may be possible to induce flowering of pineapple by placing pieces of an apple on the rosette and adjacent leaf axils. I do not know if this will work, so I would be interested to know of your experience if you try this method of forcing.

RATOON CROPS

If the pineapple mother plant is large and healthy, and if you leave one or two suckers on it while the fruit is developing, additional fruit will form and be ready for harvest about a year after the initial fruit. With good care, most will continue to produce additional fruit every year for several years. If the ratoon fruit is significantly smaller than the original fruit, it is probably best to start over with new suckers taken from the mother plant.

MINIATURE PINEAPPLES

If you don't have the patience to wait two to three years for a pineapple, but would like to grow a miniature pineapple fruit as a novelty, it can be done in about six to eight months. Using one-gallon containers and crowns (or other propagules), grow as previously described until good rooting has occurred, usually in about two or three months. Then force flowering as previously described. In four months, more or less, from forcing, you should have a miniature pineapple plant complete with a miniature pineapple. This fruit is edible, but only barely so, as it is of very poor quality and contains very little flesh relative to the core and rind.

PROBLEMS

Growing pineapples in containers subjects them to about the same problems that afflict other container-grown plants. For example, too little light results in poor growth, poor color, legginess and a failure to flower without repeated forcing. Overwatering is also typical, causing root damage that results in poor growth, yellowing and dying of leaves, and poor to no fruiting. Typical houseplant insect pests may be encountered, the most serious being mealybug.

Anyone experienced in growing houseplants should not encounter serious problems in growing pineapples in containers.

Texas Citrus and Subtropical Fruits is maintained by Julian W. Sauls.
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HOME FRUIT PRODUCTION-ORANGES

Julian W. Sauls, Ph.D.
Professor & Extension Horticulturist
Texas Cooperative Extension

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Sweet oranges, which are native to northeastern India, are the most widely grown species of citrus. They spread rapidly along trade routes between Asia, Europe and Africa, so little is known of their actual introduction to Europe. Columbus reportedly established a planting in Hispaniola on his second voyage in 1493. Spanish explorers introduced oranges throughout the New World, including to Florida when they founded San Augustine in 1565. While Texas is noted for its red grapefruit, orange trees are common throughout areas of the state where citrus can be grown.

CLIMATE

Oranges are grown throughout the world in tropical and subtropical areas, but they achieve the best quality under subtropical conditions. For the most part, the warm, humid conditions of south Texas produce a thin-skinned, yellowish orange fruit with yellowish orange flesh that is quite sweet and juicy. By contrast, cooler climates such as California and Arizona produce fruit having brightly colored, thick, peel and orange flesh.

Mature, healthy orange trees that are well-hardened by exposure to previous cool weather can tolerate temperatures in the middle to low 20's without leaf or twig damage, but ice will form in the fruit after 3 to 5 hours at or below 27. Severe freezes, however, do kill orange trees in south Texas, so long-term success will sooner or later require cold protection measures.

SOILS AND SITE SELECTION

Orange trees on sour orange rootstock are well-adapted to deep, well-drained soils. Loamy soils are preferred while heavy clays and poorly-drained soils will result in poor growth and production as well as shorter life.

For maximum cold protection, oranges in the home landscape should be planted on the south or southeast side of the house. Distance from the house or other buildings and driveways or walkways should be at least 12 feet to allow adequate room for the tree to grow to its mature size. While large, overhanging shade trees will provide some cold protection, orange trees grow and produce best in full sun.

VARIETIES

Sweet oranges are generally classified as round oranges, navel oranges, pigmented or blood oranges and acidless oranges. Too, they are classified as seedy or seedless (0-9 in Texas) and by season of maturity. Early season oranges mature in September or October. Mid-season oranges mature in late November to early January, and late season oranges mature in February or March.

Most of the world's orange production is the round oranges, all of which are rather difficult to peel. Navel oranges are characterized by the presence of a secondary fruit embedded in the blossom end of the fruit, creating a "navel" opening. The navel can be small and almost inconspicuous to large and protuberant. Navel oranges are fairly easy to peel and are the premier orange for eating out-of-hand.

Blood oranges contain red anthocyanin pigments in the flesh, but the pigmentation requires cool night temperatures to develop. In Texas, few of the blood oranges have more than a few flecks of pigment. The acidless oranges are insipid and of poor quality; no varieties are grown in Texas.

Round orange varieties in Texas comprise about 7,000 acres in commercial production. 'Parson Brown' originated as a chance seedling at the home of Reverend N.L. Brown near Webster, FL, in 1865. Its fruit are round, medium large, has a thick, pebbly peel and contains 10-20 seeds. It usually matures in early September in the Valley. Both peel and juice color are poor, as is juice quality.

'Hamlin' originated as a chance seedling in an orchard planted in 1879 near Deland, FL. Its fruit are round, small to medium, commercially seedless (0-6 seeds) and has a smooth, thin peel. Both peel and juice color are poor. It matures in late September in the Valley.

'Marrs' arose as a limb sport of 'Washington' navel in 1927 in Donna, TX. The tree is small by comparison to other oranges. Its fruit are medium large, round to slightly oblate, with a thin, smooth, moderately thick peel that is easily bruised during harvest. It can contain as many as nine seeds. The peel is yellowish, as is the juice, but quality is not particularly good because of low acidity, although the flavor is sweet. It matures in late September.

'Pineapple' orange originated from seedlings planted about 1860 near Citra, FL. Its fruit are medium large, somewhat flattened on both ends, with a moderately thick, smooth peel that develops good orange color under cool night conditions. Juice color and quality are very good. It usually contains 15-25 seeds. 'Pineapple' matures about Thanksgiving in the Valley. Unfortunately, the name 'Pineapple' has been used in Texas to designate seedy oranges, which includes both 'Parson Brown' and true 'Pineapple' orange. Basically, if the orange in question matures well before Thanksgiving, it isn't 'Pineapple'.

'Jaffa' was introduced to Florida in 1883 from Palestine, but it does not appear to be quite the same as the original variety. Its fruit are small to medium, commercially seedless, with a thin, smooth peel. Peel color is yellow as is juice color. The flesh is melting in texture and of very high quality, producing a thick, nectar-like juice. 'Jaffa' usually achieves maturity in the Valley about Christmas. By some accounts, 'Jaffa' in Texas may be better described as Palestine Jaffa Blood Orange, as flecks of pigment often occur in the fruit during cooler winter conditions in the Valley.

'Valencia' orange is the most widely planted orange variety in the world. It originated in either Spain or Portugal, but no one knows which. It was introduced to Florida in 1870. 'Valencia' fruit are medium large, commercially seedless, with a moderately thick peel. It is usually slightly oblong in shape. Peel color, juice color and eating or juice quality are excellent, setting the standards to which other round oranges are compared. It matures in early February and holds well on-tree into the summer. Fruit will regreen at the time of the spring growth flush.

Navel oranges supposedly originated in the Mediterranean area from which they were taken to Brazil. They were introduced by the U.S.D.A. to the United States from Brazil in 1873. A number of varieties have been tested in the Valley, but there has been little advantage of one over another. 'Washington' is a large, oblong fruit with a protuberant navel that is considered parent to most other navel oranges. 'Thompson' is similar to 'Washington', as are 'Atwood', 'Fisher', 'Summerfield', 'Texas' and a number of others which originated from 'Washington'.

The two most widely planted navel orange varieties in Texas are 'Everhard' and 'N33E'. 'Everhard' is similar to the 'Baianinha Piracicaba' of Brazil, having rather smaller fruit that are oval to round. The navel is very small and closed, commonly being inconspicuous or absent altogether. The fruit is thin skinned, of very good flavor, and it reaches maturity in late September.

'N33E' is a local selection which was discovered as a limb sport of 'Marrs' orange in the late 1960's near Edinburg, TX. While the fruit is similar to 'Washington' navel, the trees are more productive and more consistent than 'Washington'. In some years, 'N33E' suffers extensive fruit splitting in August-September, yet production still remains high.

The blood oranges are similar to round oranges in their growth and appearance, the exceptions being in internal flesh characteristics. The flavor of blood oranges is rich and sprightly. There are a few blood oranges in Texas, including both highly colored types and those with only flecked coloration in the flesh. Even the highly colored types in Texas do not develop the dark red coloration for which the blood oranges are noted. 'Moro' and 'Sanguinelli' are usually seedless and develop the most intense color, while 'Ruby' is lightly flecked at best, with 10-15 seeds. 'Ruby' and 'Moro' are considered mid-season, while 'Sanguinelli' is late season.

Other citrus varieties, that are called "oranges", such as 'Temple' and 'Ambersweet', are actually hybrids and are discussed in Home Fruit Production--Mandarins.

PROPAGATION

Either T-budding or inverted T-budding onto sour orange seedling rootstocks is the primary means used to propagate oranges in Texas. Because of the high degree of nucellar embryony (seeds come true-to-type) in most orange varieties, they can be grown from seed. However, seedage has two major drawbacks: 1) the seedling-grown trees will be short-lived because of their susceptibility to Phytophthora disease (both foot rot and root rot) and 2) fruit production will usually be delayed for up to 15 years until the seedling trees grow through juvenility and become capable of bearing.

PLANTING AND ESTABLISHMENT

Most orange trees propagated in the Lower Rio Grande Valley are grown in field nurseries. Such trees are then dug as if they will be balled-and-burlapped, but instead of wrapping the root ball with burlap, nurserymen commonly use a strip of burlap under the tree to lift it into a two-gallon container. Since the root ball is intact and includes the soil in which it was growing, such trees can be transplanted directly from the container.

Some orange trees, however, are container-grown entirely in an artificial, soilless medium--which requires special treatment at transplanting. After the planting hole is ready, remove the tree from the container and use a gentle stream of water from the garden hose to wash an inch or so of the medium from all around the root ball, thereby exposing the peripheral roots. Thus, the outer roots are placed in contact with the soil of the planting site and growth commences almost immediately.

Under no circumstances should soil around the proposed planting site be removed to form a shallow basin for watering--to do so almost guarantees that the young tree will contract foot rot and die before its fifth year. The soil in the planting site should be at least as high as the surrounding yard, if not higher. In addition, the tree should be set slightly higher than it was in the nursery container to assure that the budunion will remain well above the soil.

Mixing topsoil, compost, peat or other materials with the backfill soil is neither necessary nor desirable in good soils. Set the tree in the hole, backfill about halfway, then water sufficiently to settle the backfill around the lower roots. Finish backfilling the hole and then cover the root ball with about in inch of soil to seal the growing medium from direct contact with the air and thereby prevent rapid drying of the root ball.

To facilitate watering, bring soil from the garden or elsewhere to construct a watering ring atop the ground around the newly planted tree. The ring should be about two feet across and several inches high and thick. To water, just fill the water ring immediately after planting. After the water soaks in, it may be necessary to add a little soil to any holes formed as the soil settled around the roots.

The watering interval should be every few days for the first couple of weeks, then gradually increased to 7 to 10 days over the next couple of months. The watering ring will gradually melt into the surrounding soil, at which time the young orange tree can be considered to be established.

All weeds and lawngrass should be completely eliminated inside the watering ring, as the developing tree cannot compete well. A systemic, contact herbicide will work very well, so long as it is not allowed to contact the young tree leaves or green bark.

The best way to protect the young trunk from herbicide damage and, at the same time, to prevent sprouts along the trunk is to crimp an 8-inch by 18-inch piece of heavy duty aluminum foil around the trunk from the ground to the scaffold limbs. Fold the foil lengthwise, bring the long edges past the trunk on both sides, crimp the two edges together and lightly squeeze the foil around the trunk.

While mulching of citrus trees is commonly practiced in southeast Texas where there is an abundance of materials to use, mulching is not recommended for oranges because it increases the possibility of the tree contracting foot rot, for which there is no cure for home gardens. If you insist on mulching, keep the mulch at least a foot away from the trunk.

Fertilizer should be withheld until after growth commences. During the first year, a single cupful of ammonium sulfate (21-0-0) split into three or four applications is adequate. Use two cups in the second year and three in the third. Just scatter the fertilizer on the ground around the tree and water thoroughly. In areas other than the Valley, use whatever fertilizer analysis that is in general use in the area for trees and shrubs--simply adjust the rate based upon nitrogen content.

Cold protection measures for orange trees will be required sooner or later. Soil banks are very effective for young trees; the soil should be put up about Thanksgiving and left in place until early March. Exercise care when taking down the soil bank, as the bark underneath will be extremely tender.

Blankets, tarps or similar covers are also very effective and have the advantage of being quickly draped over the young tree. The corners should be stretched outward and tied down. More elaborate protection can be provided by erecting a frame structure of wood or PVC pipe over the plant to facilitate the use of plastic or large tarps during particularly severe cold weather. Supplemental heat can also be provided under the covers; incandescent bulbs and heat lamps are useful.

MATURE TREE CARE

Watering should be slow and thorough; probably every couple of weeks would suffice in any but the very sandy soils. Nutrition should continue at about one cup of ammonium sulfate per year of tree age annually in split applications in

February, May and September, i.e. a 6-year-old tree should receive about six cups of 21-0-0 for the year. Adjust the rate for other fertilizers based upon the relative nitrogen content.

Lawngrass should be kept back about a foot from the canopy of the tree. Other than cold damage, no pruning should be necessary, as the orange tree will develop its natural shape without pruning. While mulching is not recommended for citrus trees, if you must mulch, keep the mulch at least one foot away from the tree trunk.

PRODUCTION, MATURITY AND USE

Budded orange trees, if properly planted and grown, will bear harvestable fruit in the third season after transplanting. Any fruit that might set in the first and second seasons should probably be removed so that all of the young tree's energy is directed into growth.

Production of navel oranges could approach 10-15 pounds in the third season, increasing to around 100-150 pounds at full maturity in the tenth season. Early and midseason oranges could start at about 20-25 pounds in the third season and increase to around 200-250 pounds per tree by the tenth season. 'Valencia' orange production will be a little less than that of early oranges.

Oranges do not "ripen" in the general sense of the word as it is applied to other fruits; instead, they mature to good eating quality. Too, peel color is no indicator of maturity, as the peel undergoes natural degreening in November and December, and peel color of 'Valencia' oranges often regreens after the spring growth flush occurs.

Oranges are classified by their season of maturity, i.e., early, midseason and late oranges. Early oranges include 'Parson Brown', 'Marrs', navels and 'Hamlin', in order of maturity from early September through early October. Midseason oranges include true 'Pineapple' and 'Jaffa', with 'Pineapple' usually maturing about Thanksgiving and 'Jaffa' about Christmas. The only late orange in Texas is 'Valencia' which matures about early February.

Most oranges do not hold well on-tree; as they become overmature, they soften and drop. Overmature navel oranges also begin to dry out on the stem end, especially the larger, more oblong fruit. 'Marrs' and navels may hold into early February, especially in seasons having fairly cool weather in December and January. Midseason oranges typically hold through late February to March. 'Valencia' oranges hold much better than other oranges, often into June or July. Within limits, the longer the fruit stays on the tree, the sweeter it becomes.

Navel oranges are typically peeled and eaten out-of-hand, the others are more commonly sliced or sectioned for fresh consumption or juiced for drinking. Seedy varieties are often referred to as "juice oranges" since juicing is about the easiest means to remove the seeds. Navel oranges can be juiced for immediate consumption, but navel orange juice becomes bitter after a few hours. With the exception of navel, the other oranges can be sectioned for freezing and the juice can also be frozen for later use.

PROBLEMS

The pest and diseases which affect oranges in Texas are detailed in Home Fruit Production-Citrus, Table 2. In addition, the Asian citrus leafminer attacks the new flushes of growth when the developing leaves are only about an inch long, leaving serpentine trails from their feeding and causing stunting and distortion of the leaf. Occasionally, trails or mines occur on fruit as well. Each growth flush is susceptible to attack and there will be four growth flushes annually. The spring flush is least damaged, since the leafminer does not overwinter well, but the later flushes can be devastated.

There are no chemical controls available for home use, although citrus spray oils do deter infestation if the application is timed to the development of a new flush of growth. Otherwise, it is best to try to ignore the damage; leafminer will not kill the tree and indiscriminate spraying kills a lot of the natural predators and parasites that help to keep leafminer populations down.

There are very few orange tree problems that are life-threatening--and the home gardener cannot do anything about those anyway. Many of the rest of the insects and diseases that afflict oranges can generally be ignored in the home garden, as blemishes to the peel affect only the appearance and, in some cases, size of the fruit.

If one must spray, first identify the problem, then select the appropriate material and apply it properly and at the appropriate time to control the pest while minimizing damage to the complex of beneficial organisms that exist in citrus.

TEXAS CITRUS and Subtropical Fruits

HOME FRUIT PRODUCTION-MANDARINS

Julian W. Sauls
Professor & Extension Horticulturist
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Mandarins include a diverse group of citrus fruits that are characterized by bright peel and pulp color, excellent flavor, easy-to-peel rind and segments that separate easily. Because all tangerines are mandarins but not all mandarins are tangerines, mandarins are commonly separated into four groups: Mediterranean, king, satsuma and common tangerines. Of these, satsumas and tangerines are of most interest in Texas.

Most mandarin trees are more erect than other kinds of citrus trees and many exhibit a drooping habit because of rather long, willowy branches. The wood is somewhat more brittle than other citrus and limb breakage is common under heavy fruit loads unless some sort of support is provided. Most varieties of mandarins are self-pollinated and self-fruitful, but some of the hybrids are self-incompatible and will produce few fruit without the presence of suitable pollenizer varieties nearby. Mandarins tend to alternate bearing, with a heavy crop in one year followed by a lighter crop in the next season.

CLIMATE

Mandarins are grown in tropical and subtropical areas worldwide, although best color and quality usually occurs under subtropical conditions. As a group, mandarins are among the most cold hardy of citrus fruits, being second only to kumquats. Small orchards of tangerines in the Carrizo Springs area and of satsumas in southeast Texas were fairly common until the severe freezes of the 1980's. Few of those orchards remain today, but interest in mandarins remains high for home production. Protection during severe freezes will be essential to successful mandarin production.

SOILS AND SITE SELECTION

Mandarins are well-adapted to all well-drained soils in virtually all of Texas along and south of U.S. Highway 90 from Del Rio to Orange--depending on rootstock. In southeast Texas, growers prefer trifoliate orange rootstock because of the additional cold hardiness which it imparts to the tree. However, trifoliate orange is poorly adapted to the saline conditions and alkaline soils which predominate in south Texas where sour orange is the rootstock of choice. Trees on trifoliate are considerably smaller than trees on sour orange, with those on 'Flying Dragon' trifoliate being even smaller than on other trifoliate rootstocks. Smaller trees are more easily protected during severe freezes, but smaller trees are also less productive.

In the home landscape, mandarins should be planted on the south or southeast side of the house for maximum protection from cold weather. Overhanging trees will provide additional cold protection but the competition for light, water and nutrients will reduce mandarin tree growth, production and fruit quality.

VARIETIES AND TYPES

The Mediterranean group of mandarins apparently originated in the Mediterranean basin, most likely in Italy. 'Willowleaf' or 'Mediterranean' is the most prominent variety. Its fruit are of medium size, oblate, with a short collar and furrowed neck on the stem end. The rind is thin and both rind and flesh color are yellowish-orange at maturity in October-November. The fruit usually have 20-25 seeds. Most mandarins of this group have small, willow-shaped leaves and a droopy growth habit.

The King group of mandarins apparently originated in Vietnam. 'King', the primary variety, was introduced to California about 1880. 'King' fruit is among the largest of all mandarins; its rind is thick, rough and yellowish-orange at maturity. The flesh is deep orange in color; the fruit are very seedy and somewhat late in maturity (February-March). Unlike most mandarins, the cotyledons of 'King' seed are cream colored rather than green.

Satsumas are probably the most important citrus in Japan where they are referred to as Unshu mandarins. A number of varieties originated there, the most well-known being 'Owari', the quality of which surpasses all other satsumas in Texas. 'Obawase', 'Okitsu', 'Kimbrough', 'Big Early' and 'Armstrong Early' are other varieties grown in southeast Texas. Characteristics of the most common varieties grown in Texas are shown in Table 1. A number of other varieties and selections exist, but most of the latter are no different from 'Owari'. Satsuma fruit are of superb quality and nearly completely seedless.

Peel color is bright reddish orange and the peel is easily detached from the fruit at maturity. The segments are readily separated, also. The fruit attains best quality under cool temperature conditions during fall and winter; thus, quality is usually better in the more northern limits of its range. Satsuma fruit, like that of most mandarins, tends to dry out and become "ricey" if not harvested soon after it matures.

Tangerines are the most important of the mandarin groups, both because of their widespread culture and because of their use in citrus hybridization. 'Clementine' ('Algerian') originated in Algeria and was introduced to the U.S. in 1909. It has deep reddish orange color and both the rind and segments exhibit slightly more adherence than most mandarins. Fruit of 'Clementine' matures earlier than 'Dancy' and it is usually smaller; the fruit will store on-tree better than most.

'Dancy' a major variety that achieves deeper color and larger size than 'Clementine', but the fruit do not hold well on-tree after maturity. Its later maturity puts 'Dancy' fruit at greater risk of losses to cold. 'Dancy' originated in 1867 as a seedling of a tangerine brought from Tangiers to Florida. It is best adapted to Florida's high humidity and heat, although it is grown in other areas.

'Ponkan' ('Warnurco', 'Chinese Honey') apparently originated in India where seedlings orchards are still widely grown. It is believed to have been sent to Florida from China in the early 1890's. Its fruit are generally large for mandarins, having orange rind and flesh. The flesh is tender and melting, with mild flavor and aroma.

'Changsha' is a seedling tangerine that was once popular in Texas landscapes because of its relative cold hardiness. The author saw two mature trees in production at the O.S. Gray nursery in Arlington, TX, in 1973. Trees grown from seed are more cold tolerant than budded trees.

'Fortune' arose from the hybridization of 'Clementine' and 'Dancy' tangerines. It achieved some importance in South Texas because of its late maturity, but such lateness would be considered undesirable in colder areas of its range in Texas.

There are dozens of other varieties of tangerines, but few have achieved the prominence of those described above and in Table 1.

MANDARIN HYBRIDS

Tangerines have been widely hybridized with other citrus, primarily grapefruit. Some of the resultant hybrids have, in turn, been hybridized with tangerines, oranges and each other, resulting in some confusion in nomenclature. In the simplest hybridizations, a cross between tangerine and orange is called a tangor, while a cross between tangerine and grapefruit is called a tangelo. When a tangelo is further hybridized with tangerine, or when two tangelos are crossed, the result is considered a tantangelo. Hybrids that include tangerine, grapefruit and orange are simply called citrus hybrids.

Of the hybrids, only tangelos are classified by their parentage, i.e., tangelo; the rest are classified as the type of citrus which the respective hybrid most closely resembles and by which the industry commonly refers to it. For example, 'Ambersweet' hybrid is a cross between an unnamed sweet orange seedling and a tantangelo (tangerine X tangelo). Because its makeup is one-half orange, three-eights tangerine and one-eighth grapefruit, and because it looks more like an orange, 'Ambersweet' is called an "orange". By contrast, 'Page' "orange" is a tantangelo hybrid that resembles an orange, despite the fact that it has no orange heritage.

The classification and heritage of the most common mandarin hybrids are presented in Table 2, which should help clarify questions of nomenclature as well as concerns that the author failed to include a number of important "tangerine" varieties in the previous section on tangerines.

Fruit characteristics of these mandarin hybrids are presented in Table 3.

The origins of the two most notable tangors, 'Temple' and 'Murcott', are somewhat obscure. 'Temple' apparently originated in Jamaica and was introduced to Florida about 1896--although it was not named until 1919. The tree is rather thorny and is undoubtedly the most cold-sensitive of all mandarins and mandarin hybrids. Indeed, its lack of cold hardiness is a major reason that 'Temple' has not succeeded in the Texas citrus industry. 'Murcott' is believed to be a tangor of unknown origin that resulted from the breeding program of the U.S.D.A. prior to about 1916. Its peel is very thin and tightly adherent. The flavor of 'Murcott' is excellent, ranking with 'Owari' satsuma and 'Ponkan' as the author's top three citrus fruits in flavor and quality for eating out-of-hand.

'Orlando' and 'Minneola' are the two most prominent tangelos, although 'Thornton was once common in south Texas. 'Orlando' is very similar to a seedy orange, although the number of seed as well as fruit size and productivity depend upon

cross-pollination from pollenizer varieties. A notable characteristic of 'Orlando' is that its leaves are distinctly cupped rather than flat.

'Minneola' is also known as 'Honeybelle' in Florida. Its fruit have a large neck at the stem end; fruit are very juicy and flavorful. It also requires cross-pollination.

Few of the tantangelos have achieved prominence in Texas landscapes, although occasional trees of 'Fairchild' and 'Bower' can be found in the Valley. 'Bower' was jointly released by the Texas Agricultural Experiment Station and the U.S.D.A. in 1973. 'Sunburst' is a relatively recent U.S.D.A. hybrid that was introduced to the Texas industry after it passed Texas quarantine requirements in 1981.

Both 'Fallglo' and 'Ambersweet' are of relatively recent origin but neither is available in Texas inasmuch as they have either not been requested by the industry or they have not passed Texas quarantine requirements.

Other mandarin-like fruits that do not fit in the above groupings include 'Cleopatra' mandarin, Rangpur lime, Otaheite Rangpur and calamondin. 'Cleopatra' mandarin is noteworthy only for its use as a rootstock for other citrus. 'Rangpur' lime is not a lime at all but a mandarin-like fruit native to India. It is noteworthy as a potential rootstock for other citrus.

'Otaheite' ('Otaheite Rangpur') is an acidless, semi-dwarf form of 'Rangpur' that is widely grown as an ornamental, often as a potted plant. Calamondin is a small-fruited, acid fruit that is grown as a potted plant that is often called "miniature orange".

PROPAGATION (AND QUARANTINES)

It is important to know that any and all citrus trees planted in Texas must have been propagated in Texas from Texas-grown plant materials, i.e., it is illegal under Texas statutes to import citrus trees, seedlings, plants, budwood or graftwood from any other state or country. Aside from the legal penalties involved, you should understand that violations of the Texas citrus quarantine laws could jeopardize not only home citrus trees from east Texas to south Texas but also the entire Texas citrus industry. At present, the Texas Citrus Budwood Foundation is working diligently to develop virus-free sources of all types and varieties of citrus currently being grown in Texas.

In the meantime, there are reputable Texas nurseries which produce citrus trees for sale to consumers--so you don't have to go to Louisiana or elsewhere to get a quality mandarin tree.

Either T-budding or inverted T-budded onto appropriate seedling rootstocks is the preferred means of propagation in Texas. As previously noted, trifoliate orange stocks are preferred in southeast Texas while sour orange stocks are better adapted to all of Texas where mandarins can be grown--including southeast Texas. 'Changsha' and the mandarin-like fruits discussed in the previous two paragraphs can be grown from seed, while those used primarily as potted plants are usually propagated from semi-hardwood cuttings under mist.

PLANTING AND ESTABLISHMENT

For the most part, mandarin trees will be purchased from a nursery rather than grown at home. Generally, the trees will be container-grown in a soilless medium--which makes the trees rather difficult to establish without special care. At planting, use a gentle stream of water from the garden hose to wash an inch or so of the medium from all around the root ball, thereby exposing the peripheral roots. Thus, the outer roots are placed in contact with the soil of the planting site and growth commences almost immediately.

Under no circumstances should soil around the proposed planting site be removed to form a shallow basin for watering--to do so almost guarantees that the young mandarin tree will contract foot rot and die before its fifth year. In wetter, lower areas in southeast Texas, the use of raised beds is recommended. The soil in the planting site should be at least as high as the surrounding yard, if not higher. In addition, the tree should be set slightly higher than it was in the nursery container to assure that the budunion will remain well above the soil.

Mixing topsoil, compost, peat or other materials with the backfill soil is neither necessary nor desirable in good soils. Set the tree in the hole, backfill about halfway, then water sufficiently to settle the backfill around the lower roots. Finish backfilling the hole and then cover the root ball with about in inch of soil to seal the growing medium from direct contact with the air and thereby prevent rapid drying of the root ball.

To facilitate watering, bring soil from the garden or elsewhere to construct a watering ring atop the ground around the newly planted tree. The ring should be about two feet across and several inches high and thick. To water, just fill the water ring immediately after planting. After the water soaks in, it may be necessary to add a little soil to any holes formed as the soil settled around the roots.

The watering interval should be every few days for the first couple of weeks, then gradually increased to 7 to 10 days over the next couple of months. The watering ring will gradually melt into the surrounding soil, at which time the young mandarin tree can be considered to be established.

All weeds and lawngrass should be completely eliminated inside the watering ring, as the developing mandarin tree cannot compete well. A systemic, contact herbicide will work very well, so long as it is not allowed to contact the young tree leaves or green bark.

The best way to protect the young trunk from herbicide damage and, at the same time, to prevent sprouts along the trunk is to crimp an 8-inch by 18-inch piece of heavy duty aluminum foil around the trunk from the ground to the scaffold limbs. Fold the foil lengthwise, bring the long edges past the trunk on both sides, crimp the two edges together and lightly squeeze the foil around the trunk.

While mulching of citrus trees is commonly practiced in southeast Texas where there is an abundance of materials to use, mulching is not recommended for citrus because it increases the possibility of the tree contracting foot rot, for which there is no cure for home use. If you insist on mulching, keep the mulch at least a foot away from the trunk.

Fertilizer should be withheld until after growth commences. During the first year, a single cupful of ammonium sulfate (21-0-0) split into three or four applications is adequate. Use two cups in the second year and three in the third. Just scatter the fertilizer on the ground around the tree and water thoroughly. In areas other than the Valley, use whatever fertilizer analysis that is in general use in the area for trees and shrubs--simply adjust the rate based upon nitrogen content.

Cold protection measures for mandarin trees will be required sooner or later. Soil banks are very effective for young trees; the soil should be put up about Thanksgiving and left in place until early March. Exercise care when taking down the soil bank, as the bark underneath will be extremely tender.

Blankets, tarps or similar covers are also very effective and have the advantage of being quickly draped over the young tree. The corners should be stretched outward and tied down. More elaborate protection can be provided by erecting a frame structure of wood or PVC pipe over the tree to facilitate the use of plastic or large tarps during particularly severe cold weather. Supplemental heat can also be provided under the covers; incandescent bulbs and heat lamps are useful.

MATURE TREE CARE

Watering should be slow and thorough; probably every couple of weeks would suffice in any but the very sandy soils. Nutrition should continue at about one cup of ammonium sulfate per year of tree age annually in split applications in February, May and September, i.e. a 6-year-old tree should receive about six cups of 21-0-0 for the year. Adjust the rate for other fertilizers based upon the relative nitrogen content.

Lawngrass should be kept back about a foot from the canopy of the tree. Other than cold damage, no pruning should be necessary, as the mandarin tree will develop its natural shape without pruning. While mulching is not recommended for citrus trees, if you must mulch, keep the mulch at least one foot away from the tree trunk.

PRODUCTION, MATURITY AND USE

Mandarins are highly productive for the size of the tree, but most are subject to strong alternate bearing, which results in significant limb breakage during the heavy crop seasons (unless some means of limb support is provided). Because most mandarins do not store well on-tree after they reach maturity, production is generally greater than the average family can use during their relatively short season.

While the mandarins are noted for their bright peel color, it is not uncommon for the fruit to attain good eating quality before the peel loses its green color. In some cases, the flesh many become "ricey" by the time the peel achieves normal color--especially in those varieties which mature in September-November. Maturity is based on "eating quality" of the fruit--not on peel color.

Mandarins are primarily eaten fresh. However, in times of plenty, excess fruit can be sectioned and canned or frozen or it can be juiced and frozen.

PROBLEMS

Mandarins are afflicted with the same pests and diseases as other citrus, so the reader is referred to Home Fruit Production--Citrus, Table 2. One pest not discussed in the HFP-Citrus publication is Asian citrus leafminer, as the pest arrived in Texas about 1994. This leafminer attacks the new flushes of growth when the developing leaves are only about an inch long,

leaving serpentine trails from their feeding and causing stunting and distortion of the leaf. Occasionally, trails or mines occur on fruit as well. Each growth flush is susceptible to attack and mandarins usually have four growth flushes annually. The spring flush is least damaged, since the leafminer does not overwinter well, but the later flushes can be devastated.

There are no chemical controls available for home use, although citrus spray oils do deter infestation if the application is timed to the development of a new flush of growth. Otherwise, it is best to try to ignore the damage; leafminer will not kill the tree and indiscriminate spraying kills a lot of the natural predators and parasites that help to keep leafminer populations down.

There are very few problems of mandarin trees that are life-threatening--and the home gardener cannot do anything about those anyway. Many of the rest of the insects and diseases that afflict mandarin can generally be ignored in the home garden, as blemishes to the peel affect only the appearance, and, in some cases, size of the fruit.

If one must spray, first identify the problem, then select the appropriate material and apply it properly and at the appropriate time to control the pest while minimizing damage to the complex of beneficial organisms that exist in citrus.

Alternate bearing is a problem that mandarin growers just learn to live with. In commercial orchards, heavy pruning during the "on-season" is sometimes used to reduce crop load--the home gardener would be better off removing some of the excess fruit soon after fruit set in the spring. Fertilizer rates should be increased by about one-fourth during the heavy crop seasons; similarly, fertilization should be reduced by about one-fourth during the light crop seasons.

Mandarin fruit tend to "plug" when pulled from the tree, i.e., a piece of the peel tears loose from the fruit and remains attached to the stem. Plugging is inconsequential for fruit that is to be used immediately upon harvest--but it is preferable to use hand pruning shears to clip the fruit from the tree to avoid damage. In clipping, the stem should be cut close to the fruit so as to preclude it from puncturing the rind of other fruit during harvest and handling.

Table 1. Characteristics of satsuma and tangerine varieties in Texas.

Variety	Fruit size	Seed	Peel color	Flesh color	Adherence	Season
Owari satsuma	Medium	0-4	Red-orange	Orange	Loose	Nov-Dec
Armstrong Early satsuma	Large	0-4	Red-orange	Lt-orange	Loose	Oct-Nov
Kimbrough satsuma	Medium	0-4	Red-orange	Orange	Loose	Nov-Dec
Obawase satsuma	Large	0-4	Red-orange	Orange	Loose	Oct-Nov
Okitsu satsuma	Medium	0-4	Red-orange	Orange	Loose	Nov-Dec
Big Early satsuma	Large	0-4	Red-orange	Orange	Loose	Oct-Nov
Clementine tangerine	Small	5-25	Red-orange	Orange	Slight	Oct-Nov
Dancy tangerine	Medium	6-20	Red-orange	Orange	Loose	Dec-Jan
Ponkan (Warnurco) tangerine	Large	3-7	Orange	Orange	Loose	Nov-Jan
Changsha tangerine	Medium	20-30	Orange	Orange	Loose	Oct-Jan
Fortune tangerine	Medium	20-30	Red-orange	Orange	Tight	Jan-Mar

Table 2. Fruit classification, parentage and makeup of mandarin hybrids.[1/]

Variety	Type[2/]	Parentage	Proportion (Tg:Gf:Or)
Tangors			
1. Murcott	"Orange"	Unknown tangerine X unknown orange	50:0:50
2. Temple	"Orange"	Unknown tangerine X unknown orange	50:0:50
Tangelos			
3. Orlando	Tangelo	Dancy tangerine X Duncan grapefruit	50:50:0
4. Minneola	Tangelo	Dancy tangerine X Duncan grapefruit	50:50:0
5. Thornton	Tangelo	Dancy tangerine X Duncan grapefruit	50:50:0
Tantangelos			

6. Robinson	"Tangerine"	Clementine tangerine X Orlando tangelo	75:25:0
7. Osceola	"Tangerine"	Clementine tangerine X Orlando tangelo	75:25:0
8. Nova	"Tangelo"	Clementine tangerine X Orlando tangelo	75:25:0
9. Lee	"Tangerine"	Clementine tangerine X Orlando tangelo	75:25:0
10. Bower	"Tangerine"	Clementine tangerine X Orlando tangelo	75:25:0
11. Fairchild	"Tangerine"	Clementine tangerine X Orlando tangelo	75:25:0
12. Page	"Orange"	Clementine tangerine X Minneola tangelo	75:25:0
13. Sunburst	"Tangerine"	Robinson "tangerine" X Osceola "tangerine"	75:25:0
Other Hybrids			
14. Fallglo	"Tangerine"	Bower "tangerine" X Temple "orange"	62:12:25
15. Ambersweet	"Orange"	(Clementine tangerine X Orlando Tangelo) X seedling orange	37:12:50

1/ Tangor is a hybrid between tangerine and orange, Tangelo is a hybrid between tangerine and grapefruit while Tantangelo is a hybrid between tangerine and a tangelo hybrid.

2/ Quotations are used to denote the type of citrus which the respective hybrid most resembles and by which the industry usually refers to it.

Table 3. Characteristics of mandarin hybrids.

Variety	Fruit size	Seed	Peel color	Flesh color	Adherence 1/	Season
Tangors						
1. Murcott "orange"	Medium	10-20	Yel-orange	Yellow	Tight	Jan-Mar
2. Temple "orange"	Medium	15-20	Red-orange	Orange	Moderate	Jan-Mar
Tangelos						
3. Orlando 2/	Med-large	0-35	Yel-orange	Yellow	Tight	Nov-Jan
4. Minneola 3/	Large	7-12	Red-orange	Red-orange	Tight	Dec-Jan
5. Thornton	Medium	10-25	Lt-orange	Orange	Slight	Nov-Dec
Tantangelos						
6. Robinson "tangerine" 4/	Medium	10-20	Yel-orange	Orange	Loose	Oct-Dec
7. Osceola "tangerine" 5/	Medium	15-20	Red-orange	Orange	Moderate	Oct-Nov
8. Nova "tangelo" 4/	Medium	0-30	Yel-orange	Orange	Slight	Nov-Dec
9. Lee "tangerine"	Medium	10-25	Yel-orange	Yellow	Tight	Nov-Dec
10. Bower "tangerine"	Large	25-40	Red-orange	Orange	Loose	Dec
11. Fairchild "tangerine"	Medium	20-30	Orange	Orange	Moderate	Oct-Nov
12. Page "orange" 6/	Small	10-25	Orange	Orange	Tight	Oct-Feb
13. Sunburst "tangerine" 7/	Medium	10-20	Red-orange	Orange	Loose	Nov-Dec
Other Hybrids						
14. Fallglo "tangerine"	Large	20-40	Red-orange	Orange	Loose	Oct-Nov
15. Ambersweet "orange"	Medium	0-30	Yellow	Yellow	Moderate	Nov-Dec

1/ Adherence refers to ease of peeling and to the ease with which fruit segments separate.

2/ Pollenizer required; use 2, 6, 7,8, 9, 12, or 13.

HOME FRUIT PRODUCTION-LOQUAT

Julian W. Sauls, Ph. D.
Professor & Extension Horticulturist
Texas Cooperative Extension

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Loquat (Japanese plum or Japanese medlar) is probably one of the more familiar of all tropical fruit plants in Texas, although few people outside of south Texas have only rarely grown the fruit. The plant is extremely cold hardy and is commonly grown as an ornamental from north Texas to the Valley.

Native to China, the loquat tree is an evergreen with large, stiff leaves. Growing alone in the open, the tree is very symmetrical, with a compact, dense crown, and can attain a height of 25 feet and a spread of 15 to 20 feet. The leaves are glossy, dark green above and whitish to rusty tomentose beneath. These characteristics of the tree have made the loquat an excellent specimen or accent in the home landscape.

CLIMATE

The mature loquat tree can withstand temperatures of 10 degrees without serious injury, but both flowers and fruit are killed at temperatures below about 27. Unfortunately, loquat blooms in late fall to early winter and must mature its fruit during the winter months. Thus, fruiting rarely occurs except in south Texas or following mild winters in south central or southeast Texas.

SOIL AND SITE SELECTION

Loquat is very well adapted to virtually all soils that have good internal drainage and are relatively non-saline. Soil pH does not seem to matter, as the trees grow equally well in the acid soils of east Texas and the alkaline soils of north, central and south Texas.

If fruit production is a consideration, loquats should be planted on the south or southeast side of the residence to obtain maximum cold protection from the house itself. Otherwise, plant it wherever in the landscape that is desired.

VARIETIES

Quite a large number of selections have been named over the years, several of which are grown in south Florida. Because the fruit has never achieved commercial status in the U.S., nurserymen tend to propagate the trees as loquats rather than as a particular variety of loquat. In Texas, it is likely that most of the loquats are from seed or were vegetatively propagated from seedlings. Consequently, fruit quality is highly variable among loquats in Texas.

PROPAGATION

Loquat is readily propagated from seed, although seedlings are frequently self-infertile and do not come true from seed. Veneer grafting and shield budding onto seedling rootstocks are both fairly successful. Air layering is a good way to propagate from a tree that bears particularly good fruit.

PLANTING AND ESTABLISHMENT

A loquat tree obtained from the local nursery will undoubtedly be container-grown in soilless media. Because soilless media forms an interface with the soil of a planting site, across which neither roots, air nor water move readily, one cannot simply take the plant from the pot and put it into a planting hole intact--as growth will be extremely slow. To assure survival and immediate growth, some of the medium should be removed from the sides and top of the root ball to expose some of the roots. This is best accomplished with a gentle stream of water from the garden hose, removing about an inch of the medium all around the ball. Upon planting, the outer roots in the ball are thereby placed into direct contact with the soil of the planting site, so survival and growth are assured, given proper watering.

Water thoroughly at planting and again every three or four days for the first week. Afterwards, lengthen the interval between waterings over the next several months until the tree is well established. For ease of watering, construct a water ring several inches high and thick, and a couple of feet across, atop the soil around the newly planted tree. Then, simply fill the ring with water as needed. In time, the ring will melt into the surrounding soil, at which time the plant will have become established.

Fertilize only after new growth commences. Use the same fertilizer as you use on the lawn grass (except do not use a fertilizer that contains a weed killer) or use ammonium sulfate (21-0-0) or whatever general fertilizer is recommended by the County Extension Agent in your area.

Based on ammonium sulfate, the young tree should receive about one cup during its first year, two cups in the second and three cups in its third year. For optimal results, the fertilizer should be split into three or more applications annually. Just scatter it on the ground and water it in.

Because a young tree cannot compete well with weeds and turfgrass, an area 2 to 3 feet in diameter, centered on the tree, should be kept free of all other vegetation. The unwanted vegetation can be killed out with a systemic herbicide, then a thick layer of organic mulch will keep it out.

MATURE TREE CARE

Continue to care for the tree as during establishment as regards water, mulching and weed control. As for nutrition, a pound per inch of trunk diameter annually is adequate, with split applications in March and June or March, June and September.

Loquat trees normally do not require pruning, as the tree establishes its natural shape without pruning, assuming that it has adequate space into which to develop.

PRODUCTION, MATURITY AND USE

Loquats should begin to bear in 2 to 3 years, with a well-developed older tree easily producing 100 pounds of fruit. A particularly heavy crop will usually be of smaller fruit size.

The flower panicles normally appear in the late fall on the ends of the branches; the flowers are fragrant, though small and not especially showy. The fruit matures in late winter to spring. Typically, the fruit is about 1.5 inches long and perhaps an inch wide, globose to pear-shaped and pale yellow to golden orange at maturity. It is firm and juicy, and contains two or three large, smooth, dark brown seeds. The flavor varies from sweet to tangy, depending upon the variety or selection.

The fruit can be eaten fresh from the tree or frozen intact for later use. It also can be made into excellent jelly, jam, preserves, cobbler or pies.

PROBLEMS

Loquat has few natural pests. The most serious problem is that of fire blight, the same disease which affects pear and pyracantha. While antibiotic treatment for fire blight is effective, probably the simplest course of action is to prune out the affected branches and destroy them.

Tipburn of the leaves frequently appears during a hot, dry summer as a consequence of soil and water salinity. Tipburn is not particularly deleterious to the tree and there is nothing you can do about it anyway.

Loquat fruit in the Valley can be an alternate host for Mexican fruit fly, but the sterile fly program pretty well keeps Mexfly in check.

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HOME FRUIT PRODUCTION-LIMES

Julian W. Sauls, Ph.D.
Professor and Extension Horticulturist
Texas Cooperative Extension

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Limes are second only to lemons in terms of importance as a flavoring agent for foods, drinks and other, non-edible, products for home and industrial use. Tenderness to cold weather precludes commercial lime production in Texas, but limes are commonly grown in home plantings in the Lower Rio Grande Valley.

CLIMATE

Lime trees are extremely cold sensitive and cannot be expected to survive the freezing temperatures that occur through most of Texas unless special efforts are provided for freeze protection. Such protection is necessary even in the Lower Rio Grande Valley during major freeze events.

SOILS AND SITE SELECTION

Lime trees are well-adapted to soils having good internal and surface drainage. Growth on heavy clays or poorly-drained soils will be reduced and problematic, as limes do not tolerate flooding conditions. Nutritional deficiencies can occur on soils high in caliche.

In the home landscape, lime trees should be planted on the south or southeast side of the house in order to take advantage of the cold protection provided by the house. For optimum growth and production, the trees should be planted in full sun.

VARIETIES AND TYPES

Mexican lime is also known as key lime and West Indian lime. It originated in Asia, was introduced to the Iberian Peninsula and North Africa by Arab traders and was brought to the Americas during the early sixteenth century by Spanish and Portugese explorers. It became naturalized in the West Indies, south Florida and some Caribbean countries.

The tree is somewhat small and bushy, with slender branches, having short spines (thorns). A thornless selection is somewhat more desirable but less productive. The fruit is small, rarely achieving 2 inches in size, round to oval in shape, and contains a moderate number of polyembryonic seeds. The rind is thin and yellow at full maturity, while the juice is faintly greenish yellow, highly acid and has the distinctive lime aroma.

Tahiti lime is also called Bearss lime and Persian lime. Although its exact origin is unknown, it appeared in a home planting is California about 1875 and is believed to have originated from seed of citrus fruit imported from Tahiti to San Francisco sometime after 1850. It is also believed to be of hybrid origin.

The tree is somewhat larger than Mexican lime, achieving heights of 20 feet under optimum conditions. The branches are variably thornless or armed with quarter-inch thorns--even on the same tree. The fruit is oval, about 2.75 inches long and up to 2.5 inches in diameter, but it will get even larger if left too long on the tree. It is characterized by the presence of a nipple on the blossom end of the fruit. The rind is thin, smooth and dark green at commercial maturity, becoming very light green to yellow at full maturity. The fruit is normally entirely seedless, although one or two seeds may occur when grown in close proximity to other citrus. The juice is greenish and acidic, having the distinctive lime aroma.

Giant key lime was released by ARS-USDA in 1994. It is a spontaneous autotetraploid Key lime seedling that was selected in 1973. The major difference in this lime is that its fruit are more than twice the size of common Mexican limes. Budwood is not available in Texas, so it is only reported as an item of interest for the future.

Rangpur lime is an acidic fruit that more closely resembles mandarins than limes. Its fruit are highly acid, very seedy, with a loose, thin rind. It is primarily used as a rootstock for other citrus and as an ornamental tree.

Palestine sweet lime is not a true lime. Its fruit are pale yellow, juicy and subacid in flavor. Its primary use is as a rootstock, although there is some production in the Mediterranean, in India and in Latin America.

Limequats such as 'Eustis', 'Lakeland' and 'Tavares' are hybrids between Mexican lime and kumquat. The fruit closely resembles Mexican lime and the trees are somewhat more cold hardy than limes--though not nearly so hardy as kumquats.

Mexican lime and the limequats are sufficiently small trees that they can be readily grown in large containers in areas where cold temperatures would preclude their being grown in the ground.

PROPAGATION

Either T-budding or inverted T-budding onto sour orange seedlings is the preferred means of propagation in Texas. Mexican lime can also be grown from seed. Air layers (marcots) of both Mexican lime and Tahiti lime are successful. The expected life of seedlings and marcots is shortened considerably by the lack of resistance to Phytophthora root and foot rot afforded by trees budded onto sour orange rootstocks. Given the limitation of Phytophthora, both seedlings and marcots will regrow true-to-type if killed to near the ground by severe freezing temperatures.

PLANTING AND ESTABLISHMENT

For the most part, lime trees will be purchased from a nursery rather than grown at home. Generally, the trees will be container-grown in a soilless medium--which makes the trees rather difficult to establish without special care. At planting, use a gentle stream of water from the garden hose to wash an inch or so of the medium from all around the root ball, thereby exposing the peripheral roots. Thus, the outer roots are placed in contact with the soil of the planting site and growth commences almost immediately.

Under no circumstances should soil around the proposed planting site be removed to form a shallow basin for watering--to do so almost guarantees that the young lime tree will contract foot rot and die before its fifth year. The soil in the planting site should be at least as high as the surrounding yard, if not higher. In addition, the tree should be set slightly higher than it was in the nursery container to assure that the budunion will remain well above the soil.

Mixing topsoil, compost, peat or other materials with the backfill soil is neither necessary nor desirable in good soils. Set the tree in the hole, backfill about halfway, then water sufficiently to settle the backfill around the lower roots. Finish backfilling the hole and then cover the root ball with about in inch of soil to seal the growing medium from direct contact with the air and thereby prevent rapid drying of the root ball.

To facilitate watering, bring soil from the garden or elsewhere to construct a watering ring atop the ground around the newly planted tree. The ring should be about two feet across and several inches high and thick. To water, just fill the water ring immediately after planting. After the water soaks in, it may be necessary to add a little soil to any holes formed as the soil settled around the roots.

The watering interval should be every few days for the first couple of weeks, then gradually increased to 7 to 10 days over the next couple of months. The watering ring will gradually melt into the surrounding soil, at which time the young lime tree can be considered to be established.

All weeds and lawngrass should be completely eliminated inside the watering ring, as the developing lime tree cannot compete well. A systemic, contact herbicide will work very well, so long as it is not allowed to contact the young tree leaves or green bark.

The best way to protect the young trunk from herbicide damage and, at the same time, to prevent sprouts along the trunk is to crimp an 8-inch by 18-inch piece of heavy duty aluminum foil around the trunk from the ground to the scaffold limbs. Fold the foil lengthwise, bring the long edges past the trunk on both sides, crimp the two edges together and lightly squeeze the foil around the trunk.

While mulching of citrus trees is commonly practiced in southeast Texas where there is an abundance of materials to use, mulching is not recommended for citrus because it increases the possibility of the tree contracting foot rot, for which there is no cure. If you insist on mulching, keep the mulch at least a foot away from the trunk.

Fertilizer should be withheld until after growth commences. During the first year, a single cupful of ammonium sulfate (21-0-0) split into three or four applications is adequate. Use two cups in the second year and three in the third. Just scatter the fertilizer on the ground around the tree and water thoroughly. In areas other than the Valley, use whatever fertilizer analysis that is in general use in the area for trees and shrubs--simply adjust the rate based upon nitrogen content.

Cold protection measures for lime trees will be required sooner or later. Soil banks are very effective for young trees; the soil should be put up about Thanksgiving and left in place until early March. Exercise care when taking down the soil bank, as the bark underneath will be extremely tender.

Blankets, tarps or similar covers are also very effective and have the advantage of being quickly draped over the young tree. The corners should be stretched outward and tied down. More elaborate protection can be provided by erecting a frame structure of wood or PVC pipe over the plant to facilitate the use of plastic or large tarps during particularly severe cold weather. Supplemental heat can also be provided under the covers; incandescent bulbs and heat lamps are useful.

MATURE TREE CARE

Watering should be slow and thorough; probably every couple of weeks would suffice in any but the very sandy soils. Nutrition should continue at about one cup of ammonium sulfate per year of tree age annually in split applications in February, May and September, i.e. a 6-year-old tree should receive about six cups of 21-0-0 for the year. Adjust the rate for other fertilizers based upon the relative nitrogen content.

Lawngrass should be kept back about a foot from the canopy of the tree. Other than cold damage, no pruning should be necessary, as the lime tree will develop its natural shape without pruning. While mulching is not recommended for citrus trees, if you must mulch, keep the mulch at least one foot away from the tree trunk.

PRODUCTION, MATURITY AND USE

Either Mexican lime or Tahiti lime will produce more fruit than most families could use, given modest care and freedom from cold damage. Budded trees will commence to bear in the third year after planted, marcots in the second year. Primary production will be in the summer months, but some fruit can be borne year round.

Mexican lime achieves maximum flavor and juiciness when the rind becomes yellow, while Tahiti lime fruit are best just before they become completely yellow. Because limes begin to drop after the rind becomes yellow, the juice can be extracted for freezing in ice cube trays. After freezing, the cubes can be stored frozen for later use.

Aside from their obvious use in the flavoring of beverages such as tea and water, limes are also used in cakes, pies, candies and marinades and flavoring for fish, meat and poultry.

PROBLEMS

Limes are afflicted with the same pests and diseases as other citrus, so the reader is referred to Home Fruit Production--Citrus, Table 2. In addition, limes can develop stylar end breakdown in which some juice vesicles rupture, allowing the juice to collect at the stylar or blossom end of the fruit. Because of its acidity, the juice will cause breakdown of the rind at the blossom end. To reduce the problem, delay harvest until ate morning or afternoon, do not pick after a rain or when the fruit is wet. Too, handle the fruit gently to avoid bruising.

One pest not discussed in the HFP-Citrus publication is Asian citrus leafminer, as the pest arrived in Texas about 1994. This leafminer attacks the new flushes of growth when the developing leaves are only about an inch long, leaving serpentine trails from their feeding and causing stunting and distortion of the leaf. Occasionally, trails or mines occur on fruit as well. Each growth flush is susceptible to attack and limes may have as many as eight or 10 growth flushes annually. The spring flush is least damaged, since the leafminer does not overwinter well, but the later flushes can be devastated.

There are no chemical controls available for home use, although citrus spray oils do deter infestation if the application is timed to the development of a new flush of growth. Otherwise, it is best to try to ignore the damage; leafminer will not kill the tree and indiscriminate spraying kills a lot of the natural predators and parasites that help to keep leafminer populations down.

There are very few lime tree problems that are life-threatening--and the home gardener cannot do anything about those anyway. Many of the rest of the insects and diseases that afflict lime trees can generally be ignored in the home garden, as blemishes to the peel affect only the appearance, and, in some cases, size of the fruit.

If one must spray, first identify the problem, then select the appropriate material and apply it properly and at the appropriate time to control the pest while minimizing damage to the complex of beneficial organisms that exist in citrus.

HOME FRUIT PRODUCTION-LEMONS

Julian W. Sauls
Professor & Extension Horticulturist
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The primary use of lemon fruits is as a flavoring agent, as their very high acidity is too much for most palates. The trees are rather cold tender, which precludes their commercialization in the Texas citrus industry. Although most Texans know true lemons, which mostly come from California and Arizona, Valleyites also know 'Ponderosa' and 'Meyer' lemon. All three types are common in home plantings in the Lower Rio Grande Valley.

CLIMATE

Lemons are among the most cold sensitive of all citrus. Because of the likelihood of damaging temperatures in most of Texas, lemon trees cannot be expected to survive for long outside the Valley unless special efforts are provided for cold protection.

SOIL AND SITE SELECTION

The various lemons are well-adapted to virtually any soil in which they are likely to be planted--if the soil has good internal drainage. Growth on heavy clay soils is likely to be reduced and problematic, as it will on soils having high caliche.

Because of cold sensitivity, lemon trees should be limited to the south or southeast side of the house and as near to it as the mature tree size will permit. While overhanging shade trees will provide some cold protection, lemons require full sunlight for optimum growth and production.

VARIETIES AND TYPES

True Lemons. True lemon apparently originated in India but little is known of its spread into the Mediterranean Basin. It was brought to the Americas by Columbus. There are two primary types of lemons: 'Eureka', which originated in California and is probably the major variety there, forms an open, spreading tree, with relatively few branches and twigs which are virtually thornless, and 'Lisbon', which originated in Australia and is characterized by a rather dense tree having numerous upright, thorny branches. Production on 'Eureka' occurs mostly in spring and summer, while that of 'Lisbon' is mostly in the summer and fall. 'Lisbon' fruit are seedier than 'Eureka' fruit and are primarily borne inside the canopy as opposed to the terminal bearing habit of 'Eureka'.

A number of other varieties exist, most of which are selections from either 'Eureka' or 'Lisbon'. For the most part, there is very little difference among the fruit of the different varieties. 'Bearss' and 'Avon' both originated in Florida and are similar to 'Lisbon'. 'Harvey' originated in Florida and is similar to 'Eureka', as is 'Villafranca' which came from Sicily. 'Perrine' is actually a hybrid of lemon and lime.

Ponderosa Lemon. 'Ponderosa' is not a true lemon although its fruit are much like citrons and lemons. It originated as a chance seedling during the 1880's. 'Ponderosa' trees are rather small and somewhat thorny; its fruit are very large and seedy, with yellow, thick, bumpy-textured peel. 'Ponderosa' is more cold sensitive than true lemons.

Meyer Lemon. 'Meyer' lemon was introduced from China in 1908. While not a true lemon, its fruit are used as a lemon substitute despite being much less acid than true lemons. Its fruit, which are moderately seedy, resemble a large orange in shape, peel color and pulp color. The tree is spreading and relatively small, nearly thornless and more cold tolerant than true lemons. Because of its popularity in south Texas, 'Meyer' lemon is known locally as Valley lemon.

Unfortunately, 'Meyer' lemon is the "Typhoid Mary" of citrus, having been the source of citrus tristeza virus diseases which have the potential to destroy the Texas citrus industry. Undoubtedly, there are 'Meyer' lemon trees in Texas that harbor tristeza virus, to which it is immune.

Other Lemons. 'Dorshapo' is a true lemon from Brazil that closely resembles 'Eureka' in fruit and tree characteristics. It is grown to some extent in the Mediterranean Basin and Latin America, but apparently not in the U.S. It is a sweet lemon of very low acidity.

Rough Lemon is similar to true lemons, although its fruit are larger, seedier and very bumpy and its juice is less acid than true lemons. Its primary use has been as a rootstock for other citrus.

PROPAGATION

Either T-budding or inverted T-budding is the preferred means of propagation. Sour orange seedling rootstocks are preferred in Texas, but other rootstocks are used in commerce in other areas. While cuttings and air layers will work, trees grown on their own roots are not as well-adapted to Texas soils. Seed can be used, but seedlings are slow to bear. Too, some of the seedlings may not come true-to-type.

PLANTING AND ESTABLISHMENT

For the most part, lemon trees will be purchased from a nursery rather than grown at home. Generally, the trees will be container-grown in a soilless medium--which makes the trees rather difficult to establish without special care. At planting, use a gentle stream of water from the garden hose to wash an inch or so of the medium from all around the root ball, thereby exposing the peripheral roots. Thus, the outer roots are placed in contact with the soil of the planting site and growth commences almost immediately.

Under no circumstances should soil around the proposed planting site be removed to form a shallow basin for watering--to do so almost guarantees that the young lemon tree will contract foot rot and die before its fifth year. The soil in the planting site should be at least as high as the surrounding yard, if not higher. In addition, the tree should be set at the same depth or slightly higher than it was in the nursery container to assure that the budunion will remain well above the soil.

Mixing topsoil, compost, peat or other materials with the backfill soil is neither necessary nor desirable in good soils. Set the tree in the hole, backfill about halfway, then water sufficiently to settle the backfill around the lower roots. Finish backfilling the hole and then cover the root ball with about in inch of soil to seal the growing medium from direct contact with the air and thereby prevent rapid drying of the root ball.

To facilitate watering, bring soil from the garden or elsewhere to construct a watering ring atop the ground around the newly planted tree. The ring should be about two feet across and several inches high and thick. To water, just fill the water ring immediately after planting. After the water soaks in, it may be necessary to add a little soil to any holes formed as the soil settled around the roots.

The watering interval should be every few days for the first couple of weeks, then gradually increase the interval to 7 to 10 days over the next couple of months. The watering ring with gradually melt into the surrounding soil, at which time the young lemon tree can be considered to be established.

All weeds and lawngrass should be completely eliminated inside the watering ring, as the developing lemon tree cannot compete well. A systemic, contact herbicide will work very well, so long as it is not allowed to contact the young tree leaves or green bark.

The best way to protect the young trunk from herbicide damage and, at the same time, to prevent sprouts along the trunk is to crimp an 8-inch by 18-inch piece of heavy duty aluminum foil around the trunk from the ground to the scaffold limbs. Fold the foil lengthwise, bring the long edges past the trunk on both sides, crimp the two edges together and lightly squeeze the foil around the trunk.

While mulching of citrus trees is commonly practiced in southeast Texas where there is an abundance of materials to use, mulching is not recommended for citrus because it increases the possibility of the tree contracting foot rot, for which there is no cure. If you insist on mulching, keep the mulch at least a foot away from the trunk.

Fertilizer should be withheld until after growth commences. During the first year, a single cupful of ammonium sulfate (21-0-0) split into three or four applications is adequate. Use 2 cups in the second year and three in the

third. Just scatter the fertilizer on the ground around the tree and water thoroughly. In areas other than the Valley, use whatever fertilizer analysis that is in general use in the area for trees and shrubs--simply adjust the rate based upon nitrogen content.

Cold protection measures for lemon trees will be required sooner or later. Soil banks are very effective for young trees; the soil should be put up about Thanksgiving and left in place through February. Exercise care when taking down the soil bank, as the bark underneath will be extremely tender.

Blankets, tarps or similar covers are also very effective and have the advantage of being quickly draped over the young tree. The corners should be stretched outward and tied down. More elaborate protection can be provided by erecting a frame structure of wood or PVC pipe over the plant to facilitate the use of plastic or large tarps during particularly severe cold weather. Supplemental heat can also be provided under the covers; incandescent heat lamps and Coleman lanterns are useful.

MATURE TREE CARE

Watering should be slow and thorough; probably every couple of weeks would suffice in any but the very sandy soils. Nutrition should continue at about 1 cup of ammonium sulfate per year of tree age annually in split applications in February, May and September, i.e. a 6-year-old tree should receive about 6 cups of 21-0-0 for the year. Adjust the rate for other fertilizers based upon the relative nitrogen content.

Lawngrass should be kept back about a foot from the canopy of the tree. Other than cold damage, no pruning should be necessary, as the lemon tree will develop its natural shape without pruning. While mulching is not recommended for citrus trees, if you must mulch, keep the mulch at least one foot away from the tree trunk.

PRODUCTION, MATURITY AND USE

Given freedom from cold damage and modest care, any of the lemons will produce more fruit than a family could use. Among the true lemons, the 'Eureka' types will produce primarily in spring to summer, while 'Lisbon' types will bear mostly in summer and fall. 'Ponderosa' and 'Meyer' lemons bear mainly in fall to winter. However, all types can have some fruit practically anytime.

At full maturity, the fruit will turn yellow on the tree. However, they may be sufficiently juicy to use before they change color. While true lemons must be cured for a couple of days in order to sustain commercial marketing, curing should not be necessary for those that will be used directly from the tree.

Aside from their obvious use in flavoring beverages or lemonade, the lemons can also be used in pies, cakes, candies and marinades. While the mature fruit will store well on the tree for months, the juice can be frozen in ice cube trays and then stored frozen for later use.

PROBLEMS

Lemons are afflicted with the same pests and diseases as other citrus, so the reader is referred to Home Fruit Production--Citrus, Table 2. In addition, the peel of true lemons is very easily bruised, releasing peel oil that causes serious oil spotting of the peel. While oil spotting does not affect the juice, it can shorten the life of the fruit. To eliminate the problem, simply delay picking until late morning or afternoon, do not pick after a rain or when the fruit is wet and handle the fruit gently to avoid bruising.

One pest not discussed in the HFP-Citrus publication is Asian citrus leafminer, as the pest arrived in Texas about 1994. This leafminer attacks the new flushes of growth when the developing leaves are only about an inch long, leaving serpentine trails from their feeding and causing stunting and distortion of the leaf. Occasionally, trails or mines occur on fruit as well. Each growth flush is susceptible to attack, of which four usually occur in March, May, July and September. The spring flush is least damaged, since the leafminer does not overwinter well, but the later flushes can be devastated.

There are no chemical controls available for home use, although citrus spray oils do deter infestation if the application is timed to the development of a new flush of growth. Otherwise, it is best to try to ignore the damage; leafminer will not kill the tree and indiscriminate spraying kills a lot of the natural predators and parasites that help to keep leafminer populations down.

There are very few lemon tree problems that are life-threatening--and the home gardener cannot do anything about those anyway. Many of the rest of the insects and diseases that afflict lemon trees can generally be ignored

in the home garden, as blemishes to the peel affect only the appearance, and, in some cases, size of the fruit.

If one must spray, first identify the problem, then select the appropriate material and apply it properly and at the appropriate time to control the pest while minimizing damage to the complex of beneficial organisms that exist in citrus.

Texas Citrus and Subtropical Fruits is maintained by Iulian W. Sauls.
Web design by Gretchen Chaffin.

HOME FRUIT PRODUCTION-GRAPEFRUIT

Julian W. Sauls
Professor & Extension Horticulturist
December, 1998

Grapefruit apparently originated as a natural mutation of the shaddock or pummelo somewhere in the West Indies. It was first described in 1750 in Barbados, while the first record of the term grapefruit occurred in 1814 in Jamaica. Credit for its introduction to the United States in accorded to Count Odette Phillipe, a Spanish don, who planted it in Pinellas County, FL, about 1823. That grapefruit originated as mutation from pummelo seems more likely when one considers the number of grapefruit varieties today, most of which originated as mutations from existing grapefruit varieties.

While Charles Volz is credited with the first successful orange plantings on sour orange rootstock in the Lower Rio Grande Valley of Texas in 1908, little is known of the first plantings of grapefruit in Texas. The earliest record of grapefruit shipments from Texas was 120 tons during the 1919-20 season. Texas grapefruit production peaked at 960,000 tons during the 1945-46 season, which coincided with a peak U.S. production of 2,485,000 tons. That total U.S. production was not achieved again until 1971-72, but Texas grapefruit production has rarely exceeded half its peak level.

While the first grapefruit were white-fleshed and seedy, the Texas grapefruit industry ultimately developed around seedless, red-fleshed varieties, all of which arose in Texas by mutation from existing grapefruit.

Except during major freezes and the recovery from them, the Texas citrus industry annually produces more tonnage, about 80 percent of which is grapefruit, than all other tree fruits and nuts in Texas combined. Because of this and the quality and importance of Texas red seedless grapefruit, the Legislature in 1993 designated red grapefruit as the State Fruit of Texas.

CLIMATE

Grapefruit achieves its best quality under conditions of hot days and warm to hot nights, which results in higher sugars and lower acids than grapefruit produced in the cooler night temperatures common in Arizona and California. It grows well in both tropical and subtropical climates of the world, but it is a little less cold hardy than oranges.

Mature, healthy grapefruit trees that are well-hardened by previous cool to cold weather can probably tolerate temperatures in the mid-20's without leaf or twig damage, although ice will form in the fruit of grapefruit after about 3 to 5 hours at 27. Because severe freezes kill grapefruit trees in the Lower Rio Grande Valley, successful home grapefruit production will sooner or later require cold protection measures.

SOILS AND SITE SELECTION

Grapefruit trees on sour orange rootstock are well-adapted to deep, well-drained soils. Loamy soils are preferred while heavy clays and poorly-drained soils will result in poor growth and production as well as shorter life.

For maximum cold protection, grapefruit in the home landscape should be planted on the south or southeast side of the house. Distance from the house or other buildings and driveways or walkways should be at least 12 feet to allow adequate room for the tree to grow to its mature size. While large, overhanging shade trees will provide some cold protection, grapefruit grows and produces best in full sun.

VARIETIES

The major grapefruit varieties in Texas are 'Ruby Red', 'Henderson'/'Ray' and 'Rio Red'. All were discovered in Texas and all are red-fleshed, seedless and have varying degrees of redness in the peel.

'Ruby Red' was discovered as a limb sport (a mutation of one limb which has different fruit characteristics than the rest of the tree) on a 'Pink Marsh' tree in 1929 by A. E. Henninger of McAllen, TX, who was granted a patent (U.S. Plant Patent No. 63) in 1934. The fruit is of excellent quality, seedless (i.e., 0 to 6 seeds), red-fleshed, oblate and thin skinned. The fruit usually has a red blush on an otherwise yellow peel. The interior color fades badly after the first of the year.

At least half a dozen other limb sports of 'Pink Marsh' were discovered in Texas between 1930 and 1940--all very similar to 'Ruby Red'--plus one limb sport from 'Foster' pink seedless grapefruit. For the most part, all are lumped together as 'Ruby Red' for commercial purposes.

'Henderson' and 'Ray' are usually lumped together in the industry as they are nearly indistinguishable. Both were discovered in the Valley in the early 1970's-- 'Henderson' as a limb sport on 'Ruby Red' and 'Ray' as four trees, the buds of which were supposed to be 'Ruby Red'. The fruit of these two varieties is similar to 'Ruby Red' in almost all respects except that the peel is more attractive than 'Ruby Red' and the flesh is even redder. While the flesh color also fades after mid-season, it retains some semblance of redness far longer than is the case with 'Ruby Red'. Three other similar limb sports of 'Ruby Red' were discovered in the 1970's by Texas growers, but none has achieved the prominence of 'Henderson'.

'Rio Red' was discovered in 1976 by R. A. Hensz as a limb sport on a tree being grown from 'Ruby Red' budwood that had been irradiated. Released in 1984, 'Rio Red' has interior color that is twice as red as 'Henderson' and its color persists throughout the season. 'Rio Red' has an overall reddish tinge on the peel and a lighter-colored halo in the flesh when viewed in cross-section. The biggest detriment of 'Rio Red' is that its basic shape is more spherical than oblate and sheepnosing of the stem end is a persistent problem.

Texas markets its 'Ruby Red' and 'Henderson'/'Ray' under the name Ruby-Sweet. Some 'Henderson' fruit are marketed as 'Flame' to distinguish it from 'Ruby Red' and to capitalize on Florida's 'Flame' grapefruit which is a nucellar 'Henderson' . 'Rio Red' is marketed under the name Rio Star.

Minor varieties in Texas include 'Duncan' which is the original white, seedy grapefruit variety and 'Marsh' white, seedless grapefruit. Some people consider the white-fleshed grapefruit to have better flavor than the pigmented varieties, but the grapefruit market obviously prefers the red-fleshed, seedless varieties. 'Garner Seedless' is a white grapefruit discovered near Laredo, TX, that created some excitement in the Winter Garden because of its apparent cold hardiness. Its hardiness, however, was due to the fact that it was propagated from seed and thereby grew on its on roots rather than having been budded or grafted onto rootstocks. Seedling citrus trees are generally somewhat more cold hardy than budded or grafted counterparts.

'Star Ruby' grapefruit is still popular with some home fruit growers and consumers, although its commercial tenure was rather short-lived. It was developed by R.A. Hensz from irradiated seed of the seedy, red-fleshed 'Hudson' grapefruit. Its flesh is the most intensely red of the Texas varieties; its peel and even the cambial layer of the wood have a pronounced reddish tinge. Its erratic and poor bearing habit, as well as its sensitivity to foot rot and to some commonly-used citrus herbicides doomed 'Star Ruby' to obscurity.

A seedy, orange-fleshed fruit that matures slightly earlier than grapefruit because of its lower acidity, is grown in a few home plantings in the Valley. It is known by various names, including 'New Zealand Grapefruit', and 'Poorman Orange'. The fruit and tree are very similar to grapefruit, but it is probably a pummelo hybrid that may have originated in China or Australia.

The following are varieties that are not available in Texas, to my knowledge, and are not likely to become available unless there is sufficient demand that they can be entered into the Texas Citrus Budwood Foundation for certification as being virus-free. They are described, however, because the author has received inquiries about them over the years.

'Burgundy' is a mutation from 'Pink Marsh' that was discovered in 1948 near Fort Pierce, FL and patented (U.S. Plant Patent No. 1276) in 1954. Its flesh is deeper red and more uniform than that of 'Ruby Red' and its color holds late into the season. That 'Burgundy' does not mature until April or May (in Florida) was a drawback to commercialization--but such late maturity may be advantageous for an extended season.

'Chironja' is an apparent grapefruit-orange hybrid that was discovered in Puerto Rico. The fruit is large and oblate like grapefruit, with peel and flesh color more like that of orange. Its flavor is pleasant, lacking the bitterness characteristic of grapefruit. It is grown to a limited extent in Puerto Rico, but not elsewhere.

'Oroblanco' is a patented hybrid between grapefruit and an acidless pummelo that was released by the University of California. It is sweet, without the bitterness of grapefruit, few-seeded and a little larger than a grapefruit. The rind is smooth, very thick and greenish yellow at full maturity, which is usually December to January in inland California and desert areas.

'Melogold', a sibling of 'Oroblanco', is somewhat larger with a thinner peel which is still considerably thicker than that of grapefruit. Its fruit are sweet, with a pummelo-like flavor, and few seeded. The rind is yellowish green at maturity, which is usually November to January in interior production areas of California and Arizona.

Neither 'Oroblanco' nor 'Melogold' have been tested nor are they available in Texas. The descriptions are based on California conditions in which they are grown; it would be expected that the rind would be thinner and less yellow under conditions in Texas.

PROPAGATION

Either T-budding or inverted T-budding onto sour orange seedling rootstocks is the primary means used to propagate grapefruit trees in Texas. Because of the high degree of nucellar embryony (seeds come true-to-type) in most grapefruit varieties, they can be grown from seed. However, seedage has two major drawbacks: 1) the seedling-grown trees will be short-lived because of their susceptibility to Phytophthora disease (both foot rot and root rot) and 2) fruit production will usually be delayed for several years until the seedling trees grow through juvenility and become capable of bearing.

PLANTING AND ESTABLISHMENT

Most grapefruit trees propagated in the Lower Rio Grande Valley are grown in field nurseries. Such trees are then dug as if they will be balled-and-burlapped, but instead of wrapping the root ball with burlap, nurserymen commonly use a strip of burlap under the tree to lift it into a two-gallon container. Since the root ball is intact and includes the soil in which it was growing, such trees can be transplanted directly from the container.

Some grapefruit trees, however, are container-grown entirely in an artificial, soilless medium--which requires special treatment at transplanting. After the planting hole is ready, remove the tree from the container and use a gentle stream of water from the garden hose to wash an inch or so of the medium from all around the root ball, thereby exposing the peripheral roots. Thus, the outer roots are placed in contact with the soil of the planting site and growth commences almost immediately.

Under no circumstances should soil around the proposed planting site be removed to form a shallow basin for watering--to do so almost guarantees that the young grapefruit tree will contract foot rot and die before its fifth year. The soil in the planting site should be at least as high as the surrounding yard, if not higher. In addition, the tree should be set slightly higher than it was in the nursery container to assure that the budunion will remain well above the soil.

Mixing topsoil, compost, peat or other materials with the backfill soil is neither necessary nor desirable in good soils. Set the tree in the hole, backfill about halfway, then water sufficiently to settle the backfill around the lower roots. Finish backfilling the hole and then cover the root ball with about in inch of soil to seal the growing medium from direct contact with the air and thereby prevent rapid drying of the root ball.

To facilitate watering, bring soil from the garden or elsewhere to construct a watering ring atop the ground around the newly planted tree. The ring should be about two feet across and several inches high and thick. To water, just fill the water ring immediately after planting. After the water soaks in, it may be necessary to add a little soil to any holes formed as the soil settled around the roots.

The watering interval should be every few days for the first couple of weeks, then gradually increased to 7 to 10 days over the next couple of months. The watering ring will gradually melt into the surrounding soil, at which time the young grapefruit tree can be considered to be established.

All weeds and lawngrass should be completely eliminated inside the watering ring, as the developing grapefruit tree cannot compete well. A systemic, contact herbicide will work very well, so long as it is not allowed to contact the young tree leaves or green bark.

The best way to protect the young trunk from herbicide damage and, at the same time, to prevent sprouts along the trunk is to crimp an 8-inch by 18-inch piece of heavy duty aluminum foil around the trunk from the ground to

the scaffold limbs. Fold the foil lengthwise, bring the long edges past the trunk on both sides, crimp the two edges together and lightly squeeze the foil around the trunk.

While mulching of citrus trees is commonly practiced in southeast Texas where there is an abundance of materials to use, mulching is not recommended for citrus because it increases the possibility of the tree contracting foot rot, for which there is no cure. If you insist on mulching, keep the mulch at least a foot away from the trunk.

Fertilizer should be withheld until after growth commences. During the first year, a single cupful of ammonium sulfate (21-0-0) split into three or four applications is adequate. Use two cups in the second year and three in the third. Just scatter the fertilizer on the ground around the tree and water thoroughly. In areas other than the Valley, use whatever fertilizer analysis that is in general use in the area for trees and shrubs--simply adjust the rate based upon nitrogen content.

Cold protection measures for grapefruit trees will be required sooner or later. Soil banks are very effective for young trees; the soil should be put up about Thanksgiving and left in place until early March. Exercise care when taking down the soil bank, as the bark underneath will be extremely tender.

Blankets, tarps or similar covers are also very effective and have the advantage of being quickly draped over the young tree. The corners should be stretched outward and tied down. More elaborate protection can be provided by erecting a frame structure of wood or PVC pipe over the plant to facilitate the use of plastic or large tarps during particularly severe cold weather. Supplemental heat can also be provided under the covers; incandescent bulbs and heat lamps are useful.

MATURE TREE CARE

Watering should be slow and thorough; probably every couple of weeks would suffice in any but the very sandy soils. Nutrition should continue at about one cup of ammonium sulfate per year of tree age annually in split applications in February, May and September, i.e. a 6-year-old tree should receive about six cups of 21-0-0 for the year. Adjust the rate for other fertilizers based upon the relative nitrogen content.

Lawngrass should be kept back about a foot from the canopy of the tree. Other than cold damage, no pruning should be necessary, as the grapefruit tree will develop its natural shape without pruning. While mulching is not recommended for citrus trees, if you must mulch, keep the mulch at least one foot away from the tree trunk.

PRODUCTION, MATURITY AND USE

Budded grapefruit trees, if properly established and grown, should bear in the third season after transplanting. Any fruit that sets in the first and second years should be removed in order to direct all of the young tree's energy into growth. The first production could easily exceed 25 pounds per tree, which should increase to some 250 pounds or more by the tenth season.

Generally, grapefruit does not 'ripen" in the normal sense of the word, rather, it matures to good eating quality. Texas grapefruit will usually achieve legal maturity in mid-to-late October, although the peel color will likely still be quite green (plus the red blushing of red-fleshed varieties). Natural degreening occurs gradually through the next couple of months. The longer the fruit remains on tree, the larger it becomes and the sweeter it becomes. Grapefruit holds very well on the tree, so fruit can be harvested as needed from late October through May.

As stated previously, the interior flesh color of 'Ruby Red' fades rapidly after the first of the year, while that of 'Henderson' begins to fade rapidly in late February or March. 'Rio Red' retains its deep red color throughout the season.

Grapefruit is primarily eaten fresh but it is readily processed as well. The juice can be extracted and chilled for use within a couple of weeks; it can also be frozen for later use. In addition, the sections can be removed from cut halves (just as it you were eating a grapefruit half), placed in locking freezer bags and frozen for use during the summer and early fall until the next crop matures.

PROBLEMS

The pest and diseases which affect grapefruit in Texas are detailed in Home Fruit Production-Citrus, Table 2. In addition, the Asian citrus leafminer attacks the new flushes of growth when the developing leaves are only about an inch long, leaving serpentine trails from their feeding and causing stunting and distortion of the leaf. Occasionally, trails or mines occur on fruit as well. Each growth flush is susceptible to attack and grapefruit should have four growth flushes annually. The spring flush is least damaged, since the leafminer does not overwinter well, but the later flushes can be devastated.

There are no chemical controls available for home use, although citrus spray oils do deter infestation if the application is timed to the development of a new flush of growth. Otherwise, it is best to try to ignore the damage; leafminer will not kill the tree and indiscriminate spraying kills a lot of the natural predators and parasites that help to keep leafminer populations down.

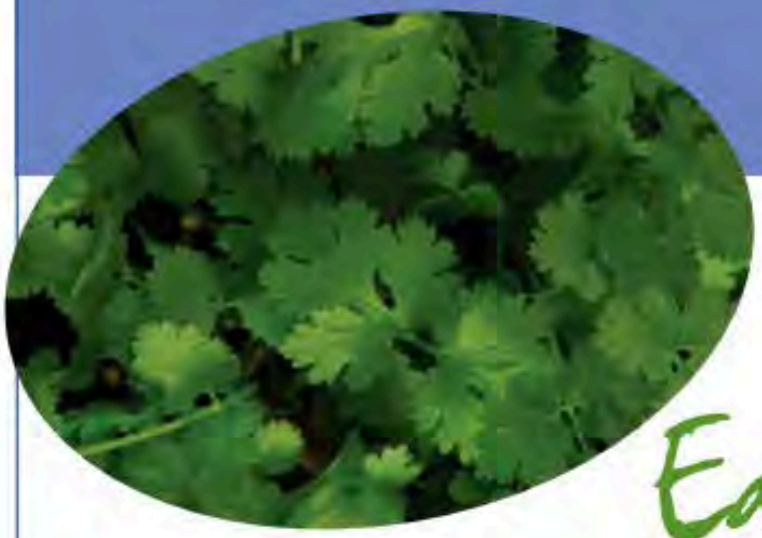
There are very few grapefruit tree problems that are life-threatening--and the home gardener cannot do anything about those anyway. Many of the rest of the insects and diseases that afflict grapefruit can generally be ignored in the home garden, as blemishes to the peel affect only the appearance, and, in some cases, size of the fruit.

If one must spray, first identify the problem, then select the appropriate material and apply it properly and at the appropriate time to control the pest while minimizing damage to the complex of beneficial organisms that exist in citrus.

Herbs

E-277
2-11

AgriLIFE EXTENSION
Texas A&M System



Easy Gardening

ANTRO • CILANTRO • CILANTRO • CILANTRO • CIL

Joseph Masabni, Assistant Professor and Extension Horticulturist, and Patrick Lillard, Extension Assistant, The Texas A&M System

Cilantro is in the same family as parsley and is originally from Greece. Both its fresh green leaves and its seeds are used in many dishes, from Mexican food to Thai food.

Cilantro leaves are used fresh in salads, salsa, and meat dishes, and can add a little zest to an omelet. The seeds, which are referred to as coriander, have a distinct flavor similar to orange and are used in pastries, sausage, and cooked fruit, and as an important ingredient in pickling spice and curry powder. Coriander oil is purported to have a medicinal quality and reduce flatulence.

Varieties

- Long Standing
- Slo Bolt
- Leisure

Soil preparation

Cilantro prefers a light, well-drained, moderately fertile loam or sandy soil, but it will tolerate many soils as long as nutrient levels and moisture are monitored.

Planting

Cilantro is a cool-season crop that does best at temperatures between 50 and 85 degrees F. It can tolerate temperatures as low as 10 degrees F, but if temperatures exceed 85 degrees F it will start to bolt. In Texas, the best time to plant cilantro is in February for an April harvest and again in September for a November harvest. Weekly plantings will ensure that you have a continuous crop.

To establish cilantro from seeds, set the seeds in a soft, well-tilled, and composted soil in January or February for a spring crop or in September for a fall crop. Set the seeds 2 inches apart in rows 12 to 15 inches apart if you are planning to harvest cilantro leaves. If you plan to harvest the seeds, plant the seeds 8 inches apart in rows 15 inches apart.

For both uses, the seed depth should be about ¼ to ½ inches. There are about 2,000 seeds per ounce, so home gardeners will not

need to purchase a lot of seeds for each season.

Figure 1. The seeds of the cilantro plant are known as coriander.

Fertilizing

Cilantro should be fertilized twice. Apply ½ teaspoon of ammonium nitrate (34-0-0) or urea (21-0-0) per square foot.

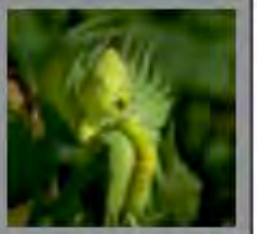
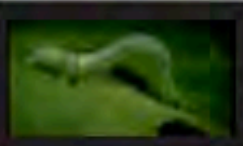
Watering

The plant's most critical need for water occurs during seedling germination and establishment. After the plants become established, they do not need much water.

Disease

Name and description		Control
	Bacterial leaf spot (*Pseudomonas syringae* pv. *coriandricola*)	neem oil

Insects

Name		Control
	Beet armyworm (*Spodoptera exigua*)	Bt Sevin® pyrethrin
	Cabbage looper (*Trichoplusia ni*)	neem oil Bt spinosad
	Green peach aphid (*Myzus persicae*)	neem oil pyrethrin azadirachtin

Weeds

	Control
Preplant	Corn gluten meal
Postemergence	20% vinegar cinnamon and clove oil d-limonene

Harvesting

Cilantro leaves are ready to harvest 45 to 70 days after seeding. Cut exterior leaves once they reach 4 to 6 inches long. Or, cut the whole plant about 1 to 2 inches above the soil level to use both small and large leaves.

Produced by Texas A&M AgriLife Communications
Extension publications can be found on the Web at *AgriLifeBookstore.org*

New

Cilantro

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties
Santo, Slo Bolt

Soil Preferences
Tolerates a wide range of soil types so long as tilth, nutrient, and moisture levels are maintained, pH 6.5 - 7.5.

Optimum Growing Conditions
Tolerates a wide range of conditions but does best under 50 - 85°F.

Establishment Methods

Planting Method	Direct seeded
Optimum Time	soil temperature 45-85°F
Seeding rate	25-50 lbs/acre
Approx seed/oz	15,000-20,000
Seeding depth	0.25-0.5"
Seedling spacing	Direct seeded on 38-40" wide raised beds in two lines, scatter shoe planter forming two seed lines 2-5" wide.

Fertility/Fertilization
Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results).

Generalized rate: 100 - 80 - 120* lb/acre	
N**	100 with 1/3 pre-plant; top or sidedress 1/3 after each cutting
P	Banded all approximately 1-2" below seed row at planting
K	Apply with nitrogen as indicated above

* If need indicated by soil test. ** Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation
Low requirement, 6-12" uniformly applied throughout growing season. Critical watering stages are at seed germination and establishment.

Pest Management

Cilantro Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Leaf spots		Neem Oil
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin

Cilantro Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Aphid	Bifenthrin, Imidacloprid, Peppermint and Rosemary Oil, Petroleum Oil, Piperonyl Butoxide, Potassium Salts of Fatty Acids, Zeta-Cypermethrin	Azadirachtin, Neem Oil, Pyrethrins
Armyworm	Bifenthrin, Spinetoram, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*, Pyrethrins, Spinosad

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	Metam-Potassium, Metam-Sodium	Corn Gluten Meal
Preemergence	Bensulide	
Postemergence	Carfentrazone-Ethyl, Clethodim, Glyphosate, Pelargonic Acid, Sethoxydim	Cinnamon and Clove Oil, Clove Oil, D-Limonene

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.
** As stated in §205.206 of the National Organic Standards, pest management decisions should

follow a hierarchical approach, which should be defined in a farm's organic systems plan. Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

Days after planting	50-55 days
Normal method	Hand clipped 1.5-2" above bed surface or root cut and bunched. Some bulk cutting of foliage with harvester is done in some states where processing usage is available.
Containers	Field wagons and bins
Packaging/Handling	10 lb box with 30 bunches
Anticipated yield/acre	100-200 field crates (100 bunches/crate) per acre

Transit Conditions

33-35°F at 95-100% RH. Shelf-life 14 days.

Comments/Production Keys

- Can tolerate light frost
- Hot weather or Gibberellic acid (ProGibb) applications causes Cilantro to bolt, seed very quickly, and cease foliage development
- Exposure to ethylene gas or other produce which emits ethylene will shorten shelf-life

Garlic

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties
California Early, California Softneck, Elephant Garlic, French Mild Silverskin, Mexican Purple, New York White

Soil Preferences
Sandy or clay loams with pH range of 6.0 - 8.4 but adaptable to a wide range of soil types if properly managed.

Optimum Growing Conditions
Cool conditions during growing season. Temperatures below 40°F for 6-8 weeks required for vernalization. once vernalized, bulbing initiates when day length exceeds 13 hours and soil temperature exceeds 60°F. Adaptable to all areas able to produce onions.

Establishment Methods

Planting Method	Transplanted (field set cloves)
Optimum Time	Soil temperature at 2" depth <85°F
Seeding rate	750 - 1000
Approx seed/oz	8,500
Seeding depth	1"
Seedling spacing	3-4" in-row, two lines on 38-40" wide raised bed *Space elephant garlic 2-4 cloves/bed ft.*

Fertility/Fertilization
Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results).

Generalized rate: 100 - 80 - 80 lb/acre	
N*	100-175; 50 lbs applied at or prior to planting, remainder in 1-2 side-dressings as rapid growth begins in spring

P	75-120 banded approximately 2" below cloves at planting
K	75-100 applied with initial nitrogen application

* Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation

15 - 20". Critical stage is from time of rapid growth initiation in spring until maturity (yellowing of tops). Generally 1-2" needed per week during this period.

Pest Management

Garlic Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Botrytis	Fluopicolide, Sodium Tetraborohydrate Decahydrate	Clove, Rosemary and Thyme Oil, Hydrogen Dioxide, Neem Oil, *Streptomyces lydicus*
Downy mildew	Acibenzolar-S-Methyl, Bacillus Pumilus, Chlorothalonil, Copper Sulfate, Dimethomorph, Fenamidone, Fluopicolide, Mancozeb, Mandpropamid, Maneb, Neem Oil, Potassium Phosphite, Azoxystrobin, Pyraclostrobin, Sodium Tetraborohydrate Decahydrate	*Bacillus subtilis*, Clove, Rosemary and Thyme Oil, Copper Hydroxide, Hydrogen Dioxide, *Streptomyces lydicus*
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin
Pink root	1,3-Dichloropropene	
Powdery mildew	Pyraclostrobin, Sodium Tetraborohydrate Decahydrate, Sulfur	*Bacillus pumilus, Bacillus subtilis*, Clove, Rosemary and Thyme Oil, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Streptomyces lydicus*, Sulfur
Purple blotch	Azoxystrobin, Boscalid, Chlorothalonil, Copper Sulfate, Cyprodinil, Fenamidone, Mancozeb, Mancozeb, Maneb, Potassium Phosphite, Propiconazole, Pyraclostrobin, Pyrimethanil, Tebuconazole	*Bacillus subtilis*, Copper Hydroxide, Extract of *Reynoutria sachalinensis*

White rot	Azoxystrobin, DCNA Dicloran, Iprodine, PCNB, Tebuconazole, Thiophanate-Methyl	

Garlic Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Armyworms	Cypermethrin, Gamma-Cyhalothrin, Lambdacyhalothrin, Permethrin, Piperonyl Butoxide, Spinetoram, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*, Pyrethrins, Spinosad
Cutworm	Cypermethrin, Deltamethrin, Gamma-Cyhalothrin, Lambdacyhalothrin, Permethrin, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*, Peppermint and Rosemary Oil, Spinosad
Mites	Petroleum Oil	Azadirachtin, Pyrethrins
Thrips	Acetamiprid, Deltamethrin, Imidacloprid, Malathion, Petroleum Oil, Piperonyl Butoxide, Potassium Salts of Fatty Acids, Sodium Tetraborohydrate Decahydrate, Spinetoram	Azadirachtin, Kaolin, Peppermint and Rosemary Oil, Pyrethrins, Spinosad

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	Metam-Potassium, Metam-Sodium, Paraquat Dichloride, Pendimethalin	Corn Gluten Meal
Preemergence	Bensulide, Dimethenamid-P, Ethofumesate, Flumioxazin, Oxyfluorfen, Pelargonic Acid	Cinnamon and Clove Oil, Clove Oil, D-Limonene
Postemergence	Bromoxynil, Carfentrazone-Ethyl, Clethodim, Fluazifop-P-Butyl, Glyphosate, Pyraflufen Ethyl, Sethoxydim	

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.

** As stated in §205.206 of the National Organic Standards, pest management decisions should follow a hierarchical approach, which should be defined in a farm's organic systems plan.

Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

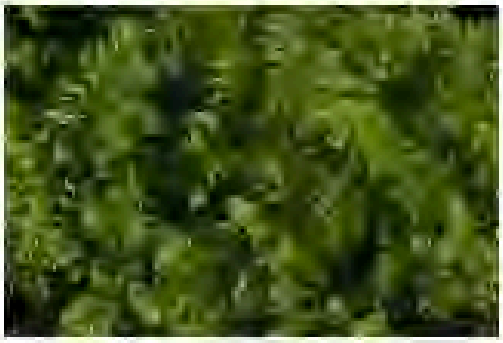
Days after planting	150-200
Normal method	Hand/machine: wind rowed with potato digger, bagged and field dried for 10-14 days
Containers	Burlap bags
Grades	U.S. #1 - uniform, free of defects and true to variety type
Packaging/Handling	Carton holding 12 1 lb packs 10 lb cartons holding 12 tube or film packs 30 lb telescope bulk cartons
Anticipated yield/acre	5,000-15,000

Transit Conditions
32°F at 65-70% RH; shelf life 6-7 months (3-4 months with common storage).

Storage
50°F at 65-70% RH; rapid sprouting enhanced at 40-50°F; prolonged storage at 40°F results in rough bulbs, witch-brooming and early maturity; storage above 65°F results in delayed sprouting and late maturity.

Comments/Production Keys

- Garlic is harvest mature when tops dry and begin to fall
- Mow or flail tops if machine harvested. Wind row to protect bulbs from sun scalding if left in field to dry
- Remove tops and roots prior to packaging or storing
- Discontinue irrigation after cloves are well filled and desired bulb size is obtained and 3-5 well formed scales surround bulbs
- Do not follow onions with garlic



Parsley

Dr. Joe Masabni
Department of Horticulture
Texas AgriLife Extension Service

Varieties
Banquet, Champion Moss Curled, Evergreen, Italian Flat Leaf, Moss Curled, Pagoda, Plains Italian, Triple Curl

Soil Preferences
Wide variety of soils but prefers well drained, sandy loams with pH 6.0 - 7.0.

Optimum Growing Conditions
Parsley grows well under a wide range of temperatures, but does best with temperatures ranging between 45-85°F. Temperatures below 45°F for 1-2 months cause bolting as temperatures increase.

Establishment Methods

Planting Method	Direct seeded
Optimum Time	Soil temperature 50-80°F
Seeding rate	20-40 lbs/acre
Approx seed/oz	15,000-18,000
Seeding depth	0.25-0.3"
Seedling spacing	In-row spacing - Drop 24-30 seed/foot Multiple rows per bed ▪ 40" bed - 6-12" between rows on bed surface with 4 rows ▪ 80" bed - 10-12" between rows

Fertility/Fertilization
Rates presented as actual lbs/acre N_2, P_2O_5, and K_2O (base actual rates applied on soil test results).

Generalized rate: 120 - 50 - 120 lb/acre	
N*	80-100 Apply 20-25% pre-plant + 20-25% when rapid growth flush initiates and another 20-25% after each cutting

P	50-80 banded approximately 1-2" below seed at planting
K	100-120 applied only if needed as indicated by soil test. Apply all with first nitrogen application.

* Ammonium nitrate is very stable and least likely to evaporate. Urea and ammonium sulfate evaporate if not incorporated.

Water/Irrigation
Maintain uniform soil moisture, 6-12" per season.

Pest Management

Parsley Diseases and Common Name of Fungicidal Controls

DISEASE	FUNGICIDE*	OMRI LISTED FUNGICIDE**
Damping-off (Pythium)	Fludioxonil	
Downy mildew	Azoxystrobin, Fenamidone, Fluopicolide, Fosetyl-Al, Mandpropamid, Potassium Phosphite, Pyraclostrobin	*Bacillus Pumilus*, *Bacillus subtilis*, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, *Streptomyces lydicus*
Leaf Spots		Neem Oil
Nematode	1,3-Dichloropropene, Chloropicrin, Metam-Potassium, Metam-Sodium, Sesame Oil	Azadirachtin
Powdery mildew	Azoxystrobin, Potassium Phosphite, Triflumizole, Potassium Salts of Fatty Acids, Propiconazole	*Bacillus pumilus*, *Bacillus subtilis*, Extract of *Reynoutria sachalinensis*, Hydrogen Dioxide, Neem Oil, Potassium Bicarbonate, *Streptomyces lydicus*, Sulfur

Parsley Insect Pests and Common Name of Insecticidal Controls

INSECT	INSECTICIDE*	OMRI LISTED INSECTICIDE**
Aphid	Acetamiprid, Imidacloprid, Malathion, Permethrin, Potassium Salts of Fatty Acids, Spirotetramat, Thiamethoxam, Zeta-Cypermethrin	Azadirachtin, Garlic Juice Extracts
Armyworm	Carbaryl, Flubendiamide, Spinetoram, Thiodicarb, Zeta-Cypermethrin	Azadirachtin, *Bacillus thuringiensis*, Garlic Juice Extracts, Pyrethrins, Spinosad
Beetle		Azadirachtin, Garlic Juice Extracts, Pyrethrins
Weevil		Azadirachtin, Garlic Juice Extracts

Weeds and Common Name of Herbicidal Controls

WEED	HERBICIDE*	OMRI LISTED HERBICIDE**
Preplant incorporated	DCPA, Bensulide, Trifluralin	Corn Gluten Meal
Preemergence		
Postemergence	Carfentrazone, Paraquat, Sethoxydim, Glyphosate, Pelargonic Acid, Clethodim, Clopyralid	D-Limonene, Clove Oil, Cinnamon and Clove Oil

* The above is a partial listing of controls intended as examples. Some labels may have been revoked since the publication of this guide. Refer to product labels for specifics and use accordingly. Ensure that products with one of the listed active ingredients are registered for the crop it is to be used on. Failure to do the above may result in crop injury, death and/or citation for law violation. Humans, animals and the environment may also be adversely affected by misuse.

** As stated in §205.206 of the National Organic Standards, pest management decisions should follow a hierarchical approach, which should be defined in a farm's organic systems plan. Please ensure that you have followed the appropriate steps and any product to be used in certified organic production systems has been approved by your certifying agent.

Harvest

Days after planting	70-80 days
Normal method	Hand clipped and bunched
Packaging/Handling	5 dozen bunches per carton (20-22 lbs)
Anticipated yield/acre	100-200 field crates per acre (100 bunches per crate)

Transit Conditions
32°F at 95-100% RH; shelf-life 8-10 weeks.

Comments/Production Keys

- Parsley is a shallow rooted crop requiring uniform soil moisture levels. Water stress will reduce leaf growth development, restricting yields.
- Good weed control a must due to plant growth habit and harvest methods
- Moderately susceptible to ozone injury
- Multiple harvests with approximately 30 days on regrowth
- Boron tolerance up to 6 ppm in irrigation water
- Market demands product to be dark green, fresh in appearance, and free from defects, seed stems and decay

Texas A&M AgriLife Extension
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Easy Gardening

DILL • DILL • DILL • DILL • DILL • DILL • DILL

Joseph Masabni and Stephen King

Assistant Professor and Extension Horticulturist, and former Associate Professor, Texas A&M Department of Horticultural Sciences; The Texas A&M University System

Dill *(Anethum graveolens)* is a perennial herb that typically reaches 2 to 4 feet tall at maturity. Its leaves are used fresh or dried as an herb in dips, soups, salads, and other dishes. The seeds are used as a spice for pickling and for adding flavor to stews and roasts.

Dill is native to southern Russia, western Africa, and the Mediterranean. It is part of the Umbelliferae family, which also includes cumin and parsley.

Figure 1. Dill seeds are used as a spice for pickling and for adding flavor to stews and roasts.

Varieties

These varieties are best for Texas:

- Bouquet
- Dukat
- Fernleaf
- Long Island
- Superdukat

Figure 2. Dill plants can survive low temperatures but grow best when soil temperature is about 70°F.

Site selection

Plant dill in full sun and protect it from strong gusts of wind. The plant can survive temperatures down to 25°F.

Soil preparation

Dill can grow fairly well in poor soil conditions. But it grows best in well-drained, sandy or loamy soil that is slightly acidic (pH 5.8 to 6.5). The soil temperature should remain at about 70°F.

Planting

Sow the seeds directly in the ground from April through May, after all danger of frost has passed. Do not transplant them.

They should germinate in 10 to 14 days.

Seedlings should be planted ¾ to 1 inch deep and from 12 to 15 inches apart.

Growing dill in containers

Dill can also be easily grown in containers, both indoors and outdoors. Choose a deep container to accommodate the tall plant and its long roots. Use normal potting compost and keep the plants well watered.

If the container is inside, place the plants where they will receive at least 5 to 6 hours of direct sunlight each day. You may need to support the plants with a stake. The dill will be ready for harvest within about 8 weeks after the seeds were sown.

Figure 3. Dill containers need enough space for the plant's tall growth and long roots.

Fertilizing

Fertilizer may be broadcast (spread on the surface throughout the planting) or applied as a side dressing (applied to the soil on or around the sides of the plant). Do not apply it directly with the seed.

In general, apply a formulation such as 20-20-20 once in late spring at the rate of 0.70 pound of fertilizer per 100 square feet. "Triple 20" fertilizer is commonly used by gardeners because it is readily available at garden centers.

Figure 4. Dill has the most flavor when it is picked before flowering begins.

A better formulation that doesn't apply too much phosphorus is 15-5-10, and it is also available at garden centers. When using 15-5-10, apply 1 pound per 100 square feet.

Harvesting

Dill grown outside matures about 90 days after seeding. Although the leaves can be harvested as soon as they are big enough to use, they contain the most flavors if picked before flowering begins. Clip them close to the stem in the early morning or late evening.

Once the flowers form, they will bloom and seed. Cut the seed heads 2 to 3 weeks after bloom. Place the cuttings in paper or plastic bags, and allow them to dry; the seeds will fall off when they are ready.

Acknowledgment

Nichole Lee Ann Boatman contributed to the manuscript for this publication.

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TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

GINGER • GINGER • GINGER • GINGER • GINGER

Joseph Masabni and Stephen King

Assistant Professor and Extension Horticulturist, and former Associate Professor, Texas A&M Department of Horticultural Sciences; The Texas A&M University System

The ginger plant *(Zingiber officinale)* is grown for its aromatic, pungent, and spicy rhizomes, which are often referred to as ginger roots.

The main active components in ginger are gingerols, which are responsible for its distinct fragrance and flavor. Gingerols are powerful anti-inflammatory compounds that can help alleviate the pain caused by arthritis. Studies have also shown that ginger helps boost the immune system, protect against colorectal cancer, and induce cell death in ovarian cancer.

Figure 1. Ginger flesh can be red, white, or yellow.

The texture of ginger rhizomes is firm, knotty, rough, and striated (banded). Depending on the variety, the flesh may be yellow, white, or red. The skin is cream-colored to light brown and may be thick or thin, depending on the plant's maturity at harvest (Fig. 1).

Site selection

Ginger thrives best in warm, humid climates. Choose a site that provides plenty of light, including 2 to 5 hours of direct sunlight. Ideal spots are also protected from strong winds.

Soil preparation

The best soil for ginger is loose, loamy, and rich in organic matter. Loamy soils allow water to drain freely, which will help prevent the rhizomes from becoming waterlogged. Thick mulch can also provide nutrients, retain water, and help control weeds.

Planting

Before planting, cut the ginger rhizome into 1- to 1½-inch pieces, and set them aside for a few days to allow the cut surface area to heal and form a callus. In early spring, plant parts of the underground rhizomes. Each piece should be plump with well-developed growth buds, or eyes.

A good source of ginger for planting is fresh rhizomes from another grower. If you are buying ginger from a store, soak the rhizomes in water overnight because they are sometimes treated with a growth retardant.

Plant the rhizomes 6 to 8 inches apart, 2 to 4 inches deep, and with the growth buds pointing upward. They can be planted whole or in smaller pieces with a couple of growing buds each. Ginger plants will grow to about 2 to 3 feet tall.

Fertilizing

If the soil is less than ideal, add a slow-release organic fertilizer at planting. Afterward, liquid fertilizer may be applied every few weeks.

These soil amendments are especially needed in regions of heavy rainfall, where rain can leach essential nutrients from the soil. You can also add compost, which will supply nutrients as well as retain water in the soil. Ginger roots benefit from fertilizer containing high levels of phosphorus (P). Have the soil tested first and amend the soil before planting according to the test recommendations.

Watering

Do not allow the plants to dry out while they are actively growing. As the weather cools, reduce watering. This will encourage the plants to form underground rhizomes. In dry areas, mist or spray plants regularly. Always avoid overwatering.

Figure 2. Harvest ginger by digging up the entire plant.

Harvesting

Ginger can be harvested by digging up the entire plant (Fig. 2). Although it may be harvested at any stage of maturity, the best time is when the plant is 8 to 10 months old. After harvest, choose rhizomes for replanting and replant them promptly.

Ginger is typically available in two forms:

- Young ginger is usually available only in Asian markets and does not need to be peeled.

- Mature ginger is more readily available and has a tough skin that needs to be peeled.

Store fresh ginger in the refrigerator or freezer. If left unpeeled, it can keep for up to 3 weeks in refrigeration or up to 6 months frozen.

Nutrition

Ginger is a good source of copper, magnesium, manganese, potassium, and vitamin B6. Historically, it has been used to relieve symptoms of gastrointestinal distress. It is also safe for pregnant women who are experiencing nausea and vomiting.

Serving

When preparing ginger, peel off the skin with a paring knife. Ginger can be sliced, minced, or julienned (Fig. 3).

The level of flavor that ginger delivers to a meal depends on when it is added during the cooking process. Added early, it will give a hint of flavor; adding it toward the end will bring about a more pungent taste.

Figure 3. Julienned ginger.

Acknowledgment
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The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

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New

Nuts

Nuts

Nuts (Crop Group 14) are high in protein, healthy fats, and are a good source of fiber. They can also help reduce your risk of certain health conditions, including heart disease.

Pecans are mild nuts that are popular for cakes, pies, salads, and grain dishes. One ounce (28 grams) of roasted pecans provides: 201 calories; 21 grams of fat; 3 grams of protein; 4 grams of carbs; 3 grams of fiber; 11% DV of vitamin B1 (thiamine); 13% of DV of zinc; 48% DV of manganese.

Like other nuts, pecans are rich in healthy fats, fiber, vitamins, and minerals. They're a good source of the mineral zinc, which plays an important role in immune function, wound healing, DNA synthesis, and growth and development.

Nuts

Pistachios are a good source of numerous nutrients, including vitamin B6, which your body needs for nutrient metabolism and immune function. Just 1 ounce (28 grams) of pistachios contains: 159 calories; 13 grams of fat; 6 grams of protein; 8 grams of carbs; 3 grams of fiber; 21% of the DV of Vitamin B1 (thiamine), 28% of the DV of Vitamin B6, 11% of the DV of Phosphorus.

Additionally, these nuts are rich in plant compounds like the carotenoids lutein and zeaxanthin, as well as anthocyanins, flavonoids, and proanthocyanidins, all of which have significant antioxidant and anti-inflammatory properties.

Almonds: incredibly popular due to their flavor, impressive nutrient profile, and relatively cheap cost. You can eat them raw or roasted, and they're often made into almond butter, almond flour, and almond milk. One serving of almonds contains: 170 Calories, 15 grams of Fat, 6 grams of Protein, 6 grams of Carbs, 3 grams of Fiber, 45% of DV of Vitamin E, 19% of the DV of Magnesium, 27% of the DV of Manganese.

These nuts are especially rich in vitamin E, a fat-soluble nutrient that functions as an antioxidant to protect your cells against oxidative damage. This vitamin also supports immune function and cellular communication.

Nuts

Walnuts are linked to multiple health benefits and have an impressive nutrient profile. Just 1 ounce (28 grams) contains: 185 Calories, 18.5 grams of fat, 4 grams of Protein, 4 grams of Carbs, 2 grams of Fiber, 50% of the DV of Copper, 11% of the DV of Magnesium, 42% of the DV of Manganese.

These nuts are an excellent source of copper, a mineral that your body needs to produce enzymes involved in energy production and neurotransmitter synthesis. Copper also aids immune function, blood vessel development, and more. Walnuts may improve brain function, and reduce risk factors for dementia, such as heart disease and type 2 diabetes.

Fruit & Nut Resources

Pecans as a Health Food

J. Benton Storey
Professor of Horticulture
Texas A&M University

September 12, 1997

A high dietary intake of saturated fats has been linked to arteriosclerosis and coronary disease. Arteriosclerosis is a process in which fatty substances, especially cholesterol and triglycerides are deposited in the walls of medium-sized and large arteries. Cholesterol in blood is transported in combination with specific aggregates of lipids and proteins called lipoprotein. Normally, most cholesterol is carried in low density lipoprotein (LDL), and is a significant risk factor for coronary heart disease. Other plasma cholesterol is transported in high-density lipoprotein (HDL). Research indicates when HDL cholesterol is high, coronary heart disease risk is lowered.

Saturated fats have been shown to increase plasma cholesterol and LDL levels. Plasma cholesterol can be reduced by twenty mg/dl by reducing the consumption of saturated fats from 17 to 10 percent of the total calories in the diet.

One would think that the more unsaturated a fatty acid is, the healthier it would be because it would reduce the plasma cholesterol. However, this is not necessarily the case. Consuming mostly polyunsaturated fatty acids tend to reduce levels of both LDL and HDL, while research indicates that consuming mostly monounsaturated fats tend to reduce only LDL.

The definitive work by Grundy measured the plasma LDL and HDL after four weeks on a liquid diet containing 40% fats from palm oil (saturated fats), high oleic safflower oil (monounsaturated fats), or high linoleic safflower oil (polyunsaturated fats). The poly and monounsaturated fat diets had equal effects on lowering plasma LDL. However, the polyunsaturated diet lowered plasma HDL more frequently than did the monounsaturated diet.

Grundy also compared a high monounsaturated fat diet that contained 40% fat and 43% carbohydrates and a low fat diet that contained 20% fat and 63% carbohydrates. Both diets lowered total plasma cholesterol. The monounsaturated diet lowered LDL by 21% compared with the low fat diet which lowered LDL by 15%. The low fat diet also raised the plasma level of triglycerides and lowered HDL, while the monounsaturated diet had no effect on either of these. Thus, the monounsaturated diet may be as effective as a diet low in fats and high in carbohydrates.

Pecan nuts contain about 65 to 70 percent oils. Approximately 65% of the oil of fresh pecans consists of oleic and 26% linoleic fatty acid. Our laboratory has consistently found high quality 'Desirable' pecans to have as much as 74% oleic.

Preliminary work indicates that there are different oleic/linoleic ratios consistent with different native pecan populations in the Colorado, Brazos and Guadalupe River bottoms. Discovery of a population high in oleic acid would be a major break-through because such germplasm could become a vital part of pecan breeding.

The pecan research team at Texas A&M University has identified a native pecan in Freestone County, Texas that has an oleic content comparable to that of olives. This native from Freestone County has been placed in the USDA Germplasm Repository as breeding material. Work should be undertaken to learn the inheritance pattern of the oleic/linoleic ratio in pecans. Future breeding procedures could be developed that would lead to higher quality nuts.

Pecans contain oil that compares very favorably with oil from other oil seed crops. These oils were purchased from a local grocery store and run through a gas chromatograph. The expeller pressed pecan oil came from a retail supplier in California. The low oleic content, compared with our own cold pressed nuts, indicates that the expeller nuts had probably been out of storage so long that they had lost much of their quality through oxidation of the monounsaturated fatty acids to polyunsaturated fatty acids and smaller carbon fragments. If the pecan oil industry is to evolve into a viable industry much more consideration should be given to the quality of the oil stock.

Only olive and canola oils compare favorably with high quality cold pressed pecans. Pecan oil could be marketed competitively with olive oil, but canola oil is lower in price. Pecan oil is now consumed as a part of the nut and it is delicious. In the future it could be marketed as a salad oil because the pecan flavor in the oil could make it more popular than less flavorable oils. A long term objective would be to produce a cooking oil for food processors.

In the storage of pecans, the oliec/linoleic ratio decreases with time. However, the conversion from monounsaturated to polyunsaturated fatty acid was found to be delayed by drying the nuts to 4% moisture immediately after early harvest. Improper drying can lead to darker seed coats and a considerable increase in free fatty acids, both of which are characteristics of deteriorating quality. Research points to the best drying temperature to be 35 degrees C (95 degrees F) with an air volume of 21 m3/sec (45 CFM).

Pecans can become an important health food because of their high level of monounsaturated fats. Dietary research with pecans needs to be conducted to confirm their value in lowering LDL content while maintaining HDL content of the blood plasma. Clinical work is now underway by Scott Grundy of the Southwest Texas Medical Center in Dallas, using high quality pecans from Texas. It is hopefully anticipated that the same positive results can be found with pecans as with high-oleic safflower because the same monounsaturated fatty acid can be found in both .

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TEXAS A&M AGRILIFE EXTENSION

Texas Fruit and Nut Production

Improved Pecans

Monte Nesbitt, Larry Stein, and Jim Kamas
Extension Fruit Specialists, The Texas A&M University System

Pecan trees grow in many settings, including woodlands, parks, urban greenbelts, courthouse lawns, and thousands of home landscapes. The pecan is the state tree of Texas and has an important place in the state's history.

Native and improved pecan trees are grown commercially on about 70,000 acres in Texas. The improved varieties were originally called papershell pecans because of their thinner shells (Fig. 1). The trees are large and long-lived; they bear larger crops than do the natives; and they can be resistant to some insects and diseases.

For information about growing native pecans, see *Texas Fruit and Nut Production: Native Pecans,* which is available at https://agrilifebookstore.org/ .

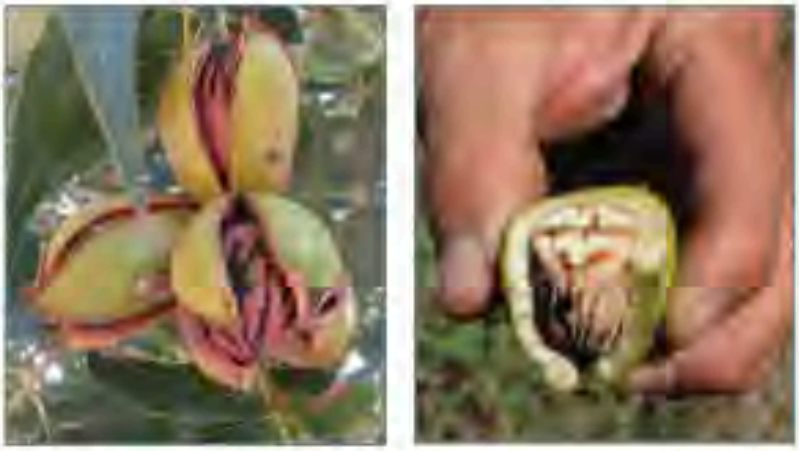


Figure 1. Improved pecan nuts are also called papershell pecans because of their thinner shells.

Commercial production of improved pecans involves many factors. Growers must determine the right orchard size, select a suitable growing site, design the orchard well, select the best varieties for the location and market, fertilize appropriately, control pests economically, and harvest and process the nuts efficiently.

Orchard size

A pecan enterprise may fail if the orchard is too big or too small. For new pecan growers, a wise strategy is to start small and expand in phases. Considerations for determining the size

of the orchard include cash flow, equipment costs, and water availability.

Cash flow: Establishing a commercial pecan orchard requires a significant capital investment for the land, equipment, irrigation well, water delivery system, and other special needs like wildlife-proof fencing. Growers must have a cash flow plan for the 5- to 7-year establishment phase, when the trees bear very few pecans.

Figure 2. A powered trunk shaker.

Figure 3. A powered pecan harvester.

Figure 4. An air-blast pecan tree sprayer.

Equipment costs: Although hobby orchards of 1 or 2 acres may be harvested expediently enough by hand, larger endeavors need specialized harvest equipment. Commercial equipment includes tractors, shakers, harvesters, cleaners, and airblast tree sprayers (Figs. 2, 3, and 4).

Because the commercial equipment needed for a 10-acre pecan orchard is generally the same as for a 100- or 200-acre orchard, small orchards (less than 50 acres) bear higher per-acre equipment costs, which may reduce their profitability.

Water availability and quality: Mature pecan trees bearing a crop need 1 to 2 inches of water per acre per week during the hottest times of the growing season. Growers must consider the quantity, quality, and delivery cost of the water available at the orchard site.

In general, a water well should be able to produce 10 gallons of water per minute for each acre of trees. Before planting, have the water tested to determine total salinity and the level of potentially damaging elements such as sodium, chloride, and boron.

Water quality analysis is available from the Texas A&M AgriLife Extension Service Plant, Soil and Water Testing Laboratory (http://soiltesting.tamu.edu).

Commercial pecan orchards can claim agricultural land tax exemptions. However, since 1986, there are few tax advantages for pecans, and profits need to be determined on a true cash basis.

For sample pecan budgets, including establishment costs, see the AgriLife Extension Agricultural Economics website at http://agecoext.tamu.edu.

Climate

The climate in all areas of Texas is suitable for pecans. However, crops can be damaged by early fall

freezes and late spring frosts. In the Panhandle and other northern Texas areas, growers should plant early-harvest varieties to avoid fall freeze injury to maturing nuts.

Freezing weather can also damage young pecan trees. Avoid planting young pecan trees in low-lying topography, or "frost pockets," which increase the potential for cold injury. Mature trees that have developed thick bark are much less likely to be damaged in these areas.

Water and disease concerns differ across the state. In general, less irrigation is needed for orchards that are east of Interstate 35 and receive at least 35 inches of rainfall per year. However, these orchards have more disease problems and a greater potential for rainy conditions during harvest.

Orchards receiving less than 35 inches of rainfall a year have fewer disease concerns but depend more on irrigation systems to supply the 55 inches of rainfall per acre needed for good tree growth and crop production.

Even in the wettest areas of Texas, rainfall is unpredictable, and irrigation is recommended for producing good-quality pecans (Fig. 5).

Figure 5. Solid set sprinkler irrigation.

Soil

Pecans grow best on deep, well-drained soils that contain adequate oxygen, nutrients, and water. Although trees can grow on shallow soil, commercial orchards are most likely to be successful if the soils are 32 inches deep or deeper. Study the site's drainage and soil depth carefully before planting, because many soils in Texas are either shallow or poorly drained and do not support profitable production.

Varieties

Improved pecan varieties are recommended for each pecan production region in Texas (Fig. 6). Considerations for choosing varieties include pollination, nut maturity date, resistance to pecan scab, and market preferences.

Pollination: Pecan trees are pollinated by wind. The pollen is blown from male flowers called catkins to female flowers called

Regional factors

North: Shorter growing season; low disease pressure; irrigation required; calcareous soils require foliar zinc sprays

West: Low disease pressure; high heat stress; irrigation required; calcareous soils require foliar zinc sprays

Central: Variable (usually light) disease pressure; variable soils; supplemental irrigation needed

East: Moderate to high disease pressure

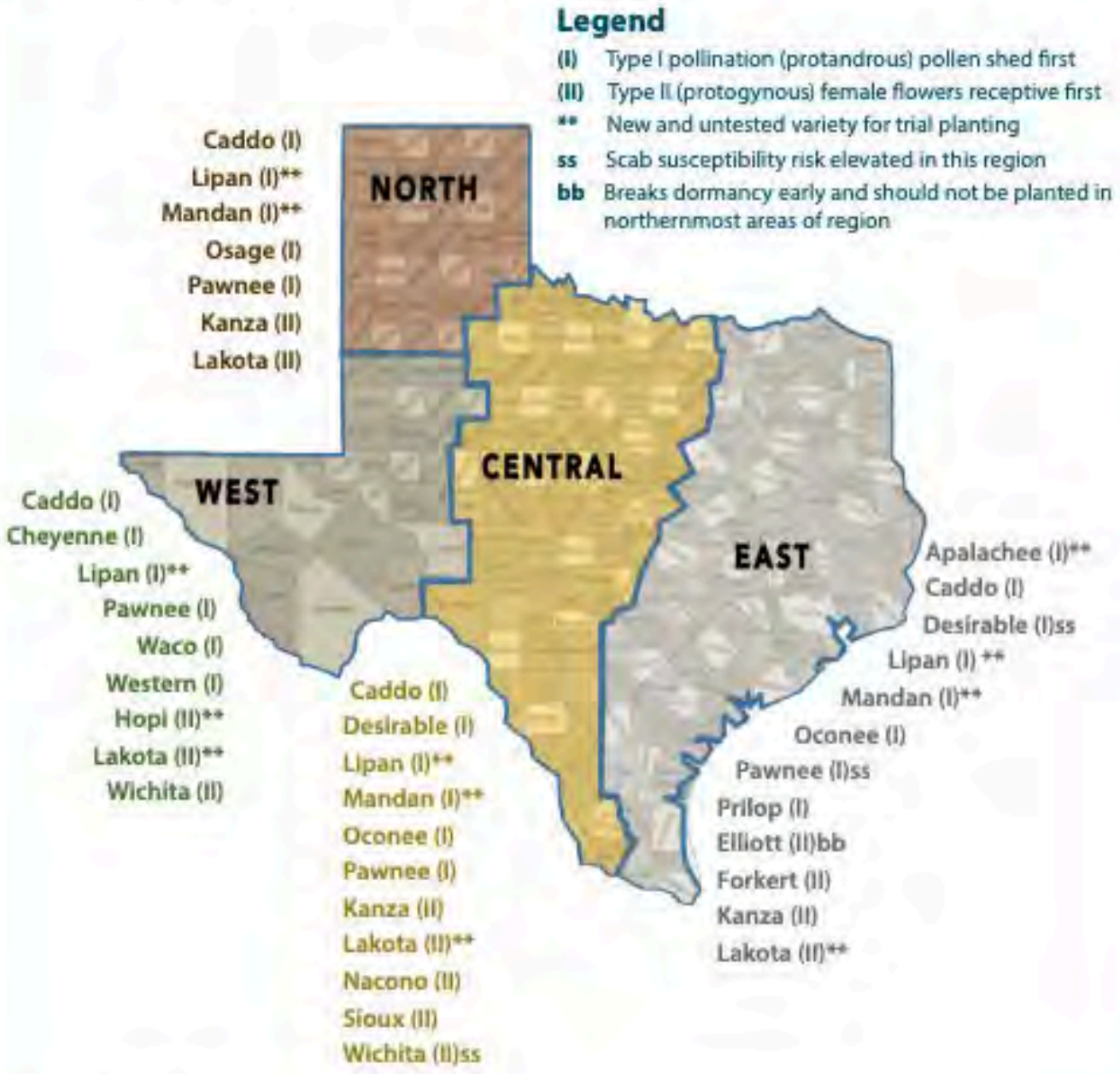


Figure 6. Pecan regions of Texas.

nutlets. On most varieties, the pollen is not dispersed (shed) at the same time that the nutlets become receptive.

To overcome this problem, each pecan orchard should contain two flowering types:

- **Type I**, or protandrous, pecans are those in which the catkins appear first. Catkins are commonly called tassels because their golden strands hang in clumps throughout the tree.
- **Type II**, or protogynous, pecans are those in which the female nutlets become receptive before the catkins begin to shed pollen.

The ratio of the two types in an orchard need not be equal: Only 15 percent of the trees need to be pollenizers for the main variety, as long as they are distributed uniformly throughout the planting. Small orchards may not need pollinizers if native or seedling trees are within sight of the new planting; however, large commercial plantings should include pollenizers within the orchard.

Early nut maturity: Because fall freezes occur earlier in North Texas, growers there should choose varieties that produce early-maturing nuts. This trait is also important for growers in other production areas who want to get the nuts to market early in the harvest season.

Scab susceptibility: Central and East Texas growers should be aware of the risk for scab disease with certain varieties (noted "ss" on the map). Varieties like 'Wichita' and 'Hopi' cannot be grown successfully in rainy conditions without fungicide sprays to prevent fungal infections, and fungicide treatment may not be enough to prevent crop loss on scab-susceptible varieties in years with abnormally high rainfall.

Figure 7. Nuts from three pecan varieties. From the top down: Lipan, Pawnee, and Kanza.

Marketing outlets: Choose varieties that will best meet the needs of your intended market. Retail markets prefer large nuts with bright-colored kernels (Fig. 7). Wholesale markets look for shelling ease and high percent kernel. Orchards should be designed to allow trees of the same variety to be harvested together, because buyers prefer uniform lots of pecans, rather than blended lots of more than one variety.

For more information about pecan varieties, see the *Texas Pecan Handbook*, which is available from the Texas A&M AgriLife Bookstore at https://agrilifebookstore.org/.

Fruit & Nut Resources

Walnut

George Ray McEachern and Jerral Johnson
Extension Horticulturist and Extension Plant Pathologist
Texas A&M University

January 27, 1997

The Persian, English, or Carpathian Walnut is grown worldwide. California produces 95 percent of the walnuts grown in the United States.

Walnut Blight

The varieties grown in California do not produce well in Texas because of a bacterial disease called "Walnut Blight." The trees look vigorous and are strong, but the flowers fail to set fruit or the fruit fails to ripen properly due to the bacterium which overwinters on infected buds and to a lesser extent, in twig cankers. During the spring, the pathogen is spread by rain and wind. During heavy spring rains, severe damage can occur because the nuts are most susceptible at this time. The bacteria can infect catkins and can contaminate pollen, both of which can spread blight infection to the flowers. Kocide 101 spray at a rate of 2 pounds per 100 gallons of water will be needed with the conditions of prolonged high humidity. Tree damage can occur from excessive use of copper sprays such as Kocide 101 or the old Bordeaux mix and caution is recommended when spraying. Always follow fungicide label instructions.

Rootstocks

Advances have been made in Texas walnut culture by Dr. Loy Shreve. He demonstrated that the native Texas Black Walnut, Juglans microcarpa, is a far superior rootstock for walnuts growing in high pH soils of Texas than the Eastern Black Walnut, Juglans nigra, or the California Black Walnut, Juglans hindsii. Growth of 10 feet or more the first year has been obtained with the Texas Black Walnut rootstock, Other rootstocks made little or no growth.

Cultivars

The need for an outstanding variety with "Walnut Blight" resistance has long been appreciated by Dr. Shreve. He traveled to Hungary and Romania in 1979 and collected several promising cultivars which were evaluated at the TAMU Center at Uvalde. The best cultivars to date are Reda, Geoagiu 86, Orastie, Germisara, and Geoagiu 3 X 4 X 453. Under Texas conditions, these cultivars appear to be superior to the standard commercial varieties Payne, Eureka, Hartley, and Broadview.

General walnut cultural practices are very similar to that of the pecan and it is recommended that they be followed.

Aggie Horticulture®

Vegetables

EHT-065
04-14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

ARTICHOKE • ARTICHOKE • ARTICHOKE • ARTICHO

Joseph Masabni, Assistant Professor and Extension Horticulturist; and Patrick Lillard, Extension Assistant, The Texas A&M System

The artichoke, a member of the thistle family, has been cultivated and enjoyed since the time of the Romans. Artichoke is both a nutritious vegetable and a beautiful landscape plant. Plants can reach 3 feet in height and width, and the flower, if allowed to bloom, can be 7 inches in diameter.

Soil preparation

Globe artichoke produces best in deep, fertile, well-drained soil, but will grow in a wide range of soils. The plant's deep roots need relatively deep soils with adequate volume for root development. Sandy soils with excessive drainage should be avoided.

Although artichokes are moderately salt tolerant, soil with a high salt content will reduce their growth and yield.

Varieties

Several varieties work well for Texas gardeners, including:

- Green Globe (standard variety)
- Imperial Star (less vigorous than Green Globe)
- Harmony
- Madrigal
- Emerald
- Grand Beurre
- Talpiot
- Purple Sicilian (purple globe)

Emerald is about 2 weeks earlier than Imperial Star and appears to need little, if any, vernalization (chilling). Emerald, Grand Beurre, Talpiot and Purple Sicilian are all grown from seed. The Purple Sicilian variety is fairly tolerant of heat and cold.

Seed preparation

Plan before fall planting because it can take up to 60 days before plants are of suitable size for planting outside. In Central Texas, artichoke is transplanted in mid-October, which means seeds must be started in mid-August. In North and West

Texas, start seeds a few weeks earlier.

Seeds can easily be started in a greenhouse, in a shady spot outside in late summer, or indoors under a grow light. Plant the seeds ¼ inch deep in potting mix when the temperature doesn't exceed 85 degrees F. Water seeds regularly and shade them from the hot afternoon sun.

Fertilizing

Artichokes grow well when fertilized regularly. It is best to have your soil tested and amend the soil according to the test results and recommendations. If a soil test is not done, follow these general recommendations:

- If manure is available, mix 100 to 140 pounds of composted manure per 100 square feet into the soil before planting.
- Phosphorus and potash are best applied before planting and should also be worked in. Apply about 0.25 pound of P_2O_5 and 0.25 pound of K_2O per 100 square feet.
- Artichokes require about 0.1 pound of nitrogen (N) per 100 square feet. Work it into the soil before planting, and apply an additional 0.3 pound per 100 square feet 6 to 8 weeks later.
- Foliar applications of a liquid fertilizer containing calcium and zinc are recommended every 2 weeks during active growth in early spring.

Planting

Transplant seedlings 2½ to 3 feet apart in rows 3 to 4 feet apart. Transplants grow slowly in the fall and winter (October through January), but in early spring artichoke plants will rapidly increase in size. Artichoke should be planted in a well-drained soil and mulched well to help reduce weeds and conserve soil moisture.

Care during the season

Do not expose artichokes to temperatures below 25 degrees F in the winter. If there is a threat of frost, cover plants with a 6-inch layer of straw mulch, leaves, a bucket or frost blanket, or some other form of frost protection.

A hot, dry climate causes artichoke buds to open quickly and destroys the tenderness of the edible parts. In the summer, irrigation will help keep temperatures down in the crop canopy to prevent bud opening.

Watering

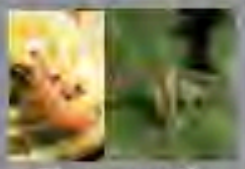
Artichokes are deep-rooted and require adequate moisture when growing and producing fruit. Moisture stress may result in black tip, which is only cosmetic damage because the edible portion of the bud is not affected. Black tip is most common when conditions are sunny, warm and windy.

Diseases

Powdery mildew, Verticillium wilt, and botrytis rot are common during rainy weather. Curly dwarf virus and bacterial crown rot are other artichoke diseases. Leave plenty of space between plants to reduce the chance of diseases becoming a problem. If you have trouble with diseases, ask your county Extension agent about disease control.

Artichokes are susceptible to root rot, so do not let the soil become too wet.

Insects

Name and description		Control
 Plume moth	Larva: Pale yellow or green, 0.04 to 0.06 inch long. Adult: buff to brownish buff with a wingspan of ¾ to 1¼ inches.	• sanitation • *Bt*
 Aphid	Soft-bodied; ⅛ inch long; green, pink, red, brown or powdery blue; usually on undersides of leaves; suck plant juices; may be covered with a fine whitish wax.	• malathion • garlic juice extract • neem oil • pyrethrins • azadirachtin
 Cribrate weevil larvae	Adults are ½ inch long, brown to black, and may appear between June and September.	• Prevent its introduction by using clean transplants.
 Spider mites	Barely visible to the naked eye; spiderlike; suck juice from undersides of leaves; leaves lose color; may form tiny webs.	• beneficial insects • strong blasts of water • insecticidal soaps • neem oil

The artichoke plume and cribrate weevil larvae photos are courtesy of Jack Kelly Clark, University of California Statewide IPM Program.

Weeds

Mulching artichokes will reduce weeds and conserve soil moisture. It is important to remove weeds when artichokes are small because the plants are most susceptible to weed competition at this stage. Large, fully developed artichoke plants compete well with weeds.

Harvesting

A healthy plant should produce six to nine buds per plant. The main harvest usually occurs in April and May. Select buds for their size, compactness and age. All buds of suitable size should be harvested by cutting the stem 2 to 3 inches below the base of the bud. Old stems should be removed as soon as all buds have been harvested to allow new stems to grow.

Serving

Artichoke is a great source of fiber and can be steamed, boiled or microwaved. The edible parts include the flesh of the base of the leaves and the heart of the flower. Rinse leaves and cut off the sharp tips, about ¼ inch, before cooking. Ask your county Extension agent for more information on preparing and serving artichoke.

Cleanup

Artichoke is a perennial plant so once the harvest is done in June, cut the plant back to soil level. This will put the plant crown into a dormant stage during the summer. The plant will send out shoots in the fall. The new shoots can be dug out to be replanted into a new location in the garden or left in place to produce another year. Make sure you leave only the most vigorous shoot on the old plant for production next spring.

EHT-066
5/14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

AGUS • ASPARAGUS • ASPARAGUS ASPAR

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Asparagus *(Asparagus officinalis)* is a highly desirable, early-spring vegetable best suited to the cooler areas of North and West Texas. It can also be grown in areas such as Dallas and Houston. It produces poorly in areas with mild winters and extremely long, hot summers. With proper care and in a suitable climate, an asparagus crown can last 15 to 25 years.

Asparagus is good source of vitamin A and C and minerals, and it tastes better when homegrown than when shipped into Texas from other areas.

Asparagus is dioecious, meaning that it has separate male and female plants. Grown for its stems or spears, asparagus yields 8 to 10 pounds or more per 100 square feet of bed if tended well. For most home gardeners, a 20-foot row or 100 square feet of bed is adequate for a family of four. That's equivalent to 20 planted crowns or 10 pounds of harvested asparagus per season.

Site selection

Because asparagus remains in the same place several years, it is important to select the right spot and prepare the seedbed well. Asparagus does best in full sunlight and deep, well-drained, sandy or light-textured soils. Asparagus plants make a good border around the edge of a garden or along a fence.

Soil preparation

Before planting, make sure that the soil is free of trash, soil insects, and perennial weeds such as johnsongrass or bermudagrass. Avoid sites where yellow nutsedge grows, as this indicates poor drainage, which is unsuitable for asparagus production.

In late fall, spread a 3-inch layer of organic matter such as manure, rotted sawdust, or compost over the beds. Till or spade them to a depth of 10 to 12 inches,

and turn the soil to cover all organic matter.

Asparagus grows well in high-pH soils and poorly if the soil pH is below 6.0. Test the soil before planting the beds and add lime if needed to adjust the pH to 6.5 to 7.5.

Varieties

The hybrid asparagus cultivars 'Martha Washington', 'UC 157', 'Jersey Giant', and 'Mary Washington' produce better than the standard cultivars. Male asparagus cultivars such as Jersey types ('Jersey Giant', 'Jersey Knight', and 'Jersey Supreme') are more productive and resist disease better than the female cultivars ('Washington' types). Also, female cultivars are less vigorous and produce many red, berrylike fruits that become volunteer weeds in the garden.

A purple asparagus cultivar ('Purple Passion') with green flesh and large spears is available for home gardens.

Planting

Asparagus is grown from 1- or 2-year-old crowns planted in January or February, or as soon as the ground can be worked. Crowns can also be grown from seeds planted in flats or peat cups. It takes at least a year to grow a good crown. To shorten the period from planting to harvest, buy and plant healthy, vigorous, 1- or 2-year-old crowns from a nursery, garden center, or seed catalog.

After the asparagus beds are tilled, mark rows 5 feet apart. Dig a furrow 4 inches wide and 4 to 12 inches deep. Separate the crowns by size, and plant those of similar size together for best uniformity in spear size at harvest.

Spread super phosphate fertilizer (0-46-0) as a band in the furrow at a rate of 2.0 pounds per 1,000 square feet or 0.75 ounce per 20-foot row. Place the crowns 12 to 14 inches apart in the furrow. Planting too closely can cause small spears. Wider planting results in larger spears but lower total yield. In loose soils, plant the crowns 6 to 12 inches deep; in heavier soils, plant them 4 to 6 inches deep (Fig. 1). Cover the furrow with 1 inch of compost topped by 2 to 3 inches of soil. Firm the soil around the roots.

Over the season, fill the furrows gradually as the shoots grow. This covers small weeds, and they die from lack of light. By the end of the first season, the furrow should reach its normal level (Fig. 1). Control weeds, but do not injure the crowns. If the crowns are planted deeply, you can cultivate the bed with garden tools or tiller (do not till too deep) without damaging the crowns.

An alternative planting method is to plant the crowns at the suggested depth

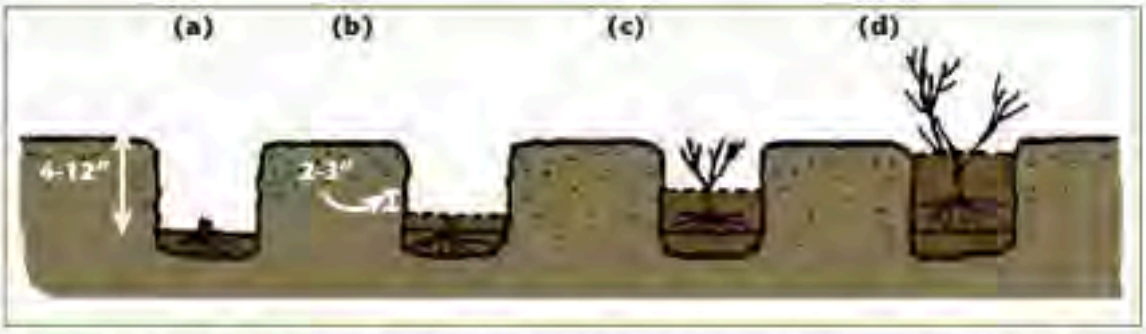


Figure 1. (a) Planting crown; (b) immediately after planting; (c) several weeks after planting; (d) at the end of the season

and immediately fill in the furrow with soil to its original level. Using this method, you do not need to gradually cover the crowns with soil, as long as the soil is not compacted over the newly planted crowns.

It takes 2 to 3 years from the time the crown is planted until the bed is in full production. When conditions are favorable, buds arise from the crown and develop into edible spears. If not harvested, the spears will develop into fernlike stalks. From these stalks, the mature plant manufactures food and stores it in the underground crown. This reserve supplies the energy necessary to produce spears the following year.

Fertilizing

Before planting a new asparagus bed, broadcast and spade in or incorporate ¼ pound of nitrogen, phosphate, and potassium per 20 feet of row or as directed by a soil test report.

For established beds, scatter 2 pounds of 10-20-10 fertilizer (or its equivalent) per 20 feet of row before growth begins in the spring, late January, or early February in most areas of Texas.

After the last harvest, apply an additional 1 to 2 pounds per 20 feet of row. If available, use a nitrogen fertilizer such as 21-0-0 at this time. Always water the fertilizer into the soil.

Watering

Asparagus plants need frequent, deep watering. Water the beds thoroughly, and allow the top 1 inch of soil to dry before watering again. The time varies from 3 to 5 days, depending on soil type and temperature. In sandy soils, asparagus roots can reach 10 feet deep if adequate soil moisture is available.

Figure 2. Till the soil early in the season before the spears emerge.

Care during the season

Asparagus competes poorly with weeds. For asparagus to grow vigorously, weeds must be controlled in the first 1 to 2 years of its establishment. To suppress weeds, spread a 4- to 6-inch-thick layer of organic mulch, such as hay, stray, compost, wood chips, or grass clippings.

Asparagus beds require little care after the first 2 years of establishment. Keep weeds pulled or hoed from the beds. To avoid damaging the spears, control weeds early before the spears emerge. Till the soil when fertilizer is applied early in the season before the spears begin growing (Fig. 2).

At the end of the harvest season, control weeds by raking lightly or mulching. Apply fertilizer and till lightly 1 to 2 inches deep to kill weeds. Cover the bed with a 3-inch layer of clean straw, compost, or other mulch material. Water it thoroughly, and allow the asparagus to grow the rest of the year. This helps ensure a good harvest the next year (Fig. 3).

After the first hard frost or freeze of fall, cut off the fern tops at ground level and mulch the bed with manure. Burn or compost the fern tops to eliminate sources of insect eggs or disease reinfestation. In southern areas, the fern may not be killed

by a freeze, so it should be removed in late November when the ferns turn yellow. Any spears that sprout may be removed and eaten.

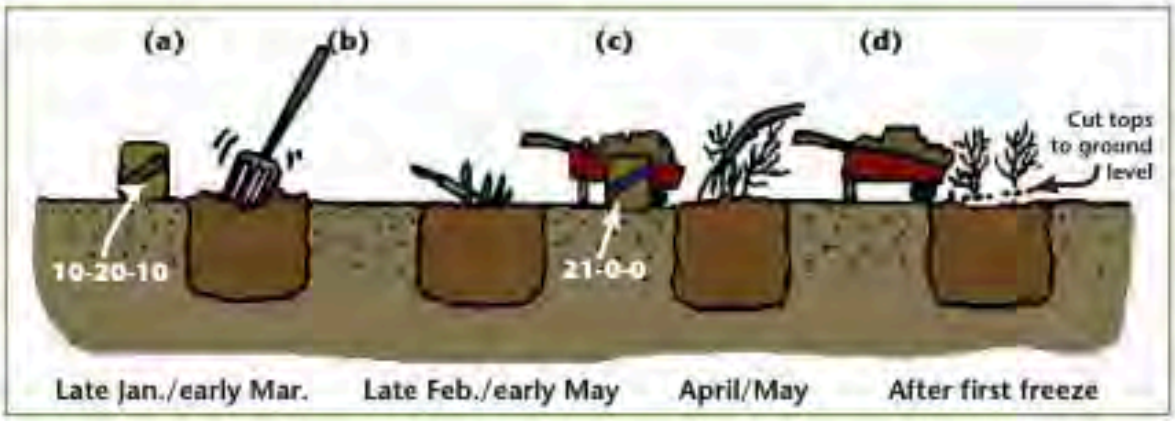


Figure 3. (a) Remove mulch, fertilize and till; (b) harvest; (c) after last harvest, fertilize and mulch; (d) remove tops and mulch with manure.

A post emergent herbicide such as glyphosate could be used against weeds before asparagus growth begins in early spring.

Harvesting

Harvest asparagus spears from established beds for about 8 weeks, depending on the area. Do not harvest during the first 2 years after planting. This waiting period enables the underground crown to grow and store enough reserves for a strong harvest for many years to come.

Harvest the spears when they are 4 to 10 inches long. To prevent the spears from becoming fibrous, harvest at least every other day. The fibrous condition is caused by overmaturity or inadequate fertility. Spears with loose or opened heads are too mature.

To harvest, snap off the spears by hand at ground level. Never snap asparagus spears above the ground or allow a stub to remain.

An alternative method is to use a knife to cut the spears 1 to 2 inches below the soil level (Fig. 4). To avoid damage to the developing buds in the crown, never cut the spear too deep. However, this method is not recommended because the knife may spread diseases from crown to crown.

Stop harvesting when the spear diameter becomes less than ⅜ inch or when the spear heads open up with rising temperatures.

Some gardeners prefer white asparagus. This is grown by using mounds of soil or mulch to deprive the spears of light. White asparagus has a milder flavor and is preferred in gourmet cuisine. When the asparagus head barely emerges through the mulch mound, use a knife to cut the spears at the desired height.

Figure 4. Some asparagus gardeners harvest by cutting the spears 1 to 2 inches below the ground level.

White asparagus is grown by covering an asparagus row with black plastic supported by wire hoops. The covering is opened on one side for harvest, then placed into position again immediately after harvest. The plastic tunnel structure is removed when the harvest season is over. Culture and pest control of white asparagus are similar to that of green asparagus.

Insects

The most significant pest of asparagus is the asparagus beetle. Left unchecked, this beetle can greatly damage asparagus in a short period. The beetle overwinters (spends the winter) in crop residue or trash in the garden or in the border.

If you see beetles feeding on asparagus, remove them by hand or spray them with Surround (organic insecticide) or Sevin.

Diseases

If you select a good site with proper drainage and pH, you can reduce if not prevent the establishment of many asparagus diseases. Common diseases that attack asparagus are crown rot and rusts; they can be controlled with organic chemicals such as sulfur or potassium phosphite.

Serving

After harvest, asparagus loses quality very rapidly—the sugar content declines and the amount of fibrous material increases. Use spears with compact heads; those with loose heads are fibrous and do not keep well.

Asparagus can be stored up to 3 weeks in plastic bags in the refrigerator. For longer storage, blanch the asparagus spears 3 to 5 minutes, package, and freeze them.

For information on preserving and serving asparagus, contact the county Extension agent.

Acknowledgments

This publication was revised from earlier versions written by Jerry Parsons, Professor and Extension Horticulturist, and Sam Cotner, Professor Emeritus and Extension Horticulturist.

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Revision

EHT-050
5/14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

BEETS • BEETS • BEETS • BEETS • BEETS • BEETS

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Beets are a cool-season crop and grow well in the cool temperatures of spring and fall. They do poorly in hot weather. Beets are well suited to large or small home gardens since they require little room. They are grown for both the roots which usually are pickled and the young tops which are used as greens. About 10 feet of row per person will provide enough beets to use fresh or for canning.

Figure 1. Avoid areas where there may be tree roots.

Site selection

Beets can be planted in partial shade and grow best in deep, well drained soils. Beets have deep roots that can reach depths of 36 to 48 inches, so do not plant them where tree roots will compete Fig. 1).

Soil preparation

Before planting, make sure the soil is free of rocks, trash and large sticks. Mix fine pieces of plant material such as grass, leaves and small sticks into the soil to enrich it. Spade the soil 8 to 10 inches

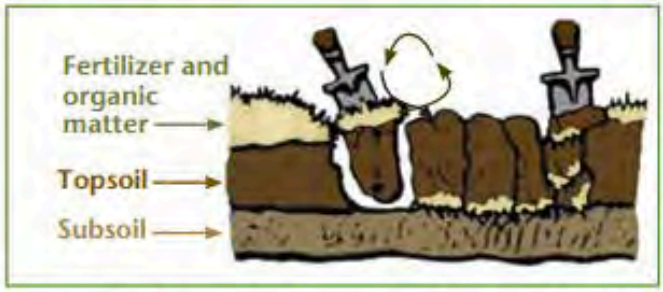


Figure 2. Turn the soil over to a depth of 8 to 10 inches. Use a spade or rototiller.

deep (Fig. 2). Be sure all plant material is covered with soil so it will break down quickly.

Beets do best in sandy soil in the spring and heavier soil in the fall because sandy soil warms faster than heavier clay soil. They do not grow well in tight clay. In poorly drained areas, make ridges 4 to 6 inches tall to allow water to drain (Fig. 3). The soil should have adequate organic matter to prevent it from crusting because crusty soil causes beet roots to be tough.

Beets are also sensitive to soils deficient in boron. Have your soil tested or ask your county Extension agent about boron deficiencies in your area.

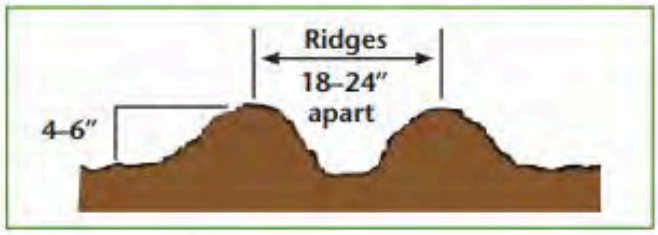


Figure 3. Ridges are very important in low, poorly drained areas. They allow the soil to drain and air to enter.

Varieties

Beets are grown for both the root and top. The tops of any variety can be used for greens when prepared properly.

- Chioggia
- Detroit Dark Red
- Pacemaker II
- Red Ace
- Ruby Queen

Planting

Beets can be grown all winter in many South Texas areas. Farther north they should be planted as soon as the soil can be worked in spring. Soil temperature must be at least 40F for beet seeds to sprout.

Using a hoe handle, stick or similar object, make a furrow ½ inch deep down the center of the ridge (Fig. 4). Each beet seed produces 2 to 6 plants. Space the seeds 1 to 2 inches apart in the row. Cover seeds lightly with loose soil and sprinkle with water. Use seed treated with a fungicide to prevent the young plants from rotting. Plants should be up in 7 to 14 days. In hot weather, cover seed with sand or light-colored mulch.

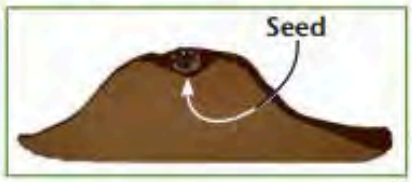


Figure 4. Make a furrow ½ inch deep down the center of the ridge.

For continuous supply of beets, make several plantings 3 weeks apart.

Fertilizing

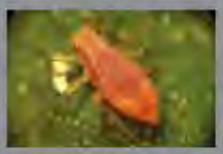
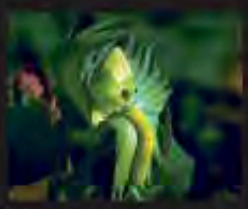
Scatter 1 cup of a complete fertilizer such as 10-20-10 for each 10 feet of row. If the garden soil has a lot of clay, add compost. Mix the fertilizer 4 inches into the soil with a rake and work into beds as shown in Figure 2. Scatter 1 tablespoon of fertilizer for each 10 feet of row beside the plants when they are 4 to 6 inches tall.

Watering

Water the plants well weekly if it does not rain. Beet root systems can reach 36 inches or more if adequate soil moisture is available.

Care during the season

Keep the beet plants free of weeds which use nutrients and moisture. Scratch the soil next to the plants with a rake or hand tool to prevent crusting. Do not work the soil more than 1 inch deep or the root systems may be injured. Begin thin-

Name and description		Control
 Flea beetle	1/16 inch long; black, brown-black with light markings; jumps quickly; eats holes in leaves	Check with your county Extension agent
 Webworm	1 inch long; green, yellow, black stripe and spots on back; eats young plant leaves	Check with your county Extension agent
 Aphid	1/8 inch long; green, pink, red, brown; underside of leaves; sucks plant juices	Check with your county Extension agent
 Beet armyworm	1¼ inches long; green with dark stripes on side; feeds on foliage	Check with your county Extension agent

ning the beets as soon as they get crowded in the row. Young tops make excellent greens. After thinning, the plants should be 2 to 3 inches apart.

Harvesting

Beets should be ready to harvest 7 to 8 weeks after they are planted.

Young, tender tops often have a mild quality, but the greens can be used until they get large and strong flavored. Young plants can be cooked with the root and top together, or you can use the root alone when it is the size of a golf ball or larger.

Pull the plants and cut off the root. If the tops are to be used, wash and place them in plastic bags in the refrigerator for 1 or 2 days. Roots will keep 1 to 2 weeks in plastic bags in the refrigerator.

If all the beets are not used, pull them and place in a compost pile or spade them into the soil.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin® is a synthetic insecticide, while Bt-based insecticides and sulfur are organic options. Sulfur also has fungicidal properties and helps control many diseases. Before using a pesticide, read the label and always follow cautions, warnings and directions.

Diseases

Diseases on beets are most severe in cloudy, damp weather. Check plants daily and treat them with an approved fungicide if diseases appear. Neem oil, sulfur, and other fungicides are available for use. Always follow label directions.

Serving

Beets can be served fresh, or they can be preserved plain or pickled. Beet roots contain small amounts of vitamins and minerals, while beet greens are an excellent source of Vitamin A and calcium.

Harvard beets is a popular, sweet and sour side dish to go with meat and poultry.

TEXAS A&M AGRILIFE EXTENSION
EHT-035
11-10

Easy Gardening

• CARROTS • CARROTS • CARROTS • CARROTS •

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Carrots are an excellent source of vitamin A and add color to a meal. They can be served cooked or raw, by themselves or in salads or other dishes.

For home planting, 5 to 10 feet of row per person should supply enough fresh carrots for table use. One foot of row will yield about 1 pound of carrots.

Site selection

Carrots do best in loose, sandy loam soils that are well drained. In heavy soils, they mature more slowly, and the roots are often rough and unattractive.

They will grow in some shade and do well in small gardens and flower beds.

Soil preparation

Remove all rocks, trash and large pieces of plant material from the soil surface. Small, fine pieces of plant material can be turned under to enrich the soil.

Spade the soil 8 to 12 inches deep. Turn it completely over so all plant material is covered. Smooth the soil and work it up into beds (Fig. 1). Beds allow good movement of air and water through the soil.

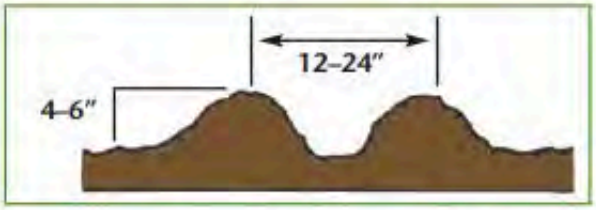


Figure 1. Ridges are very important in low, poorly drained areas. They allow the soil to drain and air to enter.

Place the carrot rows 1 to 2 feet apart. If ridges are farther apart, plant two rows of carrots on each ridge (Fig. 2).

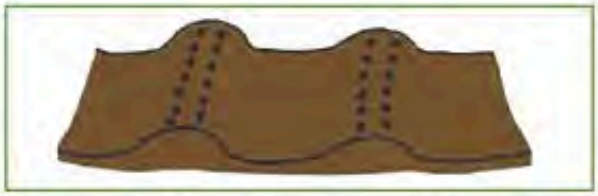


Figure 2. If the ridges are more than 1 to 2 feet apart, plant two rows of carrots on each ridge.

Varieties

Carrot varieties that do best in Texas include Danvers 126, Danvers Half Long, Imperator 58, Nantes, Nantes Half Long, Red Core Chantenay, Royal Chantenay, Scarlet Nantes, and Sugar Snax.

Planting

Begin planting carrots as soon as the soil can be worked in the spring. In South Texas, plant carrots any time from July through February. In many South Texas areas, carrots can be grown all winter. For a fall crop in other areas, plant them in August.

Using a hoe handle or stick, make one or two rows ½ inch deep on top of each prepared ridge. Scatter 18 to 20 seeds per foot in the row. Because carrot seeds require 14 to 21 days to sprout, many gardeners mix a few radish seeds, which sprout quickly, with carrot seeds to mark the row. Cover the seeds lightly (Fig. 3).

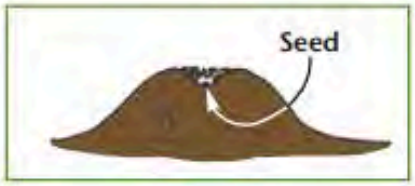


Figure 3. Cover carrot seeds lightly with soil.

Carrots grow best in cool temperatures of early spring and late fall. Night temperatures of 55 degrees F and day temperatures of 75 degrees F are ideal for carrots. High temperatures cause poorly colored, low-quality carrots.

Fertilizing

Before planting carrots, scatter on the soil 1 cup of a complete fertilizer such as 10-10-10 for each 10 feet of row to be planted. Use a rake to mix the fertilizer into the soil to a depth of 3 to 4 inches.

Once the plants emerge, scatter 2 tablespoons of fertilizer per 10 feet of row beside the plants when the tops are about 4 inches high. Fertilize again when tops are 6 to 8 inches high if the tops become pale.

Watering

Water the plants as required to keep the soil moist to about 3 inches deep.

Care during the season

When the carrot tops are 4 inches high, thin the plants to 2 inches apart. Some carrots will be large enough to eat. Thin the carrots to 4 inches apart as they continue to grow. Overcrowding and rocky soils result in poor quality roots (Fig. 4).

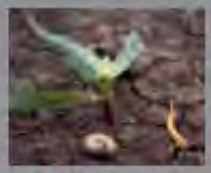
Figure 4. Rocky soils result in poor-quality carrot roots.

If radishes were mixed with the carrots, pull and eat them as they mature.

To prevent the soil from crusting, scratch the soil lightly around the plants and sprinkle the row with water often to prevent crusting, or cover the seeds with vermiculite or sand. This is especially helpful for crops planted in the hot summer.

Weeds

Keep the carrots in your garden free of weeds, especially when they are small. Weeds will take nutrients and moisture from the soil and reduce your carrot yields.

Name and description		Control
 Cutworms	Slender, ½ to 1½ inches long; yellow to white, dark head and tail; feeds on the root	Wireworm nematodes
 Wireworms	Smooth; up to 1¼ inches long; dull gray, brown to black; striped or spotted; soft bodied; curls up when touched; cuts off young plants near the soil level	Weed control, sanitation, hand removal

Insects

Many insecticides are available at garden centers for homeowner use. Sevin® is a synthetic insecticide; organic options include Bt-based insecticides and sulfur. Sulfur also has fungicidal properties and can help control many diseases.

Before using a pesticide, read the label and always follow cautions, warnings, and directions.

Diseases

If leaf spots appear on the plants, dust them with an approved fungicide. Remove from the garden any carrot plant that becomes yellow and stunted.

If the roots have knots on them, your soil may have nematodes. Neem oil, sulfur, and other fungicides can be used. Always follow the label directions.

Harvesting

Carrots should be ready for harvest 70 to 80 days after planting. Pull them from the soil when the roots are 1 to 1½ inches in diameter. To avoid breaking the carrot while pulling, loosen the soil around the carrot with a spade.

To prevent the roots from wilting after harvest, remove the carrot tops and place them in the compost pile.

Pull unused carrots and place them in a compost pile or spade them into the soil.

Storage

Wash the carrots and store them in the bottom of the refrigerator. Carrots will keep several weeks if you place them in a plastic bag to increase humidity and store them at a temperature near 32 degrees F.

Acknowledgments

This publication was revised from earlier versions written by Sam Cotner, Professor Emeritus and former Extension Horticulturist.

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TEXAS A&M AGRILIFE EXTENSION
EHT-067
6-14

Easy Gardening

COLE CROPS • COLE CROPS • COLE CROPS • COLE

Joseph Masabni, Assistant Professor and Extension Horticulturist;
and Patrick Lillard, Extension Assistant, The Texas A&M University System

Cole crops include broccoli, cabbage, cauliflower, and Brussels sprouts. They are all cool-season crops that can be grown successfully in most Texas home gardens if the right varieties are planted at the right time.

Brussels sprouts and cauliflower are the hardest to grow, while broccoli and cabbage are the easiest. For most gardens, broccoli is an ideal choice because it produces quickly, and each plant can be harvested several times.

Site selection

Cole crops do best in full sunlight when grown in sandy loam soils with lots of organic matter. They prefer soils with a pH of 6 to 6.5; yield will be reduced if the soil pH is below 6.

Soil preparation

Add a 3-inch layer of organic matter—such as compost, leaves, or grass clippings—to the garden soil and turn it in a few weeks before planting. This will give the leaves or grass clippings time to decompose and release nutrients into the soil before planting. Dig the soil as deep as a garden spade or shovel will reach, usually 10 to 12 inches. Turn the organic matter under the soil as soon as possible after application.

Fertilizing

Have your soil tested every 3 to 4 years to determine how rich it is or what nutrients it is lacking. Soils in East Texas usually are very acidic, while soils in South and West Texas usually are alkaline, and soils on the plains usually have plenty of potassium. If you do not have your soil tested, apply about 1 to 2 pounds of a complete fertilizer (such as 10-20-10) for each 100 square feet or about 30 feet of row to be planted. Spread the fertilizer over the soil surface after the soil is dug. Then mix the fertilizer into the soil 2 to 3 inches with a rake or tiller.

After fertilizing, bed the soil by pulling it into ridges 12 inches wide, 6 to 8 inches high, and 36 inches apart (center to center). This is necessary for good drainage. Creating raised beds is most important in heavier soils as they do not drain very well. Bedding the soil also mixes the fertilizer into the row where plants can reach it. Apply more fertilizer as the plants grow during the season.

Varieties

Several varieties work well for Texas gardeners, including:

Broccoli

- Arcadia
- Bonanza
- Green Comet
- Green Magic
- Packman
- Premium Crop
- Southern Comet

Brussels Sprouts

- Diablo
- Jade Cross
- Royal Marvel
- Tasty Nugget

Cabbage

- Early Jersey Wakefield
- Golden Acre
- Green Boy
- Market Prize
- Rio Verde
- Ruby Ball
- Savoy King

Chinese Cabbage

- Brisk Green
- Jade Pagoda
- Michihili
- Monument

Cauliflower

- Alverda (Green)
- Brocuverde (Caul/Broc hybrid)
- Imperial
- Majestic
- Snow Crown
- Snowball Y Improved
- Violet Queen (Purple)

Planting

Most cole crops need 18 to 24 inches between plants and 36 inches between rows. Broccoli spaced too closely will have small heads and fewer side sprouts. Cauliflower and cabbage can easily spread 2 feet if well fertilized. Space Brussels sprout plants 14 to 18 inches apart because they grow more upright (Fig. 1.).

Figure 1. Space broccoli and Brussels sprouts 14 to 18 inches apart. Space cauliflower and cabbage 24 inches apart. Plant radishes or greens between the young plants.

Broccoli, cauliflower and cabbage can be grown in both spring and fall, but fall planting often is more successful because very early spring planting is often delayed by wet or cold weather. Delayed spring planting exposes plants to too-hot weather before they mature. Variety selection is very important because early-maturing varieties usually are the most successful. In areas south of Region II (Fig. 2), Brussels sprouts should be grown only as a fall crop

because they will not mature before summer temperatures get too hot. Brussels sprouts are the most cold tolerant of the cole crops.

Figure 2. Texas gardening regions.

Start with good transplants, which can be bought from a nursery or garden center. If you want to grow your own transplants, plant seeds in peat pots or similar containers about 3 to 4 weeks before the fall crop or 6 weeks before the spring crop is to be transplanted. By growing plants from seed, you will have many more varieties to select from and at the time you want them. Experienced home gardeners plant seed for the fall crop directly into the garden and thin the plants after they come up. The small plants can be transplanted to other spots in your garden or to a neighbor's garden.

Transplant cole crops to the garden according to the following dates:

Region	Spring	Fall
I	Mar. 1 – Apr. 7	July 15 – Aug. 1
II	Feb. 15 – Mar. 20	Aug. 1 – Aug. 20
III	Feb. 1 – Mar. 5	Aug. 20 – Sep. 20
IV	Jan. 15 – Feb. 20	Oct. 1 – Oct. 20
V	Jan. 1– Feb. 1	Nov. 1– Nov. 20

Gardening regions of Texas are shown in Figure 2.

Be sure to acclimate the transplants to the cold of early spring or heat of early fall before transplanting. Broccoli and cabbage will survive temperatures as low as 25 degrees F when properly conditioned, and Brussels sprouts will survive 20 degrees F or lower if the temperature drops gradually.

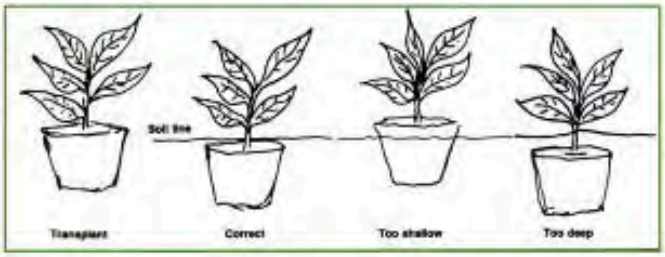


Figure 3. Correct planting depth.

Set the transplant in the garden at about the same depth it was in the pot. Be sure peat pots are moist and not exposed to air after planting. If cole crops are covered too deeply, the stems will rot (Fig. 3.)

Care during the season

Keep soil moist but not soaked. Mulch with a dark-colored plastic cover or compost in the spring or a white plastic cover, dried grass clippings, or leaves in the fall. Mulch helps reduce the need for water, controls weeds, and regulates soil temperatures.

Do not hoe too deep or too close to the plants to avoid damaging the shallow root system. About 4 weeks after transplanting, apply 1 pound of fertilizer for each 30 feet of row beside the plants.

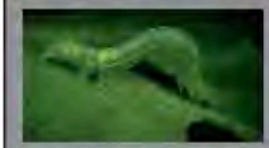
Photo: Bruce Patty Leander

Figure 4. Cauliflower with leaves tied over the head (blanched).

Water the fertilizer into the soil. Another application usually is needed about 4 weeks later. If nitrogen fertilizer such as ammonium nitrate or ammonium sulfate is used, apply 1 cup per 30 feet of row.

When the cauliflower head can be seen easily, gather the longest leaves together over the head and tie them with a rubber band or soft twine (Fig. 4.) This is called blanching. It shades the head and prevents it from becoming yellowish green in color. Check plants often for insect damage after blanching. The head should be ready to harvest 8 to 10 days after blanching.

Insects

Name and description		Control
 Aphid	⅛ inch long; soft-bodied; green, pink, red, brown or powdery blue; usually on undersides of leaves; sucks plant juices; may be covered with a fine whitish wax.	malathion garlic juice extracts neem oil pyrethrins azadirachtin
 Harlequin bug	Adult and nymph; black and yellow; shield shaped; sucks juices from plants.	Sevin® azadirachtin garlic juice extracts pyrethrins
 Cabbage looper	Up to 1½ inches long; pale green with light stripe down back; doubles up or loops when it crawls; chews leaves.	*Bt* garlic juice extracts pyrethrins
 Imported cabbage worm	Up to 1¼ inches long; velvety green with three faint gold stripes on back; chews ragged holes in leaves; bores into head. *Photo–James Dill, University of Maine*	*Bt* spinosad garlic juice extracts pyrethrins

Before using a pesticide, read the label. Use it in strict accordance with cautions, warnings and directions.

Diseases

There are a few diseases of concern when growing cole crops, but there are some practices that will help keep disease pressure down. Rotate crops every year. Do not plant the same crops or crops of the same family in the same place more than once every 3 to 4 years. Leave plenty of space between plants to reduce disease problems. If you have trouble with diseases on cole crops, ask your county Extension agent about disease control.

Harvesting

Cauliflower. Cut center heads when they are tight. Overly mature heads become open and loose, and flowers begin to open.

Broccoli. Cut center heads when the very first flower shows the slightest yellow color. Leave side sprouts for later harvest.

Brussels sprouts. Sprouts appear between leaves and the main stem on lower leaves first. They must have cool weather for best quality. When the sprouts are about 1 inch in diameter and the lower leaves begin to turn yellow, cut off lower leaves and remove sprouts with your fingers or a knife. New sprouts form higher up the stem as the plant grows.

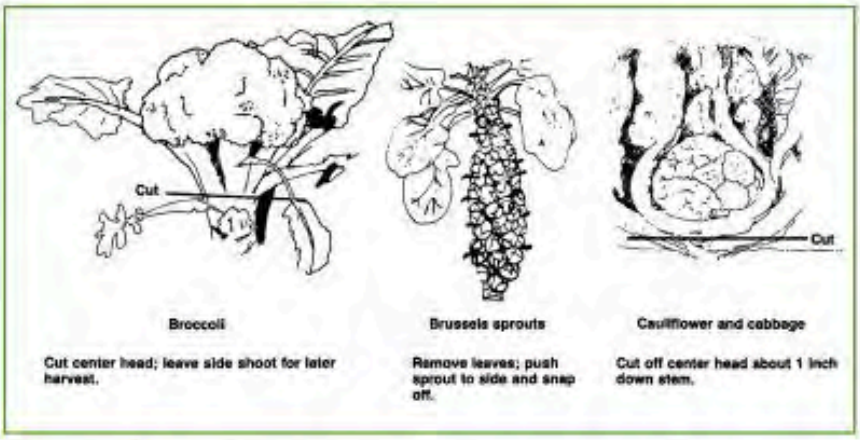


Figure 5. Proper harvesting.

Cabbage. Harvest when the head becomes firm. This can be tested by pressing with the thumb in the center of the head.

Broccoli, cauliflower and Brussels sprouts must be harvested as soon as they are ready (Fig. 5.) Delayed harvest results in tough, poor quality produce. Cabbage holds longer in the garden after maturity. Cabbage plants left undisturbed after harvest sometimes develop small sprouts similar to Brussels sprouts near the cut surface. This usually is not enough to justify leaving the plants, especially in small gardens.

Serving

Cole crops are a good source of protein, minerals and vitamins when properly prepared. Broccoli, cauliflower, and Brussels sprouts can be served raw in salads or cooked. Steamed or mashed cauliflower or broccoli is a good warm dish for cold days. Cabbage is served cooked, raw in cole slaw, or processed into sauerkraut. Ask your county Extension agent for information on preparing and serving cole crops.

Cleanup

Spring cole crops can be followed by summer crops such as southern peas, okra, beans, cucumber, and cantaloupes. Turn leaves and trimmings from cole crops under the soil. Compost large stems.

Acknowledgments

The original version of this publication was authored by B. Dean McCraw. Insect photos courtesy of Bart Drees, the Texas AgriLife Extension Service.

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EHT-051
5/14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

COLLARD GREENS • COLLARD GREENS • COLLARD G

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Collards are one of the most nutritious vegetables. They are low in calories and high in protein, vitamins, and minerals. Although they are a member of the cabbage family, collards do not form heads. They are grown for their leaves.

Collards tolerate more heat and cold than most other vegetables grown in Texas. They are easy to grow, productive, and well suited to either large or small gardens. Collards grow best in cool weather and need as much sunlight as possible.

Soil preparation

Collards need a deep soil that is well drained and well prepared. The roots of a collard plant easily reach depths of 2 feet of more. Dig the soil as deep as possible or at least 10 inches. This will loosen the soil so the small feeder roots can grow more easily.

Before planting, remove rocks and large sticks from the soil; then spade it over to cover the plant material on the soil surface. Allow time for the material to begin rotting.

If the soil is mostly clay or light sand, add organic matter. A 4-inch layer of compost is enough. Spread the compost over the planting area before digging.

Just before planting, scatter a complete garden fertilizer such as 10-10-10 over the area you will plant. Use 2 or 3 pounds for each 100 square feet, or about 1 cup for each 10 feet of row. Use a rake to mix the fertilizer 3 to 4 inches into the soil.

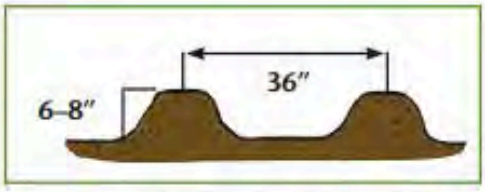


Figure 1. Work the soil into ridges that are 6 to 8 inches high and at least 36 inches apart.

Work the soil into ridges that are 6 to 8 inches high and at least 36 inches apart (Fig. 1). This brings the fertilizer under the

row, where the plants can reach it easily. The ridges also allow water to drain away from the plant roots.

Varieties

Collard varieties suitable for growing in Texas include Blue Max, Champion, Flash, Georgia LS, Georgia Southern, Top Bunch, and Vates.

Planting

Collards can be started from transplants or from seeds sown directly in the garden. Transplants usually are used for the spring crop. They add 4 to 5 weeks to the growing season because they can be grown indoors before the weather is warm enough to plant the seeds outside. Collard seeds sprout when the soil temperature reaches 45 degrees F.

Move the transplants into the garden as soon as the soil can be worked in the spring; in most of Texas, this is in February or March. Set the plants in the soil at about the same depth as they were grown indoors. Space them 18 to 24 inches apart in the row (Fig. 2). Water the plants after transplanting.

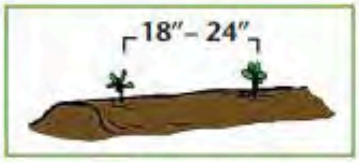


Figure 2. Space collard plants about 18 inches apart.

When planting seeds, make a shallow furrow about ½ inch deep down the center of the bed. Scatter the seeds lightly in the furrow. With a little practice, you can easily scatter the seeds by using your fingers to lightly tap the edge of the open seed packet. One teaspoon of seed will plant about 30 feet of row.

Cover the seeds with about ¼ inch of loose soil or compost; then sprinkle them with water. The plants should come up in 6 to 12 days. However, the colder the soil is, the more slowly the seeds will sprout.

For a fall crop, plant the seeds in the garden about 80 days before frost, which corresponds to August or September in most areas of Texas. Seed them heavily and then thin them.

Care during the season

After the plants have sprouted, let them grow until they get about 4 to 6 inches tall or become crowded in the row. Then thin the plants gradually until about 18 inches remain between them. Crowding causes the leaves to be smaller and less green.

Figure 3. Thinned plants can be either transplanted to another spot or used as greens.

The young plants can be either transplanted to another spot or used as greens (Fig. 3).

Fertilizing

Scatter 1 cup of garden fertilizer beside the plants for each 30 feet of row, about 1 tablespoon per plant. This is called side-dressing. Mix the fertilizer lightly with the soil, and water.

The plants may need to be side-dressed again in 4 to 6 weeks if they become pale and there is no sign that insects caused the change.

When the plants are thinned to their final spacing or if they become pale green, add a little more fertilizer. Collards need plenty of nitrogen to develop their dark green leaf color.

Name and description		Control
 Aphid	Green, pink, red, brown; ⅛ inch long; soft bodied; underside of leaves; often called 'plant lice;' sucks plant juices	Pyrethrins and/or Rotenone
 Cabbage looper	Light green, white, or pale yellow inchworm; has three pairs of prolegs; feeds on foliage	*Bacillus thuringiensis* (Dipel, Thuricide, Biotrol)
 Harlequin bug	Black with red or yellow markings; up to ¾ inch long; sucks plant juices causing plant to wilt and the leaves to turn brown	Sevin

Watering

Water the plants well each week if it does not rain.

Weeds

Keep the garden free of weeds because they rob the plants of water and nutrients. Pull the weeds or hoe them carefully to prevent damage to the collard plant's roots.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin® is a synthetic insecticide; organic options include Bt-based insecticides and sulfur. Sulfur also has fungicidal properties and helps control many diseases.

Before using a pesticide, read the label and always follow cautions, warnings, and directions.

Diseases

Collards are subject to some diseases. If the plants have spots on the leaves, you may need to use a fungicide. Check the plants daily, and treat them with an approved fungicide if diseases appear. Neem oil, sulfur, and other fungicides are available for use. Always follow the label directions.

Harvesting

Collards can be harvested in two ways. For small plants that need thinning, cut the entire plant about 4 inches above the ground (Fig. 4). Sometimes they will sprout back from the side of the stem.

Usually, only the lower leaves of collards are harvested. This allows the plant to continue growing and producing more leaves. In mild regions, such as South Texas and coastal areas, collards will produce all winter.

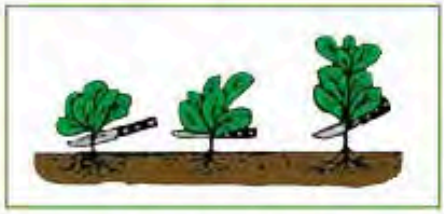


Figure 4. To harvest collards, cut small plants at ground level, or remove the lower leaves as the plant grows.

Collards can stand temperatures of 20 degrees F or less in some cases. They taste sweeter after a light frost.

Serving

To prevent the loss of nutrients, do not cook collards in too much water. Your county Extension agent can provide more information on cooking and serving collards.

TEXAS A&M AGRILIFE EXTENSION
EHT-033
11-10

Easy Gardening

CUCUMBERS • CUCUMBERS • CUCUMBERS • CUCU

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Cucumbers are grown for eating fresh or preserving as pickles. They mature quickly and are best suited to larger gardens. However, they can be grown in small areas if the plants are caged or trellised.

Site selection

Although cucumbers do best in loose sandy loam soil, they can be grown in any well-drained soil.

Cucumbers must be grown in full sunlight. Because their roots reach 36 to 48 inches deep, do not plant them where tree roots will rob them of water and nutrients.

Soil preparation

Remove rocks, large sticks, and trash before preparing the soil. Leave fine pieces of plant material such as dead grass and small weeds because they will help enrich the soil when turned under.

Spade the soil to 8 to 12 inches deep (Fig. 1). This is about the depth reached by most shovels or spading forks. Turn each shovel of soil completely over to cover all plant materials with soil.

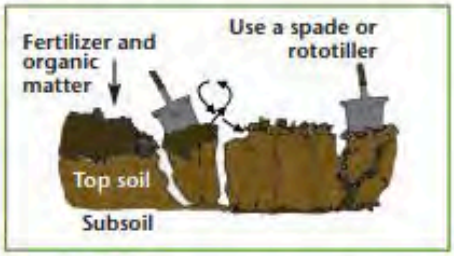


Figure 1. When preparing the soil, turn over the soil to a depth of 8 to 12 inches and add fertilizer and organic matter.

Work the soil into beds 4 to 6 inches high and at least 36 inches apart (Fig. 2). Ridges are especially important in heavy soils and poorly drained areas because cucumbers must have good drainage.

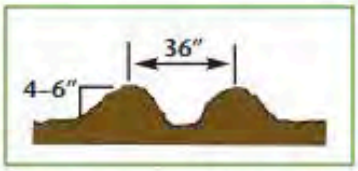


Figure 2. Work the soil into beds 4 to 6 inches high and at least 36 inches apart.

Varieties

Cucumbers are grown for slicing or for pickling. The cucumbers best suited for slicing are 6 to 8 inches long and 1 inch or more in diameter when mature. Cucumbers grown for pickling are 3 to 4 inches long and up to 1 inch in diameter at maturity. Either type can be used for pickling if picked when small.

Varieties to grow in Texas for pickling include Calypso, Carolina, Fancypak, Multipik, and National Pickling.

For slicing, varieties include Burpless, Dasher II, Poinsett, Pointsett 76, Slice Master, Straight 8, Sweet Slice, and Sweet Success.

Planting

Cucumbers require warm temperatures and cannot survive frost. Do not plant cucumbers until all danger of frost has passed and the soil begins to warm.

Cucumbers are a vine crop requiring a lot of space. The vines can reach 6 to 8 feet long or more. In large gardens, cucumbers can spread out on the ground. Plant them in rows on the ridges prepared earlier. Use a hoe or stick to make a small furrow about 1 inch deep down the center of each ridge.

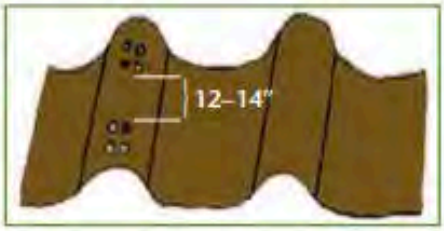


Figure 3. When planting cucumbers, drop three or four seeds in groups every 12 to 14 inches in the row.

Drop three or four seeds in groups every 12 to 14 inches down the row (Fig. 3). By planting several seeds, you are more likely to get a stand. Remove extra plants soon after emergence.

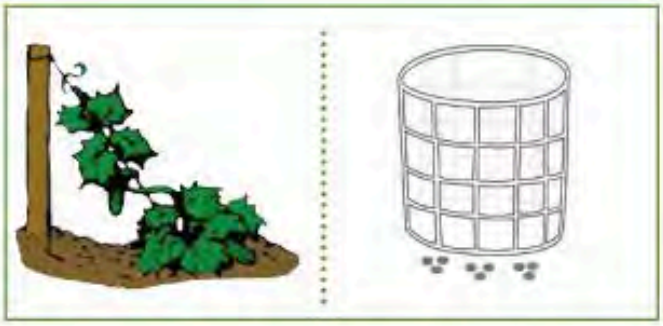


Figure 4. In a small garden, cucumbers can be trained along a wire attached to a wall.

Figure 5. If a wire cage is used, plant three or four seeds in hills 4 to 6 inches high along the cage.

Cover the seeds with about 1 inch of fine soil. Use the flat side of a hoe to firm the soil over the seeds, but do not pack it.

In small gardens, you can train cucumbers on a fence, trellis or cage if wire is available (Figs. 4 and 5). Plant three or four seeds in hills 4 to 6 inches high along the trellis or cage.

You can plant fast-maturing crops such as lettuce and radishes between the cucumber hills to save space. These will be harvested before the cucumber vines get too large.

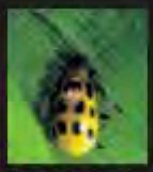
Fertilizing

Cucumbers require plenty of fertilizer. Scatter 1 cup of a complete fertilizer such as 10-10-10 or 10-20-10 for each 10 feet of row; then work the fertilizer into the soil and leave the surface smooth.

When the vines are about 10 to 12 inches long, apply about ½ cup of fertilizer for each 10 feet of row or 1 tablespoon per plant.

Watering

Soak the plants well with water weekly if it does not rain.

Name and description		Control
 Banded cucumber	Banded cucumber beetle, ¼ inch long; yellow-green with 3 yellow bands	Pyrethrins or rotenone
 Spotted Cucumber	Spotted cucumber beetle, ¼ inch long; yellow-green with 12 black spots	Pyrethrin or rotenone
 Squash bug	Squash bug, up to 1 inch long; gray-brown, reddish brown when small	Sevin or Thiodan

Care during the season

Keep the cucumbers as weed free as possible. Do not plow or hoe the soil deeper than about 1 inch because you may cut the feeder roots and slow the plant's growth.

Figure 6. Male cucumber flowers open first and always drop off.

Figure 7. Female cucumber flowers form the cucumbers.

Cucumbers produce two kinds of flowers, male and female. Male flowers (Fig. 6) open first and always drop off. Female flowers (Fig. 7) form the cucumber and should not drop off.

If the female flowers do begin to drop off, touch the inside of each male and female flower with a soft brush or cotton swab. This will pollinate the flowers and help them develop into fruit.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin is a synthetic insecticide; organic options include Bt-based insecticides and sulfur. Sulfur also has fungicidal properties and helps control many diseases.

Before using a pesticide, read the label and always follow cautions, warnings, and directions.

Diseases

Several diseases attack cucumbers. Most of these diseases show up as spots on the upper or lower sides of leaves or on fruit. Check the plants daily, and spray them with an approved fungicide if diseases appear. Neem oil, sulfur, and other fungicides are available for use. Always follow label directions.

Harvesting

Harvest cucumbers when they reach the desired size and are green in color. Do not wait until they turn yellow. Yellow cucumbers are over mature and will have a strong flavor.

Acknowledgments

This publication was revised from earlier versions written by Jerry Parsons, former Professor and Extension Horticulturist, and Sam Cotner, Professor Emeritus and former Extension Horticulturist.

EHT-036
02-11

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

LANT • EGGPLANT • EGGPLANT • EGGPLANT • EG

Joseph Masabni, Assistant Professor and Extension Horticulturist, and Patrick Lillard, Extension Assistant, The Texas A&M System

Eggplant originated in India and is a member of the nightshade family, which includes potato and tomato. At one time the Spanish called it the "apple of love" and considered it an aphrodisiac. Other Europeans called it the "mad apple" and thought it caused insanity. While neither has been proved, eggplant is known to be very nutritious. It is a great source of fiber and has a fair amount of iron, potassium and protein.

Soil preparation

Eggplant prefers well-drained, fertile, sandy loam soils with a pH between 5.5 and 7.2. Remove all weeds and till the soil to loosen it to a depth of 6 to 10 inches. The higher the organic matter content of the soil the better, so incorporate a 3- to 4-inch layer of compost if possible.

Varieties

There are many different varieties of eggplant, including the small, round, green 'Kermit' eggplants; the skinny, long Japanese pickling eggplant; and the traditional large 'Black Bell' eggplant.

Suggested varieties for Texas include:

- Black Bell
- Black Magic
- Epic
- Classic
- Florida High Bush
- Florida Market
- Night Shadow

Oriental-type varieties that do well in Texas include 'Ichibon' and 'Tycoon'.

Planting

Although eggplant can be seeded directly into the garden, it is always better for the beginning gardener to use transplants. If you can't find the varieties you want in garden centers, make sure you start seeds 6 to 8 weeks before they are to be transplanted outside. Grow the seeds indoors. They will germinate in 5 days if kept at 86 degrees F,

but could take up to 14 days at 65 degrees F. Eggplant is a tropical plant, so it is very sensitive to cold and should not be planted outside until after all risk of frost has passed and daytime temperatures are at least 65 degrees F. The plants will grow to 2 to 4 feet, so space them 24 to 36 inches apart.

Fertilizing

Eggplant needs a consistent supply of nutrients. It is best to get a soil test and follow its recommendations.

If no soil test is conducted, add a total of 2 to 3 pounds of a complete fertilizer (6-12-12, 10-10-10, or 9-16-16) per 1,000 square feet. Apply half the fertilizer before planting and the other half after the first fruits appear.

After transplanting the eggplant, pour ¼ cup of starter solution around each plant. Make a starter solution by dissolving 2 tablespoons of a complete fertilizer in 1 gallon of water.

Watering

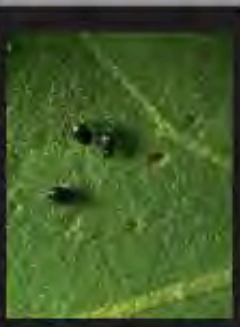
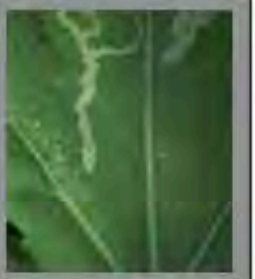
Eggplant also needs consistent water, at least 1 inch per week. It is better to give one thorough soaking than several frequent, short waterings, because frequent watering promotes shallow roots.

Weather and soil type, of course, will affect water demand. High temperatures, high winds, and sandy soils will all increase the need for water.

Care

Keep weeds under control because they compete with plants for water, nutrients and light. Many different types of mulch can be used, both organic and inorganic, to conserve soil moisture and reduce weed competition.

Insects

Name and description		Control
	Cutworm — Larvae have rough skin with various size conical granules.	Bt neem oil diatomaceous earth spinosad
	Eggplant flea beetle — 1/16 inch long; bronze-black, blue, or green, with light markings; jumps quickly; eats holes in leaves.	Sevin® neem oil diatomaceous earth spinosad
	Serpentine leafminer — Small, yellowish larvae inside the leaves; cause tunnels or trails on the leaves.	remove infected leaves neem oil diatomaceous earth spinosad biological controls: Dacsure, Disureig-sure
	Spider mites — Barely visible to naked eye; spiderlike; suck juice from undersides of leaves; leaves lose color; may form tiny webs.	beneficial insects strong blasts of water insecticidal soaps neem oil diatomaceous earth spinosad

Diseases

Quite a few diseases can damage eggplant at various stages, including seed rot, damping-off, anthracnose, late blight, alternaria leaf spot, and verticillium wilt.

Three conditions must be met for a disease to take hold: the presence of the disease pathogen, a susceptible host, and a favorable

environment. If any one of these elements is lacking, the disease cannot spread. It is much easier to prevent a disease than to control it.

Diseases can be prevented by planting resistant varieties, rotating crops, using proper irrigation and plant spacing, and practicing good sanitation (such as disposing of diseased plants).

Harvesting

The fruit can be harvested when they are one-third to full size. Harvest before the skin becomes dull and the seeds become hard. One general rule is if you lightly press the side of the fruit with your thumbnail and the indention stays, then the fruit is ripe and ready to be picked.

While the fruit can be broken off the plant, it is better for the plant if they are cut off. Beware of the spines on the fruit stem, as they can hurt an ungloved hand. Handle the harvested fruit gently so they don't get bruised.

Storing

Harvested fruit can be stored at 45 to 50 degrees F with 90 percent humidity for a week.

Serving

Eggplant can be cooked many ways. It can be baked, stewed, sautéed, fried or stuffed. It can be cooked whole or in pieces. It can be cubed and used in curries and stews. Baba ghanoush is a dip made from mashed or pureed eggplant with tahini, garlic, lemon juice, and a few other spices. And, of course, there is the ever popular eggplant Parmesan.

Acknowledgments

Insect photos courtesy of Bart Drees, The Texas A&M AgriLife Extension Service.

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The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

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New

EHT-057
5/14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

BEANS • GREEN BEANS • GREEN BEANS • GREENBE

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Green beans are a popular, warm-season, vegetable crop for home gardens. They grow well in most Texas soils. Like most vegetables, green beans grow best in well-drained soil and with plenty of sunlight.

Varieties

Several bean varieties are recommended for planting in Texas:

Snap beans

- Blue Lake
- Early Contender
- Greencrop
- Tendercrop
- Topcrop
- Derby
- Goldencrop Wax
- Kentucky Wonder
- Tendergreen

Pinto beans

- Dwarf Horticultural
- Luna
- UI-114

Lima beans

- Florida Butter
- Fordhook
- Jackson Wonder
- Florida Speckled
- Henderson Bush

Soil preparation

Before planting green beans, remove all weeds and trash from the planting area. Then till the soil 8 to 10 inches deep and rake it several times to break up the large clods. It is best to work the garden soil only when it is dry enough to not stick to garden tools.

Planting

In the spring, plant green beans only after all danger of frost has passed. In the fall, plant them 10 to 12 weeks before the first expected frost. Use ¼ to ½ pound of seed for each 100 feet of row of green beans. If possible, use fungicide-treated seeds to protect the seedlings from diseases until they are up and growing. Do not eat treated seeds.

For bush beans, plant the seeds about 1 inch deep and 1 to 2 inches apart in the row (Fig. 1). The rows should be 2½ to 3

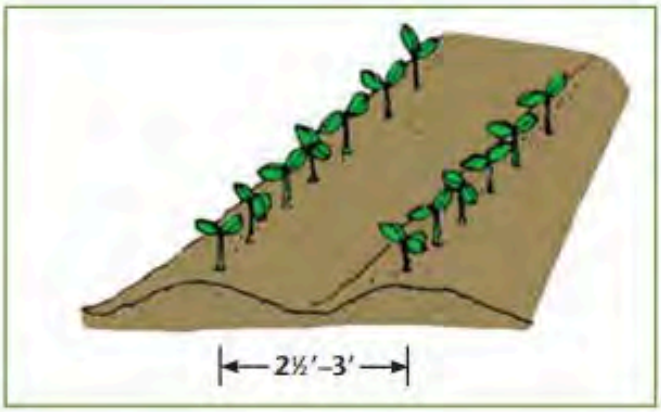

Figure 1. Plant bush beans on rows that are 2½ to 3 feet apart.

feet apart. After the beans have sprouted, thin the plants to 3 to 4 inches apart (Fig. 2).

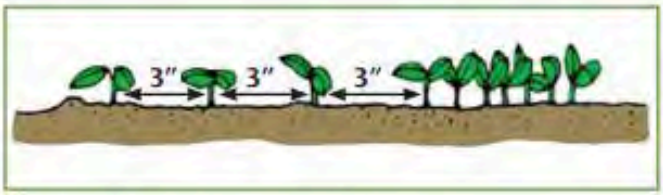

Figure 2. After the bush beans are up, thin them to 3 to 4 inches between plants.

For pole beans, plant the seed in rows 3 to 4 feet apart. Plant them in hills about 3 feet apart in the row (Fig. 3). Place a 6- to 8-foot stake in the center of each hill. Plant three to four seeds around the stake, about 1 inch deep in the soil. As the bean vines mature, they will grow up the stake.

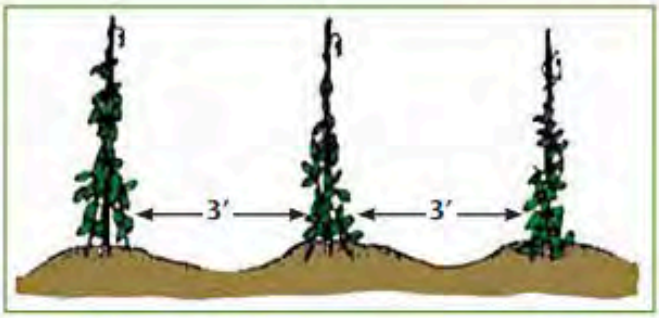

Figure 3. Plant pole beans in hills about 3 feet apart. Place a 6- to 8-foot single pole or stake in the middle of each hill.

Try to plant when the soil is moist enough to cause the seeds to germinate and emerge quickly.

Fertilizing

Beans grow best when the soil is fertilized well. For an area that is 10 feet long and 10 feet wide, use 2 to 3 pounds of fertilizer such as 10-20-10. Spread the fertilizer evenly over the area then mix it in with the top 3 to 4 inches of soil.

Watering

Water the plants about once a week in dry weather. Do not let the soil dry out while the beans are blooming or the blooms will drop and yields will be decreased.

Care during the season

The roots of beans grow near the soil surface. When hoeing and pulling weeds, do not dig too deep, or the plant's roots will be damaged. After the plants begin to flower and set beans, apply ½ cup of fertilizer for every 10 feet of row. Scatter the fertilizer between the rows. This will help the plants produce more beans. Water the plants after fertilizing.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin® is a synthetic insecticide; Bt-based insecticides and sulfur are organic options. Sulfur also has fungicidal properties and helps in controlling many diseases. Before using a pesticide, read the label and always follow cautions, warnings and directions.

Name and description		Control
 Aphid	⅛ inch long; green, pink, red, or brown; feeds on underside of leaf or on leaf petioles; sucks plant juices	Check with your county Extension agent
 Spider mites	Spiderlike; barely visible to the naked eye; feed on underside of leaf causing yellow spots on the top of it; may form tiny webs	Check with your county Extension agent

Diseases

Diseases may be a problem during cool, wet weather. If spots appear on leaves or bean pods, treat the plant with an approved fungicide. Neem oil, sulfur, and other fungicides can be used.

Before using a pesticide, read the label. Again, always follow cautions, warnings, and directions.

Harvesting

Green beans are ready to pick when they are about the size of a small pencil. Pull them carefully to avoid damaging the plant. Overmature beans are tough and stringy.

If beans are picked when they are ready, the plants will continue producing for several weeks.

Storing

You can store fresh beans in the crisper, in plastic bags or in other containers in the refrigerator. They usually can be stored in the refrigerator for a week.

Serving

Fresh green beans add color and variety to meals. Green beans are a fair source of vitamins A and C if they are cooked for a short period in a very small amount of boiling water. Cook them just until they are tender. Do not cook them too long or they will become mushy and lose their bright green color.

Fresh steamed green beans is an easy dish to prepare.

Acknowledgments

This publication was revised from earlier versions written by Jerry Parsons, former Professor and Extension Horticulturist, and Sam Cotner, Professor Emeritus and former Extension Horticulturist.

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Revision

TEXAS A&M AGRILIFE EXTENSION

EHT-071
6-14

Easy Gardening

HARVESTING • HANDLING • STORING VEGETABLES •

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

To help ensure that the vegetables you grow and prepare are of high quality, you need to harvest them at peak maturity, handle them properly, and store them under optimum conditions.

Vegetables continue their life processes even after they are picked. If the vegetables are mature at harvest, their life processes need to be slowed by chilling. If they are immature produce such as green tomatoes, store them at room temperature to enhance the ripening process.

Except for ripening, storage does not improve a vegetable's quality. To be acceptable, a vegetable must be cultivated properly and of good quality at harvest.

It can be difficult to determine when vegetables reach peak quality. The first step is to keep a record of the cultivars planted and the dates they were planted.

Although some vegetables are more prone to damage during harvesting than others, avoid bruises and cuts in handling all produce. Discard any vegetables with signs of decay or rot to prevent them from affecting the good produce. Some vegetables should be washed in cold running water immediately after they are harvested to remove any soil, dust, or other contaminants and to help lower their temperature.

Three keys to protecting the quality of your produce after harvest are temperature, moisture, and ventilation.

Temperature: For produce such as peas and sweet corn, the conversion of sugar to starch is critical to interrupt at harvest. To minimize this conversion, the produce must be cooled immediately. If possible, harvest these vegetables early in the morning or right before you intend to use them.

Moisture: The proper humidity level for storage varies by commodity. Leafy-type vegetables require a high humidity of about 95 percent; in contrast, onions can be stored in drier conditions, such as 65 to 70 percent relative humidity.

Ventilation: Minimize wilting and tissue breakdown by ensuring that air can circulate properly.

Recommendations for specific vegetables

Follow the guidelines below to help ensure a high-quality harvest.

Asparagus: Cut, just below soil line, shoots that are 6 to 8 inches tall. The stalks should be fresh and firm with compact, closed tips. Angular or flat stalks are apt to be woody.

Store asparagus in the refrigerator and wash just before use.

Beans—broad, lima, and green shell: Harvest these beans when the pods are well filled but have not begun to yellow. Keep the beans cold and humid, and use them as soon as possible.

Beans—snap: For maximum tenderness, harvest snap beans before they are fully mature, when the pods are almost full size but before the seeds begin to bulge. They should be free from scars and strings when snapped.

Keep snap beans cold (at 45 to 50 degrees F) and humid, and use as soon as possible. Wash the beans before storage to help retain their moisture content.

Beets: Pull early beets when they are about 2 inches in diameter. If they are allowed to get much larger, they become woody, especially in warm, dry weather.

For late-crop beets, remove all but about 1½ inches of the tops. Wash and refrigerate them immediately.

Broccoli: Harvest broccoli when the flower heads are fully developed but before the individual flower buds open enough to show the bright yellow flowers. Cut them off at 6 to 7 inches below the flower heads. The small, tender leaves are also edible and nutritious.

Store harvested broccoli in the cold drawer of the refrigerator.

Brussels sprouts: Harvest when the sprouts (buds) at the base of the plant become solid. Remove the buds higher on the plant as they become firm, but do not strip the leaves from the plants since they are needed for further growth.

Store the sprouts in the cold section of the refrigerator.

Cabbage: Harvest cabbage when the head becomes solid and firm. The outer leaves should be a uniform green or purple (depending on the type). Excessive water uptake by plant roots causes splitting. To prevent mature heads from splitting, twist the plants enough to break several roots.

Store harvested cabbage in the crisper and use within 1 to 2 weeks.

Carrots are ready to be harvested when they are small and succulent. Do not let them get over about 1 inch in diameter.

Always pull the largest carrots in the row. Remove the tops and wash the carrots before transferring them to refrigerated storage.

Cauliflower should be harvested when the curds, or aborted flower heads, are full sized (6 to 8 inches) but still compact, white, and smooth. Curds exposed to sunlight appear

rough, coarse, and cream colored. When the head is 3 to 4 inches across, loosely tie the tips of the outer leaves above the curd to exclude sunlight.

Chill cauliflower immediately after harvest.

Celery can be cut when the plants reach 12 to 15 inches tall. While they are young and tender, remove the lowest leaves (8 to 10 inches long) from a few plants and use them in salads, soups and cooked dishes.

Wash and store harvested celery in the refrigerator.

Corn—sweet: Watch corn for signs of ripeness for earliest harvest. Corn silks darken and dry out as the ears mature. As the kernels fill out toward the top, the ends become more rounded instead of pointed.

Pick sweet corn in the milk stage, when a milklike juice exudes from the kernels if crushed with a thumbnail. Because sweet corn converts from sugar to starch very rapidly, cook, eat, or chill it immediately after harvest.

Cucumbers: Harvest them when fruits are bright, firm, and green and before they get too large. A rule of thumb: harvest sweet pickles at 1½ to 2 inches long; harvest dills when they are 3 to 4 inches long, bright green, and less crisp. Avoid yellowed cucumbers.

You can store cucumbers in the refrigerator 5 days. Do not try to pickle salad-type cucumbers.

Eggplant: Harvest eggplants when the fruits are near full size—about 6 to 8 inches in diameter—but still firm and bright in color. Older fruits become soft, seedy, and dull colored.

Keep the harvested fruit cool and humid.

Garlic should be harvested when the leaves lose color and the tops begin to fall over. Store it in a cool, dry place.

Gourds: Harvest the edible gourd varieties when the fruits are young, tender, and 8 to 10 inches long; harvest the ornamental varieties when the fruits are mature and fully colored but before the first fall frost.

Greens: There are many kinds of greens, including beet greens, collards, dandelions, kale, mustard greens, Swiss chard, turnip greens, and others. Break off the outer leaves when they are 6 to 10 inches long and before they start to yellow. Avoid wilted or flabby leaves.

Wash and chill the harvested leaves immediately.

Horseradish: Harvest horseradish when the roots have reached maximum size in late fall or early spring.

Jerusalem artichoke: Dig the tubers after early fall frosts or in very early spring before the new growth starts. Wash and store artichoke heads in the refrigerator.

Kohlrabi can be harvested when the "bulbs" (thickened stems) reach 2 to 3 inches in diameter. Store them in the refrigerator.

Lettuce: Harvest leaf varieties of lettuce when the outer, older leaves are 4 to 6 inches

long; harvest heading varieties when the heads are moderately firm. The older, outer leaves may be removed from plants of either type of lettuce as soon as the leaves are 4 to 6 inches long. New leaves provide a continuous harvest of tender, tasty lettuce until hot weather brings on bitter flavor and seed stalks start.

After harvest, wash the lettuce and store in the refrigerator.

Melons—honeydew: Harvest honeydew when it is yellowish to creamy white with a soft, velvety feel. The rind should be slightly soft at the blossom end and have a faint, pleasant odor.

Melons—muskmelon: Harvest muskmelon when it is at three quarters to full slip; full slip or ripe is when the stem separates readily from the fruit under moderate pressure and leaves a circular depression. The outer rind should not have any green color.

If the melons are fully ripe, store them in the refrigerator. If not, store them in a cool area.

Melons—watermelon: Harvest watermelon when the fruits are full size and have a dull surface and a cream-colored ground spot.

Okra: For optimum quality, harvest okra that is 3 to 4 inches long. Harvest the pods before they reach the hollow, puffy stage and while they are easy to break or cut from stalk. For continued harvest, pick okra every day or two. Chill the harvested okra immediately.

Onions: The ideal onion bulb is 2 to 4 inches in diameter. Pull all onions when the tops fall over. Remove any adhering dirt. Do not harvest onions when the soil is wet. Let the harvested onions dry for a day or two with the tops on; then clip 1 inch above bulb before storing them in a cool, dry place.

Harvest green onions when they are 6 to 8 inches tall.

Parsley: Cut parsley when the older leaves are 3 to 5 inches long. Continue to take the outer leaves for fresh, tender parsley until the first killing frosts of winter.

Store harvested parsley in the refrigerator.

Peas: If the peas will be shelled, harvest the pods when they are shiny green and fully developed. Overly mature peas are of poor quality. For the edible podded varieties (such as snow and Chinese peas), harvest when the pods are fully developed (about 3 inches) and before the seeds are more than half developed.

After harvest, peas deteriorate rapidly at high temperatures. Wash and chill them immediately.

Peppers: Harvest bell peppers when they are 4 to 5 inches long and have full, well-formed lobes. Immature peppers are pale, soft, pliable, and thin fleshed.

Harvest jalapeños when they are 2 to 2½ inches long. Mature peppers turn orange or red; this does not mean that they are hotter.

Store harvested peppers at 45 to 50 degrees F.

Potatoes—Irish and "new": For Irish potatoes, a good harvest size is 2 to 3

inches in diameter. However, individual preference is the rule here.

Harvest "new" potatoes at any size, but generally do not dig before they are 1¼ to 1½ inches in diameter. Let the potatoes dry several hours in garden after digging them.

Do not expose potatoes to sunlight for any length of time. Remove any adhering soil, but do not wash the potatoes before storing them. Store harvested potatoes in a cool, dry area.

Pumpkins: Pick pumpkins when they are full size, the rind is firm and glossy, and the bottom of the fruit (the portion touching the soil) is cream to orange colored. Store harvested pumpkins in a cool, dry area.

Radishes: Harvest radishes when they are about 1 inch in diameter. Wash and chill them immediately.

Rutabagas: Harvest rutabagas when the roots reach full size but before heavy fall frosts. Thin the rutabagas early to ensure that they have rapid, uniform growth and highest quality. Store harvested rutabagas in the refrigerator.

Spinach should be harvested when the large leaves are 4 to 6 inches long. Pull the larger, whole plants or harvest the older leaves and allow new growth to develop.

Wash the leaves thoroughly and store them in the refrigerator.

Squash: Harvest squash when it is 4 to 6 inches long for yellow crookneck squash, 6 to 8 inches long for yellow straight neck, and 3 to 4 inches in diameter for white scallop. A glossy color indicates tenderness.

Harvest winter squash when the fruits are full size. The rind is firm and glossy and bottom (portion touching soil) of fruit is cream to orange colored. Light frost will not damage mature fruit.

Because squash, like cucumbers, are susceptible to chilling injury, do not store them at cold temperatures for more than 2 to 3 days.

Sweet potatoes: Harvest sweet potatoes late in the fall but before the first early frost. Lift the sweet potatoes to avoid cuts, bruises, and broken roots. Remove the adhering soil but do not wash the potatoes. Cure them for at least 14 days in a warm, well-ventilated location. Store them in a cool, dry place.

Tomatoes: Harvest tomatoes when they are fully colored but still firm. Harvest red tomatoes for eating fresh, cooking, or canning. Do not can overripe tomatoes! If necessary, pick mature green or slightly pink tomatoes and ripen them at room temperature, out of direct sunlight.

Store ripe tomatoes in the refrigerator.

Turnips: Harvest the turnips when the roots are l½ to 2½ inches in diameter but before heavy fall frosts. For greens, harvest the leaves 4 to 6 inches in length. Keep topped turnips cold and humid.

Acknowledgments

This publication was revised from earlier versions written by Sam Cotner, Professor Emeritus and former Extension Horticulturist, and Al Wagner, former Professor and Extension Horticulturist.

TEXAS A&M AGRILIFE EXTENSION
EHT-068
6-14

Easy Gardening

IRISH POTATOES • IRISH POTATOES • IRISH POTA-

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Irish potatoes are one of America's most popular vegetables—the average American eats about 125 pounds of potatoes and potato products each year.

The edible part of the plant is an underground stem called a tuber (not a root). Irish potatoes contain 2 percent protein and 18 percent starch. They are an inexpensive source of carbohydrates and, when prepared properly, provide good amounts of vitamins and minerals.

Irish potatoes are a cool-season crop; they grow best in early spring and late fall when the days are warm and the nights are cool. However, the tops of the plant cannot withstand frost.

Varieties

The most common types of Irish potatoes are red or white. Most red varieties store longer than do white varieties; on the other hand, most white varieties have better cooking qualities than red varieties.

Many gardeners plant some of each in the spring. The whites are used first and the reds stored for later use.

Several varieties grow well in Texas:

- Red flesh: Dark Red Norland, Norland, Red LaSoda, and Viking
- White flesh: Atlantic, Gemchip, Kennebec, and Superior
- Yellow flesh: Yukon Gold
- Russet: Century Russet, Norgold M, and Russet Norkatah

Site selection

For best production, potatoes need full sun. They do best in a loose, well-drained, slightly acid soil. Poorly drained soils often cause poor stands and low yields. Heavy soils can cause the tubers to be small and rough.

Soil preparation

Before spading, remove the rocks, trash, and large sticks from the soil. Spade

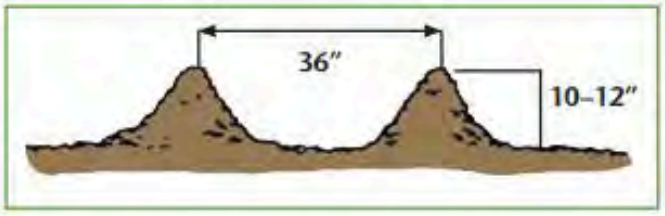

Figure 1. Before planting potatoes, work the soil into beds 10 to 12 inches high and 36 inches apart.

the soil 8 to 12 inches deep turning the earth over to cover all plant material.

Work the soil into beds 10 to 12 inches high and 36 inches apart (Fig. 1). Bedding is vital for drainage.

Because potatoes need adequate fertilizer early in the season, apply most of the fertilizer just before planting. Use 2 to 3 pounds of complete fertilizer such as 10-20-10 for each 30 feet of row in bands 2 inches to each side and 1 inch below the seed piece. Do not allow the fertilizer to touch the seed piece.

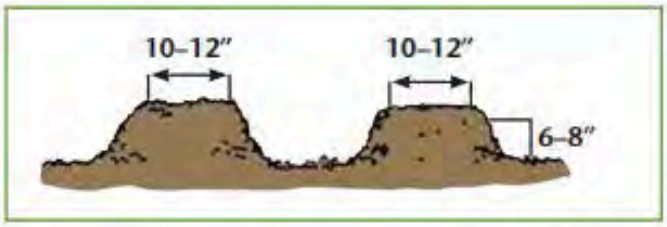

Figure 2. Flatten the beds at 6 to 8 inches high and 10 to 12 inches wide.

To apply the fertilizer, flatten the beds at 6 to 8 inches high and 10 to 12 inches wide (Fig. 2). Using the corner of a hoe or stick, open a trench about 4 inches deep on each side of the bed. Apply half of the fertilizer—about 2 cups for each 30 feet of row—in each trench.

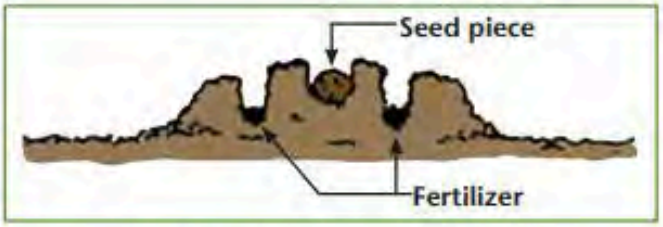

Figure 3. Plant the seed pieces in a row between two bands of fertilizer.

The seed pieces will be planted in the row between the two bands of fertilizer (Fig. 3).

Seed preparation

Unlike most other vegetables, Irish potatoes are not grown from seed. Instead, pieces from the potato itself start new plants. Buy good seed potatoes that are free of disease and chemicals. Do not buy potatoes from a grocery store for planting.

The seed potato contains buds or "eyes" that sprout and grow into plants. The seed piece provides food for the plant until it develops a root system. If the seed is too small, it will produce a weak plant. One pound of seed potatoes will make 9 to 10 seed pieces.

For a spring crop, cut large seed potatoes into pieces weighing about 1½ to 2 ounces, about the size of a medium hen egg. Each seed piece must have at least one good eye (Fig. 4).

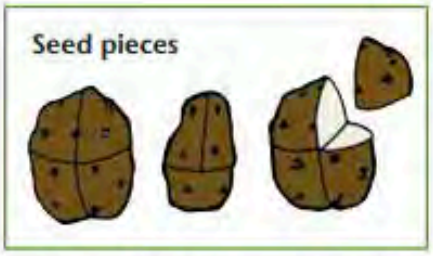

Figure 4. Cut large seed potatoes into pieces, each having at least one good eye.

Cut the seeds 5 or 6 days before planting. Hold the cut seed in a well-ventilated spot so it can heal over to prevent rotting when planted in cold, wet or very hot weather. Plants killed by a late spring frost will not come back if the seed piece is rotten.

For fall-grown potatoes, plant small, uncut potatoes because they are more resistant to rotting in hot weather than cut potatoes. Select mature potatoes about 1½ inches in diameter.

Potatoes have a rest period that must be broken before they will sprout. The rest period is more easily broken in small, mature potatoes.

To be sure the rest period is broken, store small seed potatoes under warm, damp conditions for 2 weeks before planting by placing them in a shady spot and covering them with moist burlap bags or mulch. The potatoes should have small sprouts at planting time.

Seed is usually more available in the spring than in the fall. Many gardeners buy extra seeds in the spring and hold it over for fall planting. For best storage, keep the potatoes in a cool, humid spot such as the bottom of a refrigerator.

Do not save your potato seeds for more than 1 year. This can cause buildup of virus diseases and reduce yield.

Planting

Plant potatoes when the soil temperature 4 inches deep reaches about 50 degrees F, or about 3 weeks before the last spring frost. In most areas of Texas, potatoes should be planted in February or early March. If planted too early, the tops can be frozen off by spring frost.

For a fall crop, plant about 110 days before the first expected frost, or mid-August in most areas.

Use a hoe or stick to open a trench about 3 inches deep down the center of the bed. Drop the seed pieces 10 to 12 inches apart in the trench (Fig. 5). Step on each seed piece after dropping it to ensure good contact with the soil.

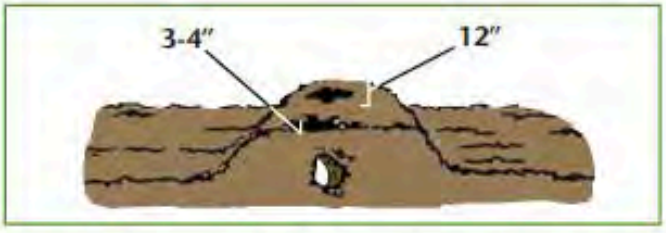

Figure 5. Drop the seed pieces 10 to 12 inches apart in the trench.

Cover the seed about 3 inches deep. If covered too deeply, the plants will be slow to break through the soil and will be more subject to disease and seed decay.

Fertilizing

The plant must have adequate moisture and fertilizer when the tubers are forming. This usually occurs when the plants are 6 to 8 inches tall. Apply 1 cup of fertilizer for each 30 feet of row beside the plants when they are about 4 inches tall.

Watering

During growth, keep the soil moisture supply constant. Water the fertilizer into the soil, especially on sandy soils.

Moisture stress followed by irrigation or rainfall can cause growth cracks and second growth (Fig. 6). If the rainfall is accompanied by hot weather, the rest period of developing tubers can be broken and can cause the tubers to sprout in the soil. Too much water enlarges the pores on the tubers and makes them rot easily in storage.

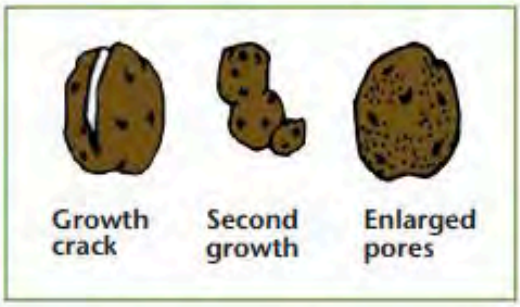

Figure 6. Moisture stress followed by watering can cause growth cracks and second growth. Too much water causes enlarged pores on the tubers.

Care during the season

All tubers produced on a potato plant arise from above the seed piece. Because

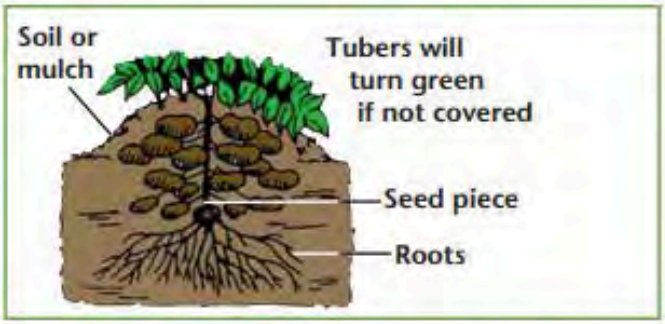

Figure 7. **Because all tubers produced on a potato plant come from above the seed piece, the soil must be pulled toward the plant as it grows.**

the seed piece is planted only 3 inches deep, soil must be pulled toward the plant as it grows (Fig. 7). This gives the tubers a place to form.

Some gardeners use thick mulch for this purpose. Potatoes formed in soft mulch often are smoother and have a better shape than those grown in soil. This is especially true if the soil is heavy.

As the potatoes enlarge, they must be protected from sunlight or they will turn green. Apply a thick layer of mulch when the plants are 8 to 10 inches tall to block sunlight, reduce soil temperature, and increase yield and quality.

Potato plants usually produce flowers and sometimes produce fruits (Fig. 8). The fruits bear the true seed of the potato plant. They look like small tomatoes but cannot be eaten.

Figure 8. **Potato plants usually produce flowers and sometimes produce fruits.**

Potato plants do not cross with tomato plants.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides. Sulfur has also fungicidal properties and helps in controlling many diseases.

Before using a pesticide, read the label and always follow cautions, warnings, and directions.

Name and description		Control
 Flea beetle	1/16 inch long; metallic bronze, black, blue or green; jumps quickly; eats small, round holes in leaves	Sevin
 Colorado potato beetle	**Adult:** black and yellow stripes; ⅜ inch long; **Larva:** red, light orange; two rows of black dots on each side; soft bodied; up to ⅜ inch long; feeds on leaves	Sevin
 Aphid	⅛ inch long; green, pink, red, or brown; soft bodied; usually found on underside of leaves; sucks plant juices	Malathion
 Wireworm	Yellow-white; dark head and tail; slender; ½ to 1½ inches long; feeds on tubers	Weed control, sanitation and hand removal
 Leafhopper	Green; wedge shaped; crawls sidewise when disturbed; up to ⅛ inch long; sucks juices from leaves; leaves curl upward and turn yellow to brown	Sevin

Diseases

Potatoes are troubled by several diseases. Treating seed pieces with a fungicide before planting can be helpful.

Check the plants daily and treat them with an approved fungicide if diseases appear. Neem oil, sulfur, and other fungicides are available for use. Always follow label directions.

A good rotation program is an effective way to control most potato diseases. If possible, do not plant potatoes in the same place more than once each 3 years. Do not follow or precede potatoes with eggplant, okra, pepper or tomato.

Seed piece treatment is especially important if your garden is too small for adequate rotation.

Harvesting and storing

Potatoes are ready to harvest when the tops begin to die and the potato skin becomes firm. The skin is set when it does not scrape easily when rubbed with the thumb. Skin set can be speeded by cutting back the tops of the plants.

Most of the potatoes should weigh 6 to 12 ounces at harvest. You can harvest small "new potatoes" during the growing season by carefully digging beside the plants with your fingers.

To harvest potatoes, dig under the plants with a shovel or spading fork. Keep the pitchfork 8 to 10 inches away from the plant to prevent cutting the potatoes. Raise the plants and shake away the soil.

Potatoes should be dug when the soil is moist. If it is too wet, the soil will stick to the potatoes. If too dry, dirt clods will bruise the potatoes.

Pull the potatoes from the vines and handle them carefully to prevent damage; damaged potatoes do not store well.

Allow the potatoes to dry; then store them in a cool spot with plenty of air movement. Most potato varieties are ready to dig 95 to 110 days after planting.

After the potatoes are dug, place the tops in the compost pile. The spring potato crop often can be followed with a summer crop such as southern peas.

Serving

Peel away the green areas on potatoes before cooking. For suggestions on how to prepare and serve potatoes, contact your county Extension agent.

Acknowledgments

This publication was revised from earlier versions written by B. Dean McCraw, former Professor and Extension Horticulturist.

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EHT-058
4-14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

OKRA • OKRA • OKRA • OKRA • OKRA • OKRA

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Okra is a warm-season vegetable that grows well in most Texas soils. A fair source of vitamin A, it can be eaten in many ways, including boiled, fried, and cooked in soups, gumbos, and casseroles.

Varieties

The best okra varieties to grow in Texas are Annie Oakley (Compact), Blondy (Compact), Burgundy, Cajun Delight, Clemson Spineless, Emerald, Lee, Louisiana Green, Stewart's Zeebest (Heirloom), and Velvet.

Site selection

For good yields, okra must grow in full sunlight in fertile, well-drained soil.

Soil preparation

Work the soil only when it is dry enough not to stick to garden tools. Spade or turn the soil as deeply as possible. Okra will grow best in soil that has been worked 8 to 10 inches deep.

Remove all rocks and trash from the soil, and then rake it soil smooth.

Planting

For the best yields, plant okra in the spring 2 to 3 weeks after all danger of frost has passed. For a good fall crop, plant at least 3 months before the first fall frost.

Plant the okra seeds about 1 inch deep and 2 inches apart in the row (Fig. 1). Space the rows at least 3 feet apart.

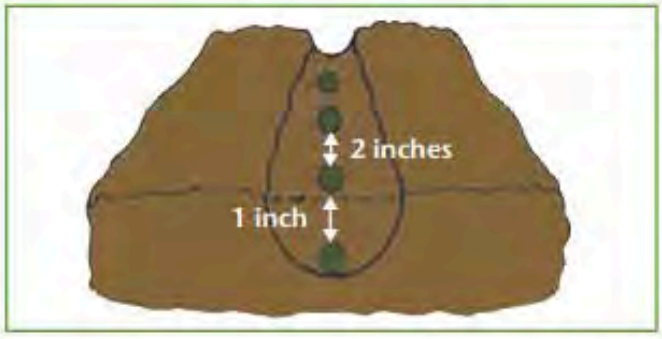


Figure 1. Plant okra seeds about 2 inches apart and 1 inch deep.

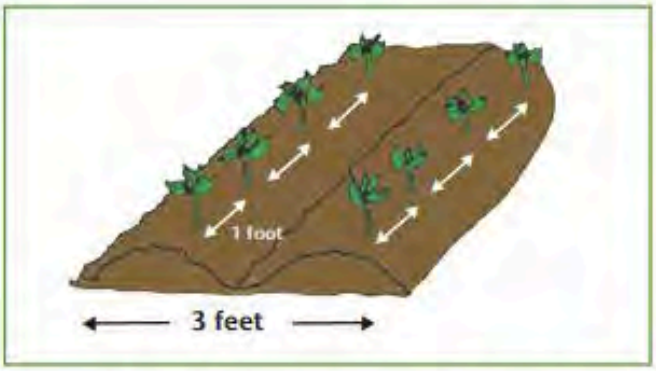


Figure 2. Okra rows should be 3 feet apart. After the plants are 3 to 4 inches tall, thin them to 1 foot between the plants.

When the okra is up and growing, thin out the plants to about 1 foot apart (Fig. 2).

Fertilizing

Before planting, use 2 to 3 pounds of fertilizer such as 10-10-10 or 15-5-10 for each 100 square feet of garden area. Spread the fertilizer evenly over the area, and then mix it well into the top 3 to 4 inches of soil.

Watering

Okra will do fairly well under dry conditions. However, if you water the plants every 7 to 10 days, the yield will be higher. Sandy soils will need water more often than clay soils.

Care during the season

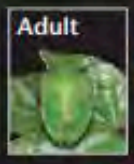
Cultivate around the okra plants to remove weeds and grass. To avoid damaging the okra roots, pull weeds close to the plants by hand.

After the first harvest, apply 1 cup of garden fertilizer for each 10 feet of row. Scatter the fertilizer evenly between the rows. Mix it lightly with the soil. Water the plants after fertilizing.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides. Sulfur has also fungicidal properties and helps control many diseases.

Before using a pesticide, read the label and always follow cautions, warnings, and directions.

Name and description		Control
 Aphids	Green, pink, red, or brown; ⅛ inch long; soft bodied; usually found on underside of leaves; suck plant juices	Malathion
 Stink bugs	Brown, green or black; shield shaped; usually about ½ inch long; discharge a foul odor; suck plant juices	Sevin

Diseases

Diseases on okra are most severe in cloudy, damp weather. Check the plants daily and treat them with an approved fungicide if diseases appear. Neem oil, sulfur, and other fungicides are available for use. Always follow label directions.

Harvesting

Okra plants will produce large flowers about 2 months after planting. The okra pods will be ready to pick 3 to 4 days later.

Harvest the pods when they are 3 to 4 inches long. If the okra gets too large, it will be tough and stringy. Pick the okra every 1 to 2 days or yields will decrease (Fig. 3).

Figure 3. Harvest okra when it is about 3 to 4 inches long.

Okra can be stored for 3 to 5 days in the refrigerator. Okra that is too mature can be dried, cured, and used in flower arrangements.

Okra seed is easily saved for next season by leaving some of the last pods on the plant until they get very large. Remove them and allow them to dry. The seeds will shell easily from the pods.

Other okra plant material such as leaves and stems can be put in a compost pile.

Acknowledgments

This publication was revised from earlier versions written by B. Dean McCraw, former Professor and Extension Horticulturist, and Sam Cotner, Professor Emeritus and former Extension Horticulturist.

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Revision

TEXAS A&M AGRILIFE EXTENSION
EHT-037
11-10

Easy Gardening

ONIONS • ONIONS • ONIONS • ONIONS • ONIONS

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Yellow, white, and red/purple onions grow very well in Texas home gardens. Green onions may be eaten fresh or chopped and added to salads. Bulb onions may be sliced and used on sandwiches or dipped in batter and fried as onion rings. Although onions are a source of vitamins A and C, they are used mostly as a flavoring in other food dishes.

Varieties

The varieties of onions that grow best in Texas are listed below.

Short day (11–12-hour day length)	
Yellow	Chula Vista, Cougar, Jaguar, Legend, Linda Vista, Mercedes, Prowler, Safari, Sweet Sunrise, TX 1015Y, Early Grano 502, Granex
White	Cirrus, Marquesa, TX Early White, Crystal Wax
Red	Red Bone, Rio Santiago, Sakata Red, Red Burgandy
Intermediate day (12–13-hour day length)	
Yellow	Caballero, Cimarron, Riviera, Utopia, Yula
White	Alabaster, Mid Star, Sierra Blanca, Spano
Red	Fuego
Long day (14–16-hour day length)	
Yellow	Armada, Capri, Durango, El Charo, Ole, Seville, Sweet Perfection, Valdez, Vaquero, Vega
White	Blanco Duro, Sterling, White Spanish Sweet
Red	Tango

Site selection

Onions grow best in full sunlight and well-drained soils.

Soil preparation

Work the garden soil only when it is dry enough not to stick to garden tools. Before seeding or transplanting, work the soil 8 to 10 inches deep.

Remove all rocks and trash from the soil; then break up the remaining clods and rake the soil smooth.

Planting

Onions are a cool-season crop and can stand temperatures well below freezing. They may be planted from seeds, from small bulbs called sets, or from transplants.

Seeding costs the least but takes longer before onions are ready. When seeding onions for bulbs, plant them ¼ inch deep during October through December. Place the seeds 1 inch apart. When the plants are about 6 inches high, thin them

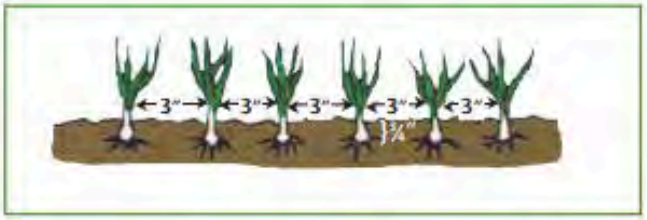

Figure 1. Plant onion transplants or sets ¾ inch deep and 3 inches apart.

to one plant every 2 to 3 inches. Eat the extra plants as green onions.

If you use sets or transplants, plant them ¾ inch deep and 3 inches apart (Fig. 1). Do not transplant onions more than 1 inch deep.

Fertilizing

Onions grow best when the garden soil is fertilized correctly. Spread 2 to 3 pounds of a fertilizer such as 10-10-10 over a 100-square-feet of garden area. Measure and spread the fertilizer; then mix it with the top 3 to 4 inches of soil.

Watering

Watering once a week usually is enough in the spring. But you may need to water more often during dry, windy weather. Water onions slowly and deeply to help grow strong, healthy roots.

Care during the season

Weeds are easy to pull or cut when they are 3 to 4 inches tall. Do not let weeds or grasses grow large because they compete with onions for nutrients.

If you use a hoe to remove weeds and grass, do not chop too deeply. You may be cutting the onion roots. Pull all weeds by hand when possible.

When the onion plants have 5 to 6 leaves, apply fertilizer again to help grow larger plants and bigger bulbs (Fig. 2). Each leaf forms a ring in the onion bulb. More leaves means more rings and larger bulbs.

Use about ½ cup of fertilizer for each 10 feet of onion row. Scatter the fertilizer evenly between the rows. Water the onions after adding the fertilizer.

Figure 2. When the onions have 5 to 6 leaves each, scatter fertilizer around the plants and water it in.

Insects

Onions have few insect problems. However, thrips, which are very tiny insects, may be found between the center leaves.

Many insecticides are available at garden centers for homeowner use. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides.

Diseases

Diseases may be a problem on onions. Brown leaf tips or brown spots on the middle and lower parts of leaves may be caused by plant diseases.

Sulfur also has fungicidal properties and helps control many diseases. Neem oil and other fungicides are also available for use.

Before using a pesticide, read the product label. Always follow cautions, warnings, and directions.

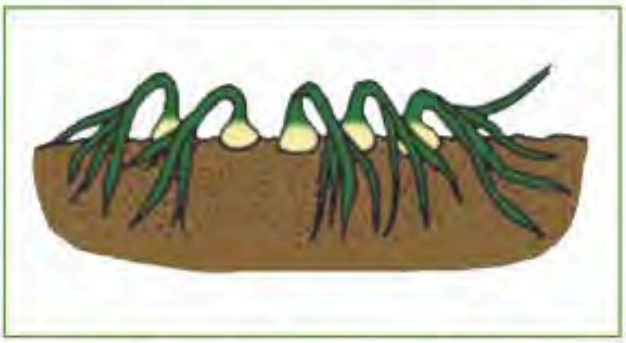

Figure 3. Harvest bulb onions when the tops begin to fall over.

Harvesting

Onions seeded in October/December or transplanted in January/February should produce bulbs in May/July.

If used as green onions, they may be picked from the time they are pencil size until they begin to form bulbs.

For dry-bulb onions, let the plants grow larger. The onions are ready when the main stem begins to get weak and fall (Fig. 3). Pull the plants out of the soil.

Leave them lying in the garden for 1 to 2 days to dry. Then remove the tops and roots and let them keep drying in baskets or boxes.

Storing

Store onions in a refrigerator crisper or in a dry, airy place such as in a wire net in the garage or carport.

Acknowledgments
This publication was revised from earlier versions written by Tom Longbrake, former Extension Horticulturist.

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TEXAS A&M AGRILIFE EXTENSION
EHT-038
11-10

Easy Gardening

PERS • PEPPERS • PEPPERS • PEPPERS • PEPPERS

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Peppers are a warm-season crop that will grow in most Texas areas. Red and green peppers are good sources of vitamin C, some vitamin A, and small amounts of several minerals. Red peppers have more vitamin A than do green peppers.

Peppers are good raw or cooked. Eat them as a snack, use them to decorate food, or add them to salads and casseroles. You can also stuff peppers with seasoned bread crumbs or meat and bake them.

Varieties

The best varieties of ***sweet peppers*** for growing in Texas include:

- Bell Tower
- Big Bertha
- California Wonder
- Gypsy
- Jupiter
- Yolo Wonder

Suitable ***hot pepper*** varieties include:

- Hidalgo Serrano
- Hungarian Wax
- Jalapeño
- Long Red Cayenne
- TAM Mild Jalapeño

Site selection

Peppers grow in all types of soils but do best in heavier, well-drained soils. Plant them in areas that receive at least 6 hours of sunlight each day.

Soil preparation

Several weeks before planting, work the soil 8 to 10 inches deep and rake it several times to break up the large clods. Work the soil only when it is dry enough not to stick to garden tools.

Incorporate large amounts of organic matter into the soil, especially if you are working with heavy clay. You can use compost, peat moss, rotted hay, or other organic matter.

Planting

Because a few plants will feed most families, it is best to buy pepper plants rather

than grow them from seed. Buy healthy plants that are 4 to 6 inches tall (Fig. 1). About three to four hot pepper plants and eight to ten sweet pepper plants usually are enough for a family of four.

Figure 1. When buying pepper plants, choose those that are dark green and 4 to 6 inches tall.

Peppers grow best in warm weather. Plant them only when all danger of cold weather has passed. Plant fall peppers 12 to 16 weeks before the first expected frost.

Make the transplant holes 3 to 4 inches deep and about 1½ feet apart in the row. Space the rows at least 3 feet apart. Before planting, fill the holes with water and let it soak in.

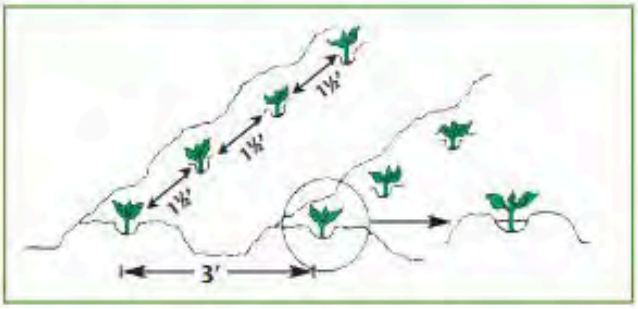


Figure 2. Peppers should be planted at least 1½ feet apart in a slightly sunken area to retain water.

Move the plants carefully from the box or flat, and set them in the transplant holes. Leave as much soil as possible around the roots. Fill the hole with soil and pack it loosely around the plant. Do not cover the roots deeper than the original soil ball. Leave a slightly sunken area around each plant to hold water (Fig. 2). Water the plants after planting.

It is best to transplant peppers in the evening or on a cloudy day. This will keep the plants from drying too much and wilting.

Fertilizing

Add 2 to 3 pounds of fertilizer such as 10-10-10 per 100 square feet of garden area. Spread the fertilizer evenly over the garden. Work it into the soil.

If you will plant single plants, place about 2 level tablespoons of fertilizer on the soil in the planting area. Mix it well with the soil (Fig. 3).

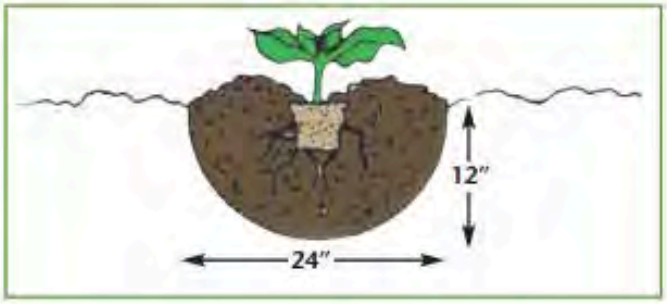


Figure 3. If you are planting single plants, work organic matter and 2 tablespoons of fertilizer into the planting area.

Watering

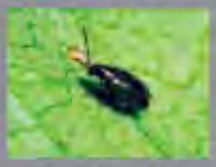
Water the plants enough to keep them from wilting. Slow, deep watering helps the root system grow strong. Do not let pepper plants wilt because this will reduce yield and quality of the fruit.

Care during the season

Hoe or till the soil lightly. Deep tilling will cut the pepper roots and slow growth. Pull by hand any weeds that are close to the plants.

After the first fruit begins to enlarge, place about 2 tablespoons of fertilizer around each plant about 6 inches from the

stem. Water the plant after adding the fertilizer. This will increase the yield and the quality of the peppers.

Name and description		Control
 Flea beetle	1/16 inch long; metallic bronze, black-bronze, black, blue or green; jumps fast quickly; eats holes in leaves	Sevin
 Leaf miners	Small, yellowish larvae inside the leaves; cause tunnels or trails on the leaves. Remove infected leaves	Biological controls (Dacsure, Disureigsure)
 Aphid	1/8 inch long; green, pink, red, brown; underside of leaves; sucks plant juices	Insecticidal soap and neem oil.

Insects

Many insecticides are available at garden centers for homeowner use. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides. Sulfur also has fungicidal properties and helps control many diseases.

Before using a pesticide, read the label and always follow cautions, warnings, and directions.

Diseases

Because diseases can be a problem on peppers, watch the plants closely. In mild weather, diseases start easily. Leaf spots are caused by fungi and bacteria and can be treated with neem oil, sulfur, or other fungicides. Again, always follow label directions.

Harvesting

If you pick the peppers as they mature, the yields will be greater. The first peppers should be ready 8 to 10 weeks after transplanting.

Pick bell peppers when they become shiny, firm, and dark green. If left on the plant, most peppers will turn red and are still good to eat.

Harvest most hot peppers when they turn red or yellow, depending on the variety. Jalapeños are mature when they reach good size and develop a deep, dark green sheen.

Storing

Store peppers in the vegetable crisper of the refrigerator or use other covered containers. Use them within 3 to 5 days after harvesting.

Acknowledgments

This publication was revised from earlier versions written by Sam Cotner, Professor Emeritus and former Extension Horticulturist and Jerry Parsons; former Professor and Extension Horticulturist.

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TEXAS A&M AGRILIFE EXTENSION
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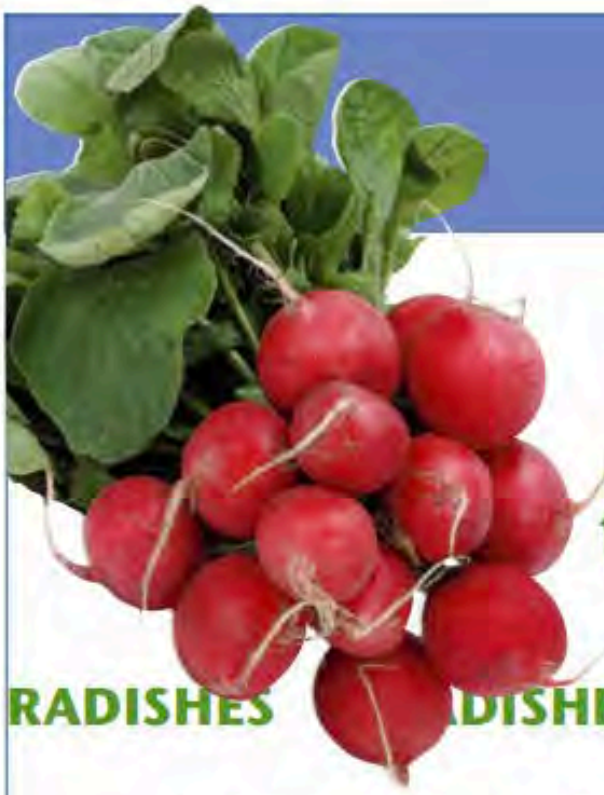

Easy Gardening

RADISHES • RADISHES • RADISHES •

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Radishes are often the first vegetable harvested from a spring garden. They are a cool-season crop and do not do well in the hot summer months.

Radishes are grown for the root, which usually is eaten raw, alone, or in salads. The leaves can also be eaten, especially when they are young and tender. Radishes are colorful and good for you. For this vegetable, a row 10 feet long is adequate for a family of four.

Site selection

Radishes can grow in partial shade, require very little room, and mature quickly. They are well suited to small gardens, flower beds, and containers.

Soil preparation, fertilizing

Radishes need loose, well-drained soil to allow the roots to expand easily. If the soil is crusty, the roots become misshapen.

To prepare the soil, remove rocks, trash, and large sticks from the planting area. Small pieces of plant material such as grass and leaves can be mixed into the soil to make it richer.

Spade the soil to a depth of 8 to 12 inches. Turn each shovelful completely over so all the plant material is covered. Scatter 1 cup of fertilizer, such as 10-20-10, on the soil for each 10 feet of row to be planted. Rake the soil until it is smooth and work up the beds as shown in Figure 1.

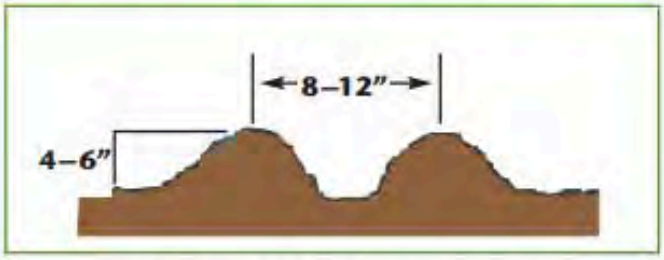

Figure 1. The 4-inch ridges are very important in low, poorly drained areas. They allow the soil to drain and let air enter the soil. Space the ridges farther apart if the radishes are to be followed by a summer crop. Plant two or more rows of radishes on each ridge.

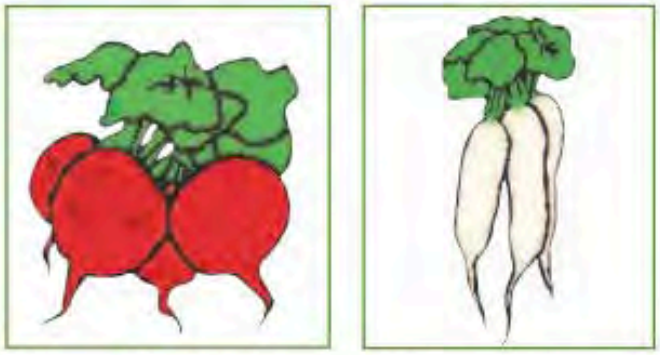

Figure 2. Red radishes, left, the most popular type, are round or oval. The white type, right, can be globe shaped or long like a carrot.

Varieties

Radishes can be of the red or the white variety (Fig. 2). Some recommended red varieties are Champion, Cherry Belle, Early Scarlet, and Early Scarlet Globe. Recommended white varieties include Chinese White Winter, Summer Cross and White Icicle.

Planting

Plant the seeds as soon as the soil can be worked in the spring. Using a hoe handle, stick, or similar object, make a furrow ½ inch deep down the center of the ridge (Fig. 3). Plant the seeds ½ inch deep and 1 inch apart in the row. Cover them lightly with loose soil, and sprinkle them with water. The plants should be up in 4 to 6 days.

Make several plantings 8 to 10 days apart for a steady supply of radishes. They will be ready for harvest about 4 to 5 weeks from planting.

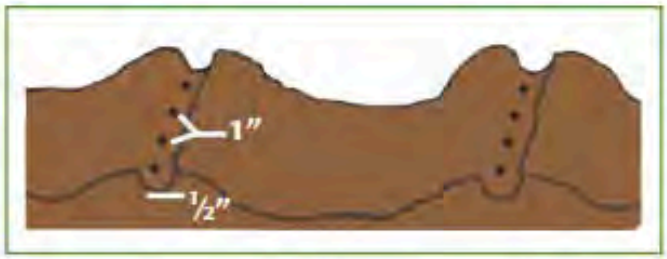

Figure 3. Plant seeds ½ inch deep and 1 inch apart in the row.

Care during the season

Scratch the soil around the plants lightly with a rake or hand tool to keep the soil from crusting. Water the plants well weekly if it does not rain.

Begin thinning the radishes when the roots start expanding. Pull every other plant (Fig. 4). The larger roots can be eaten; those left in the row will continue to get bigger without being crowded.

Keep the radishes free of weeds, which rob weak root systems of nutrients and moisture.

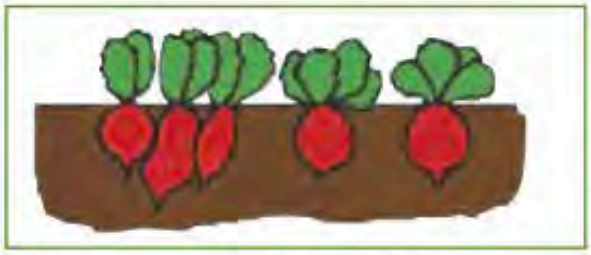

Figure 4. To thin radishes, pull every other plant.

Harvesting

Harvest radishes when they are young and tender (Fig. 5). If left in the ground too long, they get tough, hot tasting, and stringy.

Figure 5. The center, left, should be solid with no cracks. Right, an over mature radish with a pithy or cracked center.

To harvest, pull the radishes, cut off the tops and small roots, and put those in a compost pile. Wash the radishes well and place them in plastic bags in the refrigerator. They will keep 2 to 3 weeks or until the next planting is ready for harvest.

Insects

Many insecticides are available at garden centers. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides. Sulfur also has fungicidal properties that help in controlling many diseases.

Before using a pesticide, read the label. Always follow cautions, warnings and directions.

Diseases

Because radishes mature so quickly, diseases usually are not a problem. Check the plants daily and treat them with an approved fungicide if diseases appear. Neem oil, sulfur, and other fungicides are available for use. Always follow the label directions.

Cleanup

After the radishes get too old or start going to seed, pull and place them in a compost pile if the soil is to be replanted soon. If the soil is to be left idle, the old radishes and tops can be spaded into the soil, helping to build the soil.

Acknowledgments

This publication was revised from earlier versions written by Jerry Parsons, Professor and Extension Horticulturist, and Sam Cotner, Professor Emeritus and Extension Horticulturist.

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EHT-061
5/14

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

RNIP GREENS • MUSTARD GREENS • TURNIP GREENS •

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Turnips and mustards, members of the cabbage family, are cool-season crops. They must be grown in the cool temperatures of early spring and fall.

Mustard is grown only for the leaves. Turnip is a dual purpose crop—the leaves are used for greens, and the root is cooked similar to potatoes and beets. When cooked properly, mustard and turnip greens are high in minerals and vitamins A and C.

Varieties

Turnips can be used either for greens or for roots. A variety developed for root production can be harvested for greens. However, a variety developed for greens may not produce a good root.

Mustard varieties can be broadleaved or curled. Broadleaved mustard has a wide, flat leaf. Curled leaf mustard produces narrow, wrinkled leaves like those of spinach.

Curled mustard will stand colder temperatures and can be grown later into the winter than can broadleaved mustard. Some gardeners do not like curled mustard because it is hard to wash sand and dirt from the wrinkled leaves. A well-mulched garden usually does not have this problem.

Turnips	
Greens	Alamo, All Top, Seven Top, Shogoin, Topper, All Top
Roots	Just Right Hybrid, Purple Top White Globe, Royal Crown, Royal Globe, Tokyo Cross, White Lady
Mustard	
Broadleaved	Florida Broadleaf, Tendergreen, Large Smooth Leaf, Savanna
Curled Leaf	Southern Giant Curled, Green Wave

Site selection

If possible, plant mustard and turnips in full sun. For best production, they also need well-drained soil.

Mustard works well as a border to a flower bed or sidewalk (Fig. 1). Both the broadleaf and curled leaf varieties are attractive and add green to a flower bed.

Figure 1. Mustard can be planted as a border to a flower bed or sidewalk.

Mustard and turnip greens are also easily grown in window boxes and containers on an apartment balcony or patio.

Soil preparation

Remove large rocks, sticks, and other bits of trash from the planting area. If the soil is heavy clay, add compost or other organic matter to loosen the soil. This is vital if the turnips are being grown for the roots; heavy soil can cause the roots to be rough and poorly shaped.

Dig the soil 10 to 12 inches deep. Spade in all plant material until it is covered to help it break down more quickly.

Planting

Plant turnips and mustards as soon as the soil can be worked in the spring. The seeds will sprout if the soil temperature is 40 degrees F or higher.

For a fall crop, start planting 8 to 10 weeks before the first expected frost. In South Texas and coastal areas, turnips and mustard grow well all winter.

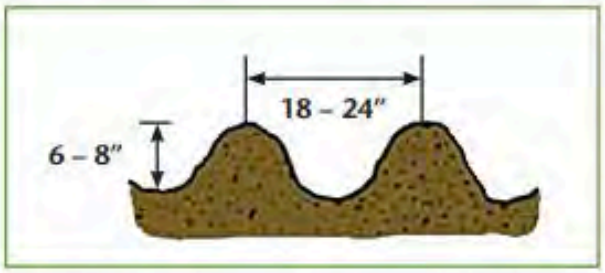


Figure 2. Make ridges 6 to 8 inches high and 18 to 24 inches apart in the soil.

Bed the soil into ridges 6 to 8 inches high and 18 to 24 inches apart (Fig. 2). Allow the ridges to settle, or pack them before planting. Just before planting, drag the top from the ridges with a rake or hoe to widen the planting bed to 8 to 10 inches (Fig. 3).

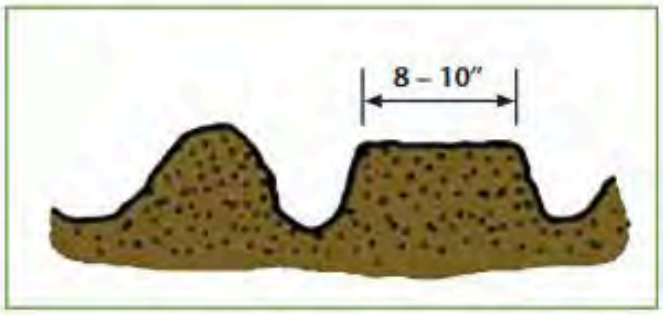


Figure 3. Before planting, widen the planting bed to 8 to 10 inches by dragging the top from the ridges with a rake or hoe.

If the ridges have been made 3 feet apart for planting other vegetables, plant two rows of mustard and turnips on each ridge. You can plant one row of seeds down each side of the ridge.

Plant the seeds in moist soil. This is vital for fall crops. Cover the seeds lightly with soft soil or compost; then sprinkle the row with water to speed sprouting. When planting a fall crop, cover the seeds with sand or light-colored mulch to keep the row cool.

Sprinkle the row regularly with water to prevent soil crusting until the small plants break through. Under good conditions, most of the plants should be up in 3 to 7 days.

To have a continuous supply of fresh, tender mustard and turnip greens, make two or three plantings 10 days apart.

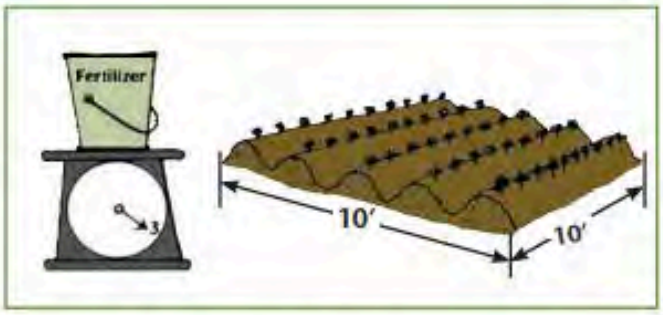


Figure 4. Scatter 2 to 3 pounds of complete garden fertilizer such as 10-20-10 over each 100 square feet.

Fertilizing

Before planting mustard or turnips, till the soil then scatter 2 to 3 pounds of complete garden fertilizer such as 15-5-10 over each 100 square feet (Fig. 4). If only one row is to be planted, use 1 cup of fertilizer for each 10 feet of row (Fig. 5.)

Phosphorus, the middle number on the fertilizer bag, is especially needed to grow good turnip roots.

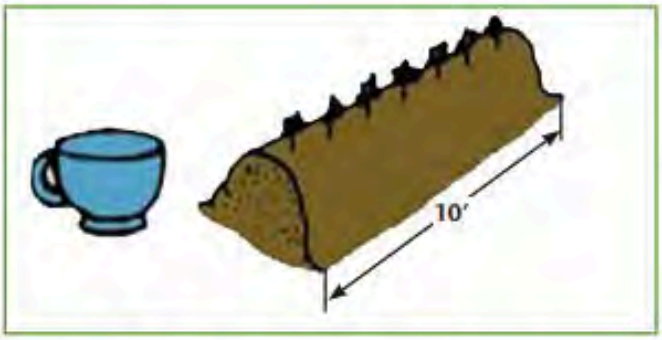


Figure 5. If you are planting only one row of mustard or turnips, use 1 cup of fertilizer for each 10 feet of row.

Watering

If it does not rain, soak the rows with water each week. Water may be needed more often in some areas. Soak the soil well to develop a good root system.

Care during the season

Keep the plants free of weeds, especially when they are small. Pull the weeds by hand or use a hoe, but do not cut too deeply with the hoe, or you may cut of the some crop roots.

Figure 6. Keep turnips 3–4 inches apart; overcrowding will prevent their roots from developing.

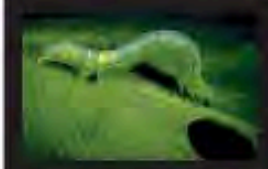
When the plants become crowded in the row, thin the row by pulling some plants. Small plants of both turnips and mustard make delicious greens. Thin the mustard plants until they are about 6 inches apart (Fig. 6). Leave the turnips 3 to 4 inches apart; remember that overcrowding prevents the turnip roots from developing.

Turnips and mustards need adequate nitrogen to develop a dark green color. When the plants are 4 to 5 inches tall, apply ½ cup of fertilizer for each 10 feet of row. Spread the fertilizer beside the plants, mix it lightly with the soil and water it into the soil.

If the soil is sandy and the season is wet, apply more fertilizer later.

Insects

Many insecticides are available at garden centers. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides. Sulfur has also fungicidal properties and helps in controlling many diseases.

Name and description		Control
 Flea beetle	1/16-inch long; black, bronze-black, blue or green; jumps quickly; eats small round holes in leaves	Sevin
 Cabbage looper	up to 1½ inches long; pale green with light stripes down back; doubles up when crawling; chews leaves	*Bacillus thuringiensis* (Dipel, Thuricide, Biotrol)
 Aphid	⅛-inch long; green, pink, red, brown; usually found on underside of leaves; sucks plant juices	Malathion
 *larva* *adult* Root maggot	Larva is ¼- to ⅓-inch long; yellowish white; legless; feeds on the turnip root	Sanitation, crop rotation, and beneficial insects

Root maggot photo courtesy of the University of Saskatchewan

Before using a pesticide, read the label and always follow cautions, warnings, and directions. Because greens are harvested often, be sure to follow the waiting periods for pesticides.

Diseases

Diseases on turnips are most severe in cloudy, damp weather. Check the plants daily; if diseases appear, treat the plants with an approved fungicide. Neem oil, sulfur, and other fungicides are available for use. Always follow label directions.

Harvesting

Mustard and turnip greens are good until the weather gets hot. Too much heat causes them to be tough and strong flavored. Harvest mustard greens when they are young and tender. Cut the large outer leaves and leave the inner leaves to continue growing. You can also cut and use the entire plants.

Figure 7a. Harvest turnip greens by pulling the entire plant when leaves are 4 to 6 inches long.

Figure 7b. Harvest turnip roots when they are 2 to 2½ inches in diameter.

Most turnip varieties produce greens in 40 days. Turnip roots generally take 50 to 60 days to produce. Harvest turnip greens by pulling the entire plant when the leaves are 4 to 6 inches long (Fig. 7a.) Turnip roots can be harvested when they are 2 to 2½ inches in diameter (Fig. 7b). If left longer they will get tough and stringy.

The ideal size of turnip roots harvested for bunching is 2 inches in diameter. If you want to top the turnip roots, the bigger roots that are 3 to 4 inches in diameter are best suited for this method.

Both mustards and turnips lose quality and go to seed quickly when days become long and hot. Do not leave them too long.

Unused leafy vegetables make good additions to a compost pile. They break down quickly and can be turned into the garden soil.

Storing

Greens can be stored several days in closed plastic bags in the refrigerator. Tur-

nip roots will keep several weeks in a cool, humid area such as a root cellar or the bottom of the refrigerator.

Serving

Cook greens only until they are tender. Use only the water that remains on the leaves after washing them. For more information on how to prepare and serve mustards and turnips, contact your county Extension agent.

Acknowledgments

This publication was revised from earlier versions written by B. Dean McCraw, former Professor and Extension Horticulturist.

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Revision

EHT-040
01-11

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

SPINACH • OTHER GREENS • SPINACH • OTHER GR

Joseph Masabni, Assistant Professor and Extension Horticulturist; and Patrick Lillard, Extension Assistant, The Texas A&M System

Greens include all leafy green vegetables. They are often called potherbs and are grown mostly for their tender leaves. Green vegetables include spinach, New Zealand spinach, Swiss chard, dandelion, and kale.

Most greens are cool-season crops and must be grown in the early spring or fall in Texas. Some greens, especially kale, will withstand temperatures below freezing and can be grown all winter in many areas.

Site selection

Greens grow best in a well-drained soil with lots of organic matter. They prefer full sunlight but will tolerate partial shade.

Soil preparation

Spinach has a deep taproot so the soil must be worked at least 8 to 10 inches deep. Dig the soil in the early spring when it is dry enough not to stick to garden tools. Break up large clods and remove trash and weeds. Work the soil into planting beds about 4 inches high. This is especially important in heavy soils. Add compost or other organic matter before digging the soil.

Fertilizing

Spinach grows best when given plenty of fertilizer. Adequate nitrogen is needed to develop the dark green leaf color. Before planting the seeds, apply a general garden fertilizer such as 10-10-10 at the rate of 2 to 3 pounds per 100 square feet. Or, fertilize as directed by a soil test report. Mix the fertilizer into the soil about 3 inches. Spinach does best when the fertilizer is applied in a band 3 inches under the row

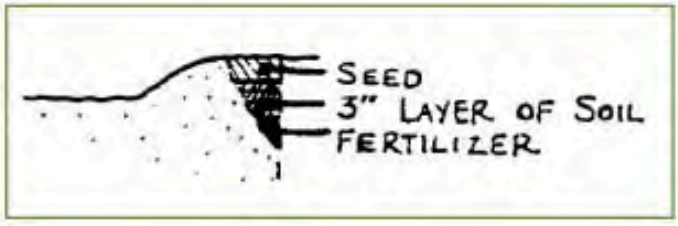


Figure 1. Apply fertilizer in a band 3 inches under the row.

(Fig. 1.) Apply ¼ to ½ cup of fertilizer for every 10 feet of row. Fertilize again about 30 days after the plants come up.

Varieties

Collards
- Blue Max
- Champion
- Flash
- Georgia Southern
- Vates

Kale
- Dwarf Blue Curled Scotch
- Dwarf Blue Curled Vates
- Green Curled
- Rebor

Mustard
- Early Mizuna
- Florida Broadleaf
- Green Wave
- Large Smooth Leaf
- Southern Giant Curled
- Tender Green

Spinach
- Bloomsdale
- Melody
- Space
- Tyee

Swiss Chard
- Bright Lights
- Fordhook Giant
- Lucullus
- Rhubarb Chard
- Rhubarb Red
- Ruby

Other Specialty Greens
- Malabar Spinach
- Pac Choi
- Radicchio
- Tatsoi
- Molokhia
- New Zealand Spinach

Planting

Plant spinach as early as the soil can be worked in the spring or in August or later in the fall. The high temperatures and long days of summer cause spinach to "bolt" or produce a seed stalk that makes it unusable tor food. Malabar and New Zealand spinach are good substitutes for spinach during hot weather, as they tolerate high temperatures but don't tolerate colder temperatures. Seeds of Malabar and New Zealand spinach are slow to germinate. Plants can be grown indoors and transplanted into the garden after the last frost in spring.

Swiss chard is sometimes called summer spinach but is actually a member of the beet family and has a taste similar to that of beet greens. Swiss chard is very tolerant of heat and light freezes and can be harvested all year in many areas of Texas.

Kale is a cool-season crop that should be planted in early spring or late fall. It is sometimes called "flowering cabbage" and makes a good border for flower beds or sidewalks.

Unless you want to freeze or can spinach, it is best to plant several short rows (10 to 15 feet long) 10 to 14 days apart instead of planting all at once. This is called succession planting. It evenly distributes your harvest rather than having all the harvest at once.

Use a hoe handle, stick, or similar tool to make planting furrows about ½ inch deep and 1½ to 2 feet apart down the bed. Plant seeds about 1 inch apart down the row and cover with loose soil or compost. For the fall crop, cover with sand or other light-colored material to reflect heat and keep the soil cooler.

Figure 2. Some greens require support.

Other greens require different spacing and support. Plant New Zealand spinach in rows 3 feet apart and thin to 2 feet between plants. As Malabar is a vining plant, it should be planted next to a fence or trellis for support, with 10 to 12 inches between plants (Fig. 2.) Dandelion is a perennial that comes back each year from the root. It becomes a weed if left unattended.

Greens can also be planted in one big block rather than in rows by spreading seed on a bed 18 to 20 inches wide and covering them with soil. This method allows more plants to be grown per foot of row but makes weed control harder because they must be pulled by hand

Care during the season

Keep plants free of weeds, especially when they are small, because weeds use water and nutrients the growing crop needs. Hand pull weeds close to the crop so that hoeing won't cut vegetable roots and cause plants to wilt. After the plants come up and become crowded in the row, begin thinning (Fig. 3). Leave kale plants 1 foot apart, chard 6 inches apart, and spinach 3 to 4 inches apart. Do not throw away thinned plants, as they make excellent tender greens.

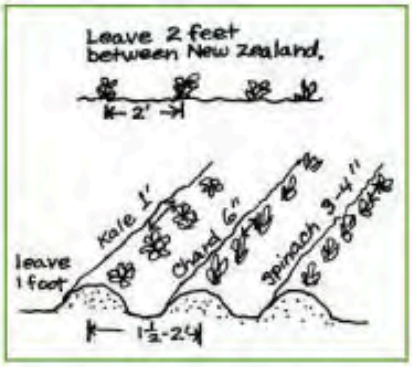


Figure 3. Thin plants to the proper spacing.

Water plants thoroughly each week, and do not allow the plants to wilt. Water is needed more often in hot weather and in light soils. When watering, make sure to thoroughly soak the soil. This encourages crop roots to grow deeper into the soil, which helps them withstand dry periods better. Mulches help prevent soil from losing moisture and are good at controlling weeds.

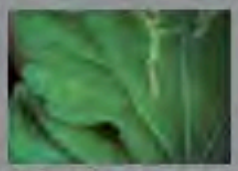
About 30 days after the plants come up, scatter ¼ cup of garden fertilizer beside the plants for every 10 feet of row and water thoroughly.

Diseases

Spinach often shows some disease damage on the leaves in cool, damp weather. Do not plant spinach in the same place in your garden more than once every 2 or 3 years. If your plants get spots on the leaves, ask your county Extension agent about disease control.

Before applying any pesticide, always read the label. Follow cautions, warnings and directions and observe waiting periods between spray applications and harvest.

Insects

Name and description		Control
 Leaf miners	Small yellowish larvae; tunnel inside leaves and cause white trails to form	Sevin® permethrin
 Aphids	½ inch long; soft bodied; green, pink, red or brown; usually on undersides of leaves; suck plant juices	azadirachtin garlic juice extracts insecticidal soaps neem oil

Harvesting

Harvest spinach when plants are 6 to 8 inches tall. Pull up the entire plant in the spring, since it stops producing in hot weather. For the fall crop in milder areas of Texas, clip the leaves just above the crown about 1 to 2 inches above ground level. Water and fertilize lightly and the plants will continue growing. Harvest lower leaves of chard and kale as the leaves grow. These plants also will continue growing (Fig. 4). Harvest the tips of Malabar spinach plants when they are 3 to 4 inches long. Dandelion, a common weed in lawns and fields, can be used as spring greens when 4 to 6 inches tall. Dandelions develop a strong flavor if left too long. If you harvest dandelions from outside your garden, be sure they have not been sprayed with a weed killer.

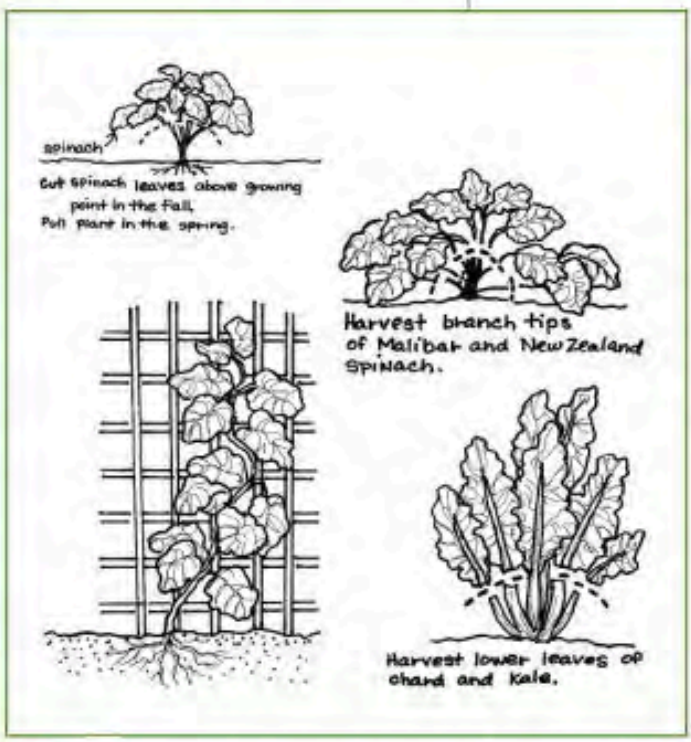


Figure 4. Harvest the lower leaves of chard and kale. Harvest the branch tips of Malabar spinach when 3 to 4 inches long. Harvest the entire spinach plant in the spring. In the fall, harvest individual leaves and plants will continue to grow.

Serving

Spinach and other greens contain lots of Vitamin A and minerals when cooked properly. Dandelion contains more Vitamin A than any other vegetable. Cook greens in a small amount of water or oil until tender. Your county Extension agent has information on preparing and serving greens.

Cleanup

Remove all unharvested plants from the garden and place them in a compost pile. Or, turn them deep under the soil, which helps control diseases and builds the soil.

Acknowledgments

The original version of this publication was authored by Frank Dainello and Jerry Parsons. Insect photos courtesy of Bart Drees, the Texas A&M AgriLife Extension Service.

TEXAS A&M AGRILIFE EXTENSION
EHT-041
3-11

Easy Gardening

SQUASH • SQUASH • SQUASH • SQUASH • SQUASH

Joseph Masabni, Assistant Professor and Extension Horticulturist; and Patrick Lillard, Extension Assistant, The Texas A&M System

Squash is a popular warm-season garden vegetable. Squash will grow well in all areas of Texas. Squash plants take up a lot of space, but because they are prolific producers it takes only a few plants to feed a family and all their neighbors.

Squash is one of the plants grown in the traditional Native American vegetable growing technique called the Three Sisters. The other two plants in the Three Sisters are beans and corn. Each plant had its role in this companion planting tradition. Corn served as a structure for the vining beans to grow up. Squash served as a ground cover to prevent weeds from growing. Beans provided natural fertilizer for all.

Yellow squash	Zucchini	Acorn
Burpee's Butterstick Dixie Early Prolific Early Summer Multipik	Ambassador Aristocrat Eight Ball Tigress El Dorado Goldfinger Gold Rush President Senator Sure Thing Tigress Zucchini Elite	Carnival Ebony Royal Table King Table Ace Table Queen
Scallop		**Butternut**
Early White Bush Patty Pan Peter Pan St. Patrick Starship Sunburst		Preclude II Waltham

Site selection

Like most vining vegetables, squash grows best in sandy, fertile soils with a pH between 6.0 and 6.5.

Soil preparation

Remove all rocks and trash from the soil. Work it up several weeks before planting, but only when the soil is dry enough not to stick to garden tools.

Squash grows best in soils that have

lots of organic matter. If possible, spread 2 to 3 inches of organic material such as compost, leaves, or rotted hay over the planting area. Then till to mix this organic material into the top 8 to 10 inches of soil.

Planting

Squash does not grow well in cool weather. Plant in the spring after all danger of frost has passed. For a good fall crop, plant early so squash will mature before the first killing frost.

Plant squash in hills 18 to 48 inches apart on rows 3 to 8 feet apart. The vining types, such as Hubbard or acorn, need more room than the bush types (Fig. 1.)

When seeding squash, plant five or six seeds about 1 inch deep in each hill (Fig. 2.) Water after planting the seed. After the seeds come up, thin them to three squash plants per hill (Fig. 3.)

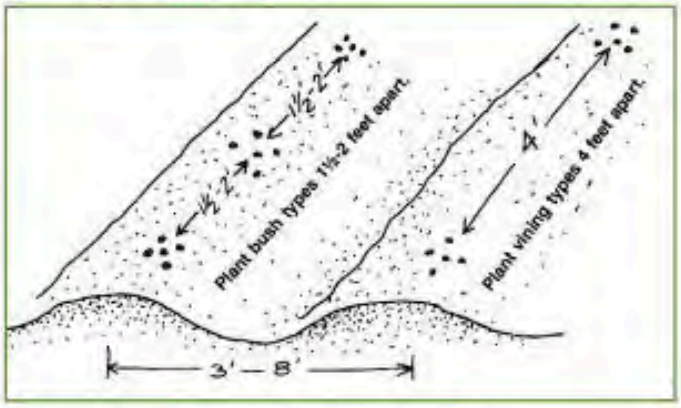


Figure 1. Plant squash on rows 3 to 8 feet apart.

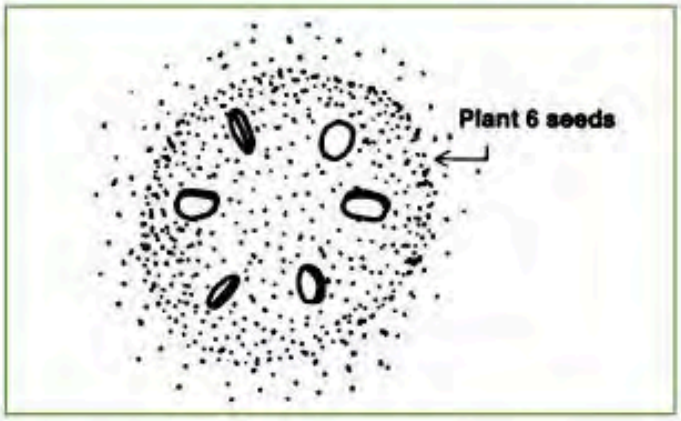


Figure 2. Plant five or six seeds in each hill.

Figure 3. When plants are 3 to 4 inches tall, thin to three plants per hill.

Fertilizing

Add 2 to 3 pounds of fertilizer, such as 10-10-10, for each 100 square feet of garden area. If you plan to grow only a few plants, use 2 to 3 tablespoons of fertilizer for each hill. Scatter the fertilizer evenly over a 2-foot by 2-foot area. Work it into the top 3 to 4 inches of soil.

Watering

Water the plants enough to keep them from wilting. If the weather is really dry, squash plants should be watered at least once a week. Sandy soils need to be watered more often than heavy clay soils.

Care during the season

Keep squash plants free of weeds. Hoe around the plants to remove small weeds. When hoeing, be careful not to damage the roots (Fig. 4.) Hand pull the weeds close to the plants.

When the first blooms appear, place about 2 tablespoons of garden fertilizer around each hill. Do not let the fertilizer touch the plants. Water the plants after fertilizing.

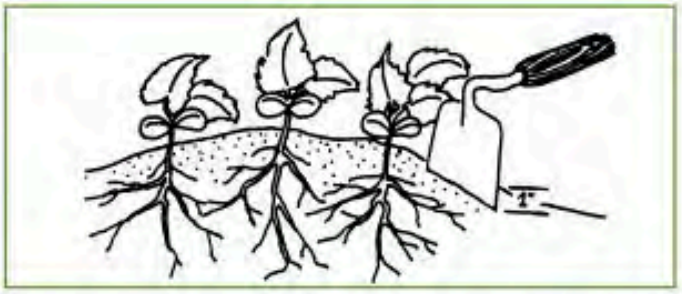


Figure 4. Hoe carefully near squash plants so you will not hurt the roots. Hoe no deeper than 1 inch.

Diseases

Squash can get many diseases, especially when harvesting begins. Spray with an approved fungicide to help control most diseases. Ask your county Extension agent what fungicide to use, and follow all directions on the container.

Insects

Name and description		Control
 Squash vine borer	White larva about 1 inch long; usually found inside the stem near the ground; causes vines to wilt and die.	*Bt* for prevention, as larvae cannot be controlled once they are inside the stem
 Squash bug	Large (½ to ¾ inch long); gray to brown; flat back.	Sevin® Thiodan®
 Cucumber beetle	Cream colored larva ¾ inch long; adult ¼-inch-long beetle with yellow body and black spots or stripes.	pyrethrin rotenone

Harvesting

Harvest yellow and green (summer) squash when the fruit and seeds are small. Always harvest mature squash so the plants will keep producing. Harvest winter (hard rind) squash when they are full sized, the skin is hard, and the bottom of the fruit is cream to orange colored. A light frost will not damage fruits of winter squash. Squash is best when cut, not pulled, from the vine.

Serving

Fresh squash adds color and variety to meals. Green and yellow squash are fair sources of Vitamins A and C. Winter squash is a good source of Vitamin A and has fair amounts of Vitamin C. Squash can be served in many ways from fried dishes to casseroles. Winter squash is often baked. Cook all types of squash only until tender to keep the vitamin content.

Storing

Green and yellow squash can be stored in the refrigerator for about a week. Winter squash can be stored for several months.

Cleanup

Old squash vines should be added to the compost pile or worked into the soil well before the spring planting season.

Acknowledgments

The original version of this publication was authored by Sam Cotner.

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EHT-015
5/13

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

SUGAR SNAP PEAS • SUGAR SNAP PEAS • SUGAR SN

Joseph Masabni
Assistant Professor and Extension Horticulturist, The Texas A&M University System

The sugar snap pea *(Pisum sativum var. macrocarpon)* is a member of the bean family. Sugar snap peas are like snow peas in that we eat the entire pod. A difference is that the pods of snow peas are flat and those of sugar snap peas are round.

Unlike beans, peas do not open when they are ripe or have a membrane in the pod. Most cultivars are climbing vines and need a trellis for support (Fig. 1). In seed catalogs, they are described as tall climbers.

Figure 1. Most cultivars are climbing vines and need a trellis for support.

Varieties

These varieties are best for Texas:

- Cascadia (60 days from planting to maturity)
- Premium (51 days)
- Sugar Ann (60 days)
- Sugar Bob (55 days)
- Super Sugar Snap (65 days)

An heirloom variety, Amish Snap, requires 60 days from planting to maturity.

Soil preparation

Before planting the peas, remove all weeds and trash from the planting area. Then till the soil 8 to 10 inches deep and rake it several times to break up the large dirt clods. Work the garden soil only when it is dry enough to not stick to garden tools.

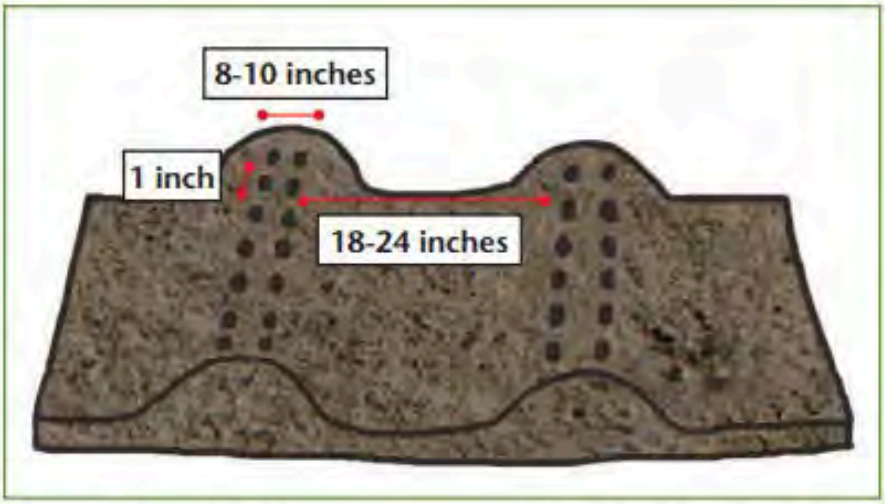

Figure 2. The beds for sugar snap peas should be 8 inches high and 18 to 24 inches apart.

Planting

In the spring, plant sugar snap peas as soon as you can prepare the soil. Sugar snap peas are a cool-season vegetable and can tolerate light frosts even when the plants are small.

In the fall, plant sugar snap peas in the last 8 to 10 weeks before the first expected frost to guarantee a plentiful harvest.

Plant the seeds 1 to 1½ inches deep and 1 inch apart in single or double rows (Fig. 2). Allow 18 to 24 inches between single or pairs of rows. Allow 8 to 10 inches between double rows in pairs.

Once the seeds have germinated, cover the seedlings if a light frost is expected. This protection will help the plants continue to grow and to produce earlier.

Fertilizing

Sugar snap peas are nitrogen-fixing plants: They take nitrogen from the air and change it into a form that they can use for food. To increase the crop, add a nitrogen-fixing inoculant, which contains the bacteria that inoculates the plant roots and helps it convert nitrogen into plant food.

An inoculant is usually a powdery material that you moisten with water and coat the seeds with before planting. Inoculants are sold in small packets at garden stores and via the Internet. They are especially useful in an area that is being planted for the first time.

Watering

Do not let the soil dry out but do not overwater. You may need to irrigate once a week if no rain has fallen.

Diseases

Fusarium wilt is the most common disease of sugar snap peas. Infected plants have yellow, wilting leaves, particularly the lower leaves.

Because peas are planted early in the season when the soil is still cold and moist, Fusarium wilt is likely to occur, especially if the soil does not drain well. To reduce the chances of Fusarium infection, incorporate abundant organic matter to the bed and improve soil aeration and drainage by preparing the soil well.

Harvesting

Harvest when the individual peas have grown to the size of BBs, or when the pods

have reached their full length. This stage is usually reached 5 to 7 days after flowering.

Pick the peas at least every other day to ensure that the pods are sweet and free of fibers. As soon as you discover an overgrown pod that you missed earlier, remove it to keep the plant blooming and producing longer.

The pods can be stored in a plastic bag in the refrigerator for up to 2 weeks. Unlike fresh green peas, these pods deteriorate only slightly in quality when stored.

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New

EHT-026
6/13

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

POTATOES • SWEET POTATOES • SWEET POTATOES

Joseph Masabni and Stephen King

Assistant Professor and Extension Horticulturist, and former Associate Professor, Texas A&M Department of Horticultural Sciences
The Texas A&M University System

Sweet potatoes *(Ipomoea batatas)* are an excellent source of beta-carotene, which is easily converted by the body into vitamin A, especially the varieties with orange flesh. A member of the morning glory or Convolvulaceae family, the plant also produces colorful flowers as well as trailing vines often used as groundcovers.

The sweet potato is a perennial plant (one that lives for more than 2 years) originating in the tropical Americas. When grown in the United States, it is treated as a warm-season annual (a plant that completes its life cycle in 1 year).

Texas is the fifth largest producer of sweet potatoes in the United States. Production is concentrated mostly in Van Zandt County in East Texas.

Varieties

This root crop has hundreds of varieties, some bred for their showy vines and others for the tasty potatoes (Fig. 1). In Texas, the most common food varieties planted are Beauregard, Centennial, Jewell, and Vardaman; the most popular is Beauregard.

Climate

Hot days and warm nights are ideal for sweet potato production, which is why Texas is a large sweet potato producer.

Figure 1. Leafy vines of the sweet potato plant.

Sweet potatoes are extremely heat tolerant. They can also tolerate light frosts as long as the soil temperature stays above 55°F.

Site selection

Sweet potatoes require full sun and a warm climate. They must be planted in a well-drained, fine sandy loam soil with a slightly acidic pH 5 to 7.5. This allows the sweet potato to grow easily but not remain in a moist environment that encourages rot and disease.

Soil preparation

Have the soil tested before planting. It may need only nitrogen. Most areas of Texas have enough phosphorus and potassium in the soil, except for the eastern counties with sandy soils and 40 to 60 inches of rainfall per year; these areas may lack potassium.

Incorporate compost or a complete fertilizer into the soil. This will be the only fertilizing needed.

Work the soil into beds 8 inches high and 3 to 4 feet apart to ensure that it drains well and warms quickly in early spring (Fig. 2).

Propagation

Unlike other vegetables, sweet potatoes are propagated from slips, also called vine cuttings. Slips can be produced at home, purchased at a local garden store, or ordered from online companies.

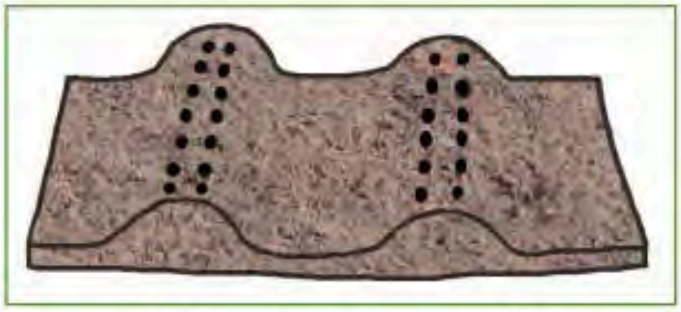

Figure 2. Soil beds 8 inches high and 36 inches wide.

Figure 3. A sweet potato producing slips.

To produce slips, buy healthy, disease-free sweet potatoes from a local market. Scrub them clean and then cut them in half. Suspend each half over a jar of water by inserting toothpicks so that half is submerged in the water. Place the sweet potato near a window for warmth and sunlight. Over the next few weeks, shoots will form on top (Fig. 3).

Wait 2 weeks after the last frost to begin planting them outside.

Planting

The optimal planting time is when the soil temperature at planting depth is over 65°F in the spring and at least 150 days before anticipated 55°F soil temperature in the fall.

Keep the beds weed free until the vines have covered the soil fully. Maintaining a weed-free area, especially in the first 40 days after planting, will improve yield quantity and quality at harvest.

Fertilization

Check the soil test results to determine how much nitrogen (N), phosphate (P),

and potassium (K) is needed. Commercial recommendations for fertilizing sweet potatoes are usually 50 pounds N, 70 pounds P, and 70 pounds K per acre (50-70-70). For a 100-square-foot planting area in a garden, that's roughly equivalent to 2 ounces N, 2.5 ounces P, and 2.5 ounces K.

To determine the amount of fertilizer to apply, check the formulation on the bag, and divide the number of ounces needed by the percentage in the formulation. For example, if the bag lists its formulation as 13-13-13, the actual amount of nitrogen needed would be:

2 ounces ÷ 0.13 = 15.4 ounces of 13-13-13

Applying this fertilizer will also supply 2 of the 2.5 ounces of phosphorus and potassium needed. To make up the difference, you will need to apply additional amounts of phosphorus and potassium separately using bone meal (0-12-0) for the phosphorus and a source of potassium such as muriate of potash (0-0-60).

An alternative would be to apply 19 ounces of 13-13-13 to get the total amount needed of phosphorus and potassium, even though an extra 4 ounces of nitrogen will be applied

Watering

Sweet potatoes need 10 to 20 inches of water per season. Because rain falls sporadically throughout the season, you will need to water them, especially at first during the slip establishment period. Transplanted slips are extremely sensitive to water stress during the first month of establishment.

To keep the tubers from rotting, do not water in the last 2 to 3 weeks before harvest.

TABLE 1. Sweet potato pests and controls

Pest	Control
Diseases	
Leaf spots	Clove, neem oil, rosemary, sulfur, thyme oil
Nematodes	Azadirachtin, sesame oil*
Insects	
Beetles	Azadirachtin, garlic juice extract, pyrethrins
Cutworms	Azadirachtin, Bt
Weevils	Azadirachtin, garlic juice extract

**Not listed by the Organic Materials Review Institute (OMRI)*

Diseases and insects

Sweet potatoes are attacked by leaf spots, nematodes, beetles, cutworms, and weevils. (Table 1).

Harvesting

The sweet potato root has a delicate skin that is easily bruised at harvest. Take care not to bruise the roots with a hoe, shovel, or other harvesting tool. Even dropping the potatoes into a harvest bucket will injure the skin.

For home gardeners, the best time to harvest sweet potatoes is immediately before or just after the first fall frost. When the sweet potato leaves turn yellow, growth has stopped and the roots have matured. This is a good time for harvest.

Acknowledgment
Courtney Angel contributed to the manuscript of this publication.

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New

TEXAS A&M AGRILIFE EXTENSION
EHT-043
11-10

Easy Gardening

ATOES • TOMATOES • TOMATOES • TOMATOES •

Joseph Masabni, Assistant Professor and Extension Horticulturist, The Texas A&M University System

Tomatoes are the most popular garden vegetable crop in Texas. They are a good source of vitamin A and fair source of vitamin C. Fresh tomatoes are popular in salads, on sandwiches and sliced. They can be cooked and used in many ways.

Varieties

Texas gardeners can grow a variety of small- and large-fruited tomatoes:

Small fruit

- Baxter's Early Bush
- Cherry Grande
- Juliet
- Red Cherry
- Small Fry

Large fruit

- Better Boy
- Big Beef
- Big Box
- Bush Beefsteak
- Carnival
- Celebrity
- Homestead

Site selection

Tomatoes grow well in most Texas areas if planted in soil that drains well. They need at least 6 hours of sunlight each day.

Soil preparation

Work the garden soil only when it is dry enough not to stick to the garden tools. Several weeks before planting, work the top 8 to 10 inches of soil. Remove all rocks and trash from the soil and rake it to break up large clods.

Tomatoes grow best in soils that have lots of organic matter. If possible, spread 2 to 3 inches of organic material such as compost, leaves, or rotted hay over the planting area. Mix this organic material into the top 4 to 6 inches of soil.

Planting

Most families need only a few plants, so it is best to buy plants and not grow them from seed. Buy healthy, green plants that are 6 to 8 inches tall.

Do not set out tomato plants until all danger of frost has passed. Transplant fall tomatoes in the garden about 100 days before the first expected frost.

If possible, set out tomatoes on raised

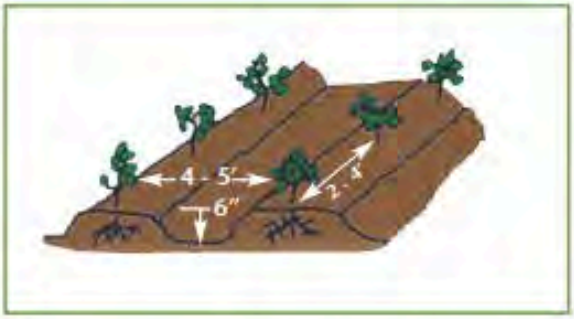


Figure 1. Plant tomatoes on beds raised to about 6 inches.

beds of soil that are about 6 inches high (Fig. 1). Make the transplant holes 3 to 4 inches deep and 2 to 4 feet apart in the row. For staked or caged plants, space the rows at least 3 feet apart. For unsupported plants, leave 4 to 5 feet between the rows.

Transplant your tomatoes in the evening or on a cloudy day to keep them from drying too much and wilting. Before placing transplants into the soil, fill the transplant holes with water and let it soak in.

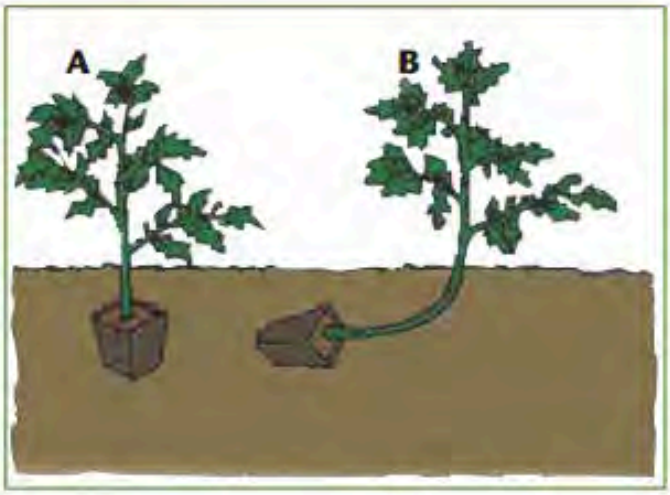


Figure 2. Plant tomatoes slightly deeper than they were first growing (A). If the plants are leggy, set them as shown (B).

Plant each transplant slightly deeper than it had been growing (Fig. 2). Pack the soil loosely around the plant. Leave a slightly sunken area around each plant to hold water.

If you plan to grow single plants, dig a hole 2 feet wide and 10 inches deep. Refill the hole with half soil and half organic matter. For this type of planting, mix 2 level tablespoons of fertilizer into this planting area.

Fertilizing

Add 2 to 3 pounds of fertilizer such as 10-10-10 for every 100 square feet of garden area. Spread the fertilizer evenly over the area, and then mix it into the top 3 to 4 inches of soil.

Watering

Water the tomato plants slowly and deeply to help them develop a strong root system. Do not let the tomatoes wilt severely, or yields and fruit quality will be low.

Care during the season

For the highest yields, place mulch around the tomato plants. Spread a 2- to 3-inch layer of organic material such as compost, leaves, or hay around the growing plants. Mulching will help stop weed growth and water loss from the soil.

You can let tomatoes grow on the ground or support them with stakes or cages. When you stake tomatoes, put the stake in shortly after transplanting to lessen root damage. A 6-foot-long

Figure 3. Loosely tie the tomato plants to support stakes.

stake set 10 inches deep in the soil will work well. As the plant grows taller, tie it loosely to the stake every 12 inches with pieces of rag or twine (Fig. 3).

Prune the staked tomatoes to produce a more orderly vine. Remove the small shoots that grow out of the point where each leaf joins the main stem (Fig. 4). Remove the shoots by bending them sideways until they snap.

Figure 4. Prune tomatoes by removing the suckers or small side shoots.

To develop the plant into two main vines, remove all but the lowest shoot. It will develop into a second branch.

Caging is another way to train tomato plants. You can make a good cage with a piece of concrete reinforcement wire 5 feet tall and 6 feet wide. Put the cages over the young plants. Push the cages down into the soil to keep them from blowing over. Using this method, you can give the vine support without having to tie it (Fig. 5).

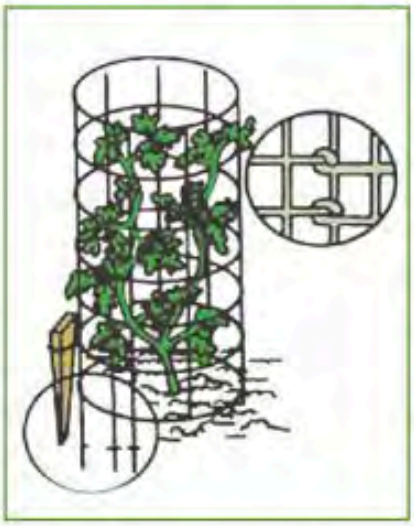


Figure 5. Cages made from reinforcing wire give good support to tomato plants.

Tomatoes growing in cages do not need to be pruned.

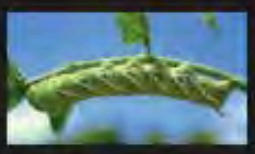
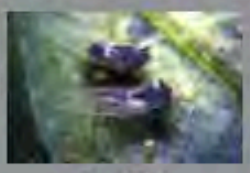
When the first fruits are about 1 inch in diameter, scatter 1 level tablespoon of fertilizer around each plant. Scatter it about 6 inches from the stalks. Work it lightly into the soil. Water the plants after fertilizing.

Fertilize the plants every 3 to 4 weeks with 1 to 2 level tablespoons of fertilizer.

To control weeds, you may cultivate or hoe around the plants. Work the soil only deep enough to kill the weeds but shallow enough not to damage the tomato plant roots.

Insects and diseases

Many insecticides are available at garden centers for homeowner use. Sevin is a synthetic insecticide; organic options include sulfur and Bt-based insecticides. Sul-

Name and description		Control
 Flea beetle	1/16 inch long; bronze-black, blue, or green, with light markings; jumps quickly; eats holes in leaves	Sevin
 Hornworm	A 3-inch-long caterpillar with a horn on the back end; green with stripes on the side	Bacillus thuringiensis (Dipel, Thuricide, Biotrol)
 Psyllid	1/8 inch long; pale green or yellow; adults are banded black and white	Sulfur dusts, permethrin, insecticidal soaps
 Whitefly	Adults are white; nymphs do not move	Pyrethrin, malathion, insecticidal soaps

fur also has fungicidal properties and helps in controlling many diseases. Neem oil, sulfur, and other fungicides are available for use.

Harvesting

For best quality, pick tomatoes at full color. If you pick them when they are pink, let them ripen at room temperature. They may be stored in the refrigerator after they reach full color.

Acknowledgments

This publication was revised from earlier versions written by Sam Cotner, Professor Emeritus and former Extension Horticulturist.

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EHT-025
7/13

TEXAS A&M AGRILIFE EXTENSION

Easy Gardening

ATILLOS • TOMATILLOS • TOMATILLOS • TOMATILL

Joseph Masabni, Stephen King and Clint Taylor

Assistant Professor and Extension Horticulturist, and former Associate Professor, and Graduate Student; all of the Texas A&M Department of Horticultural Sciences; The Texas A&M University System

The tomatillo or husk tomato *(Physalis ixocarpa)* looks much like a tomato. The fruit is generally green but can be orange, yellow, red, or even purple. It is enclosed in a papery wrapping called a calyx. The condition of the calyx is commonly used as an indicator of freshness in fresh markets.

Varieties

Tomatillos are not grown extensively in Texas. Seed companies carry a wide selection of varieties, including 'Cape Gooseberry', 'Golden Nugget', 'Mayan Husk Tomato', 'Mexican Husk', and 'Rendidora', which is an improved cultivar.

Soil

Tomatillos prefer well-drained, sandy loam soils with a pH between 5.5 and 7.3. They do not do well in wet conditions. In general, they grow in any soil that is suitable for tomatoes.

Climate

Native to Mexico and Guatemala, tomatillos are sensitive to cold. The best growing conditions are 80 to 90°F days with 60 to 70°F nights, low humidity, and sparse rainfall.

Propagation

Tomatillos are normally planted as seed. About 2¼ oz of seed is sufficient to plant an acre.

Commercial operations in the United States use transplants. Tomatillos are seeded in a greenhouse and sold as 3-week old transplants. Cuttings can also be used as they root very easily.

Planting

Space 'Rendidora' 16 inches between the plants and 4 feet between the rows.

For other varieties, plant every 2 feet in

TABLE 1. Common pests and diseases of tomatillos

Pests		
Name	**Damage**	**Control**
Cutworms *Agrotis segetumor*	Larva feeding inside the fruit and on the stems and leaves	azadirachtin, abamectin, bifenthrin, cyhalothrin, deltamethrin, flubendiamide, carbaryl, gamma-lambda-cyhalothrin
Root-knot nematode *Meloidogyne* sp.	Wilting caused by galls created on the roots	Nematicide
Tobacco budworm *Heliothis virescens*	Larva feeding inside the fruit	*Bt* subspecies *kurstaki* **strain** HD1
Whiteflies *Trialeurodes vaporariorum*	Feeding on the leaf underside; also can transmit disease-causing organisms	azadirachtin, pyrethrin
Diseases		
Name	**Damage**	**Control**
Black spot *Diplocarpon*	Black lesions, primarily on the leaves but can spread to the fruit	Fungicide
Tobacco mosaic virus	Wilting, dwarfing, loss of yield	Quarantine

rows 5 feet apart. If you are starting with seeds, plant 3 or 4 tomatillo seeds 2 feet apart. When the plants reach 4 to 5 inches tall, thin them to one plant every 2 feet.

Insects and diseases

Tomatillos have only a few serious insect pests and diseases (Table 1). Insect pests include cutworms, root-knot nematode, tobacco budworm, and whiteflies. Common diseases are black spot and tobacco mosaic virus.

Figure 1. **A tomatillo plant can produce 60 to 200 fruits during a growing season.**

Harvesting

The plants begin bearing fruit 65 to 85 days after seeding or transplanting and continue for 1 to 2 months or until the first frost. The fruit are picked just as the husk, or calyx, bursts. If left on the plant too long, the flavor and quality will suffer.

Harvesting is done by hand, typically every day.

A plant may produce 60 to 200 fruits in a growing season (Fig. 1). An average yield is 2½ pounds per plant, or about 9 tons per acre.

In commercial operations, the tomatillos are placed in 10-pound cartons in the field. The fruit is then set out for 2 weeks to let the husks dry.

Storage

After the 2-week drying period, the cartons can be stacked and stored at 55 to 60°F and 85 to 90 percent humidity for up to 3 weeks.

Uses

Tomatillos are used primarily for fresh consumption. They are often used in soups and sauces, most notably in green sauces for Mexican and Guatemalan dishes. Some tomatillos are preserved as jam or canned whole for later use (Fig. 2).

Figure 2. Tomatillos are often used in Mexican dishes, such as green sauces for enchiladas verde, and green salsa dips for chips.

Texas A&M AgriLife Extension Service

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The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

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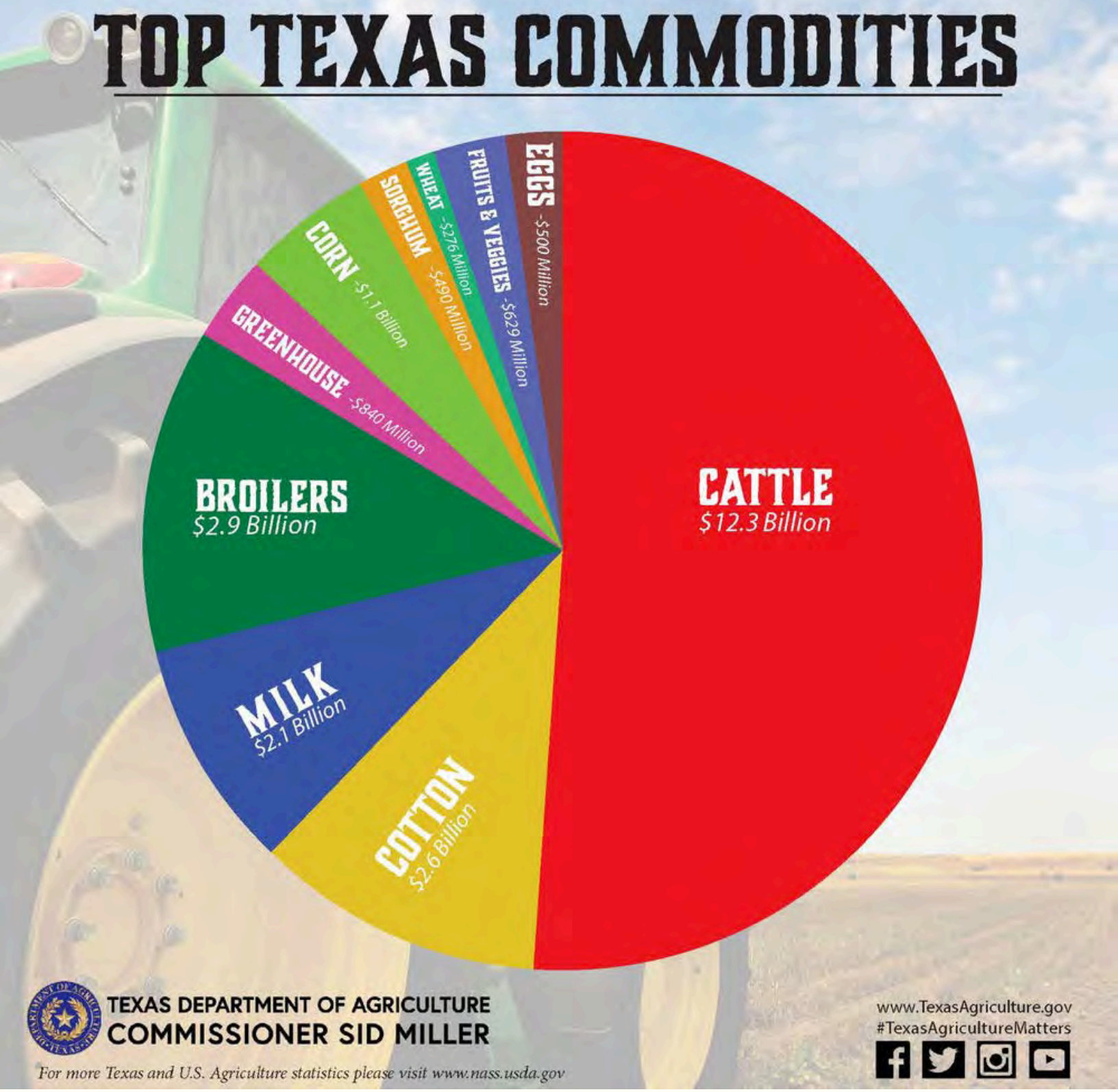
New

Appendices

Appendix I: Texas Agricultural Statistics

Texas Agricultural Statistics

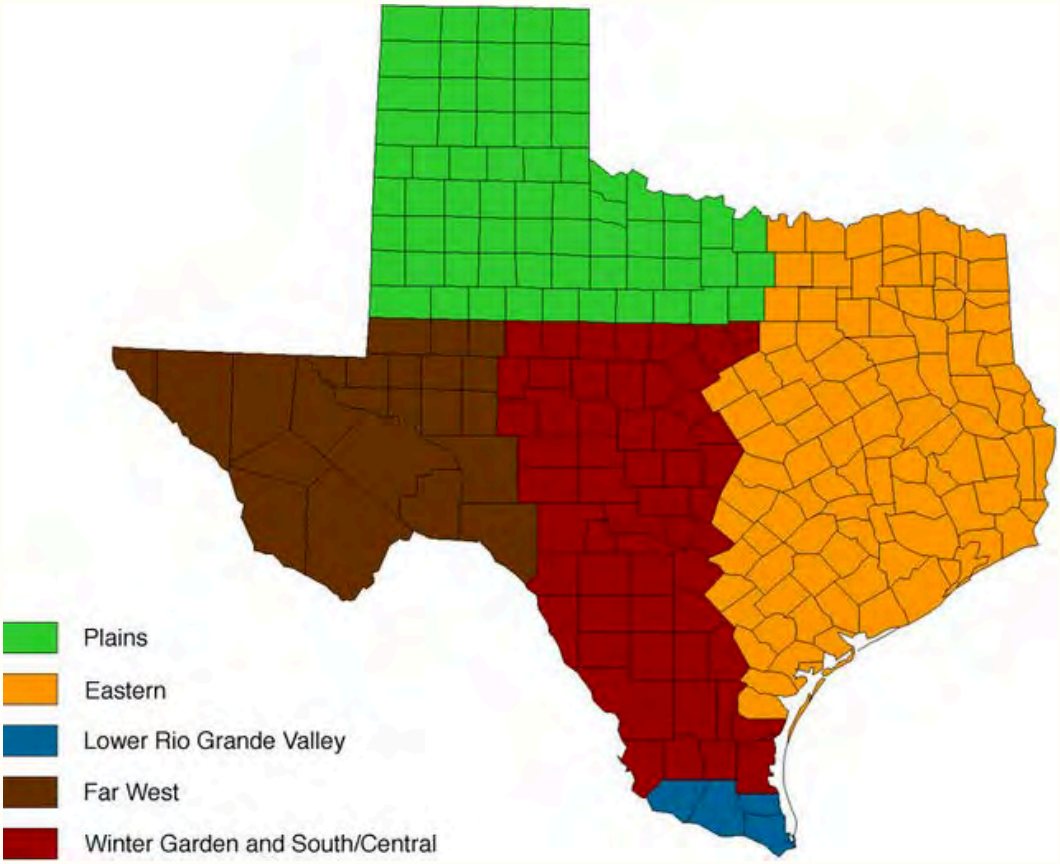
- In 2017 Texas farms sold $24 .9 billion in agricultural products compared to 25.4 billion in 2012.
- Texas leads the nation in number of farms and ranches, with 248,416 farms and ranches covering 127 million acres.
- Of 408,506 producers in Texas 37% are women.
- For 36% of producers in Texas, farming is their primary occupation.
- Of 127 million acres in farmland, 7% (176,837 acres) is dedicated to orchards.
- The average farm in Texas is 411 acres.
- The average farm size in Texas decreased by 12 acres from 2012.
- Although cattle farms (beef farms specifically) dominated in numbers in Texas, farms with poultry inventory showed the largest increase since 2012.
- The average age of Texas farmers and ranchers is 59 years.
- Texas producers with military service accounted for 50,004 farms and 52,357 producers with an average age of 68.
- The average farm size of a Texas producer with military service is 385 acres.
- 1 of every 7 working Texans (14%) is in an agriculture-related job.
- The average age of young producers (age 35 or less) was 29 and accounted for 21,304 farms.
- The average farm size owned by a young producer in Texas is 385 acres.
- New and beginning producers (10 years or less on any farm) came in at 118,999 operating 77,419 farms with an average size of 348 acres.
- The number of female producers increased 69% in Texas compared to 2012.
- The category of Asian farmers in Texas increased significantly compared to 2012.



- Top 10 commodities in terms of market value in 2017:
  - Cattle, $12.3 billion
  - Cotton, $2.6 billion
  - Milk, $2.1 billion
  - Broilers, $2.9 billion
  - Corn, $1.2 billion Greenhouse & nursery, $1.3 billion
  - Forestry, $859 million
  - Greenhouse, $838 million
  - Eggs, $506 million
  - Sorghum, $486 million
  - Vegetables, $352 million
  - Wheat, $276 million

Appendix II: Geographical Regions of Texas

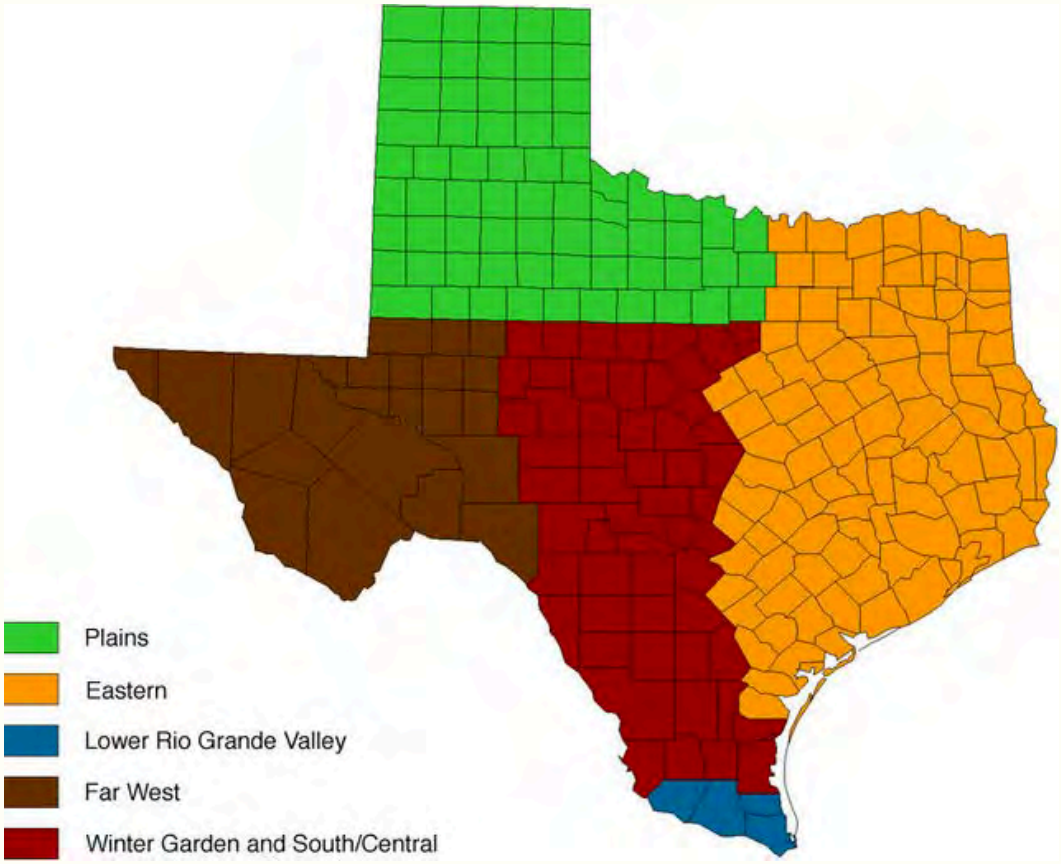
Geographical Regions of Texas



Plains Region. Includes northern Panhandle (Amarillo, north to Oklahoma) and South Plains (Lubbock, south to Big Spring), with vast dryland and center pivot irrigation production (Ogallala Aquifer). Clayey soils to the north and generally sandy soils to south and east. Includes eastward Rolling Plains along the Red River to I-35 and south to I-20 and Abilene, with dryland production and with some pockets of irrigation. Region varies from 2,000 to 4,600 feet elevation; 26 inches of rain on the east to 16 inches on west at the NM border and growing seasons from 160 to 240 days. Grains, cotton, and oil seed crops predominate but major acreages of horticultural crops.

Eastern Areas. Includes East Texas; typified by sandy soils, small farms and family operations with intensive crop production and numerous cow-calf/pasture operations. Bordered by I-35 on west and OK and LA on north and east and extends southward to Beaumont and Upper Gulf Coast, south to Houston, Corpus Christi, and Coastal Bend region. Good seasonal rains but irrigation is common. Humid summers, long growing season, and close proximity to rural roadside and major metro markets.

Geographical Regions of Texas



Lower Rio Grande Valley. Major vegetable region in the state; includes the four southern most counties. Alluvial soils along the Rio Grande River, subtropical environment with 340 frost-free days, irrigation water from canals or wells along the river. A wide diversity of crops for fresh and processing markets, including citrus and early season vegetables for early market windows and agronomic crops of cotton, grains, sugarcane, and other crops. Intensive pest pressures nearly year round.

Far West Texas. Includes Trans Pecos region (Del Rio, north on US 277) and west to El Paso, with arid lands in the upper Chihuahuan Desert and Desert Grasslands; sparse rainfall (10 inches or less) but intensive crop production where irrigation water is available from the Rio Grande and Pecos Rivers. Crops include cotton, grains, and intensive vegetable and other horticultural crops on alluvial soils in a high desert environment. Production systems are similar to those in NM and AZ.

Winter Garden and South/Central. Includes the Winter Garden and Uvalde area, an intensive irrigated region west and south of San Antonio and the Hill Country. Extends northward to Abilene and southward to the Lower Rio Grande Valley. Diversified dryland and irrigated crop production (Edwards Aquifer) inter-dispersed in the vast rangeland and beef production areas.

RESOURCES

https://aggie-horticulture.tamu.edu

https://www.beefitswhatsfordinner.com/cuts

https://aggiemeat.tamu.edu/4-h-ffa-retail-identification-cuts/

https://cottonbugs.tamu.edu

http://cotton.tamu.edu

https://www.dairymax.org

https://milk4texas.org

https://national4hpoultry.ca.uky.edu/marketpoultry

https://americanlamb.com/cuts-of-lamb/

https://pathtotheplate.tamu.edu/youth/food

https://www.southwestdairyfarmers.com

https://www.texasagriculture.gov

https://www.texasbeefcheckoff.com/

https://texascorn.org/

https://texaswheat.org/