

Olives

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Introduction

The olive is native to the Mediterranean region, tropical and central Asia and various parts of Africa. The olive has a history almost as long as that of Western civilization, its development being one of civilized man's first accomplishments. Everyone is familiar with the biblical story of the dove sent out by Noah which returned with an olive branch. The olive was also important to the Greeks and the Romans, who made it a part of their mythologies to celebrate the use of its oil as an essential food and fuel for lamps. The main olive producing countries are Spain, Italy, and Greece whereas emerging countries in the production of olives include Argentina, Chile, Australia, and the USA. It was the Spanish who spread the olive to America. Catholic missionaries spread the olive to Mexico and later to California, as well as to South America. Because of climatic similarities with the Mediterranean, production of olives in the USA is primarily limited to California.

The late Earnest Mortensen of the Texas Agricultural Experiment Station brought olive trees to the Winter Garden area in the 1930's. Studies there showed that the olive trees would produce in Texas conditions. Some of Mortensen's trees continue to survive today and before the freeze of 1983, isolated plantings of olive trees, mostly used as ornamentals, could be found in parts of central and South Texas.

There has been an increase in olive plantings in the last 10 to 15 years primarily southwest of San Antonio as well as several attempts in the Hill Country. Not all of these plantings have been successful. We continue to emphasize that the planting of olives can be quite risky in many parts of the state as the best production and quality will occur in areas with mild winters and long, warm, dry summers to mature the fruit. Biased claims made by folks wanting to sell trees, irrigation equipment or install trees should be considered with great caution.

Climate is the most important limiting factor in the distribution of the olive in Texas and elsewhere. Temperature controls growth, reproduction, and survival of the olive. Growth begins after mean temperatures warm to 70 degrees F in the spring and continues until temperatures drop below this point in the fall. Unlike the fruit trees that we are familiar with, such as the peach, the olive does not set fruiting buds in the fall. Instead, the olive will only set flower buds after being exposed to cool night (35-50 F) and mildly warm day temperatures (<80 F) during the winter. This unique warm day/cool night "vernalization" is essential for fruit bud development, and varieties differ in the range of tolerable temperature that will satisfy this requirement.

Olive trees must experience vernalization to produce fruit; however, it will freeze from extreme cold. Cold hardiness of olives is similar to citrus, improving with tree age and in-

creased trunk size. It will sustain damage to leaves and small stems at 17° F and more severe damage at 12° F. The tree can be killed to the ground with temperatures below 10° F, but mature trees can re-grow from the underground crown following a severe freeze.

Survival and freeze damage of olives depends on how long the temperature stays low as well as how well the trees are hardened off, i.e. gradual temperature decline as opposed to go-



Young trees severely damaged by cold

ing from 95° F to 25° F; high wind and low humidity can also make the freeze injury worse. Rapidly growing trees in the fall from too much water and fertilizer are particularly sensitive to sub-freezing temperatures. Freezes in Texas are very unpredictable in their frequency and occurrence. They can occur both unexpectedly in the fall and the spring, in addition to the middle of winter.

There are very few sites that meet the climactic requirements of the olive in Texas. Studies by the late Jim Denny at Texas A&M University indicated that the olive could be grown as a fruit tree in large parts of East, Central, and South Texas; however, the trees would freeze to the ground three of ten years. Extreme South Texas does not typically experience enough cool vernalization weather to set fruit on the olive. The olive may be grown as an ornamental in those areas which do not receive enough cold to set fruit.

In North and West Texas and the Hill Country, the frequency of freezing temperature is too great to allow for cultivation of olive. Because very cold, dry air may sometimes invade the

entire state during severe winters, damage to the olive is a threat almost anywhere olive trees are planted in the state, with danger increasing the further north you go. Efforts must be taken to protect olive trees, especially during the first three years of establishment, to insure their survival.

Serious freeze injury problems have occurred during the middle of the winter as opposed to early or late in the season. Once established for 3 to 5 years, olive trees gain more cold hardiness; however, Texas climatic conditions are very erratic particularly in the middle of the winter. It is not uncommon for it to be 65° F in January only to hit 100° F in February; such



Bark splitting from freeze injury

events lead to the loss of cold hardiness or acclimation of the olive trees. Then when it gets severely cold in March, the trees are often times frozen to the ground.

General rules of thumb are that young trees will be killed in the winter when the temperature drops below 25° F, small branches on mature trees will die when the temperatures drop below 22° F, mature trees can be killed to the

ground in the winter when the temperature drops below 15° F and rain, very high humidity, and/or hot dry winds during bloom in the spring can seriously hamper fruit set.

Botany

The olive (*Olea europaea* L.) is a subtropical evergreen tree or shrub with opposite leaves. The leaves are lanceolate (lance-shaped), waxy green on top and grayish green on the bottom. Young bark is green, but older bark is gray. In the Mediterranean, olive trees are known to live for over a thousand years. If the top is damaged, a new tree will sprout from underground parts.

Under the proper conditions, at about five years of age, the olive will begin to bear the familiar olive fruit. Fruit is borne on panicles, or fruiting branches, arising from buds above the point where the leaves join the stem on the previous season's growth. The cream-colored flowers are very similar to those of the waxleaf ligustrum (privet), a member of the same botanical family (the Oleaceae) which is widely grown in Texas as an ornamental.

Two types of flowers arise on the tree: perfect and staminate. Staminate flowers contain only male parts; the pistil is aborted. 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. Most olive varieties are self-fertile, but increased production can result from cross pollination.

The olive is the only member of the Oleaceae to bear edible fruit. The fruit, a drupe like a peach, is not palatable as a fresh fruit because of the presence of a bitter glucoside. Thus olive fruit must be processed in order to be served as food; either pressed for its oil or processed with lye and salt to produce the canned or preserved table fruit. While fruit processed in California has almost all of the bitterness removed, that processed in the Mediterranean area is often left somewhat bitter.

The olive should not be confused with the Russian-olive (*Elaeagnus angustifolia*) or the

Anacahuita (*Cordia boissieri*), which is sometimes called the Texas or Mexican Olive. Both of these plants belong to different botanical families. The olive, however, is related to the Desert Olive (*Forestiera* sp.) and the American Wild-Olive (*Osmanthus* sp.). The fruits of these two "olives" are not edible.

Soil Adaption

The olive has a wide adaptability with regard to soils; it will tolerate a variety from sands to clays with a pH of 5.5 to 8.5. Olive trees have fairly shallow root systems so they do not need a deep soil, but the soils must be well-drained. Three to four feet of unstratified soils is optimum for production. Realize that clay or rock layers and/or different soil textures can hinder water drainage and cause the olive trees to drown out. It is not the dry times that we are concerned about, but rather the times when the area gets an abundance of water from either irrigation or rainfall. If groves remain saturated for an extended period of time the trees will die.

Site Preparation and Planting

Orchard sites should be prepared 12 to 18 months prior to planting the trees. This involves killing perennial weeds and grasses and deep chiseling or ripping down the planting rows to insure breakup of any hard layer. Soil sample(s) should be taken from the area, and any needed amendments applied prior to planting, so that they can be more easily incorporated around the planting site. The irrigation system should also be installed so the trees will not suffer for water immediately after planting. Watering with a tank and hose should be done at planting, but it is not practical for ongoing establishment and maintenance of the orchard.

Trees should be spaced to insure adequate sunlight around each tree as the olive bears fruit on the one year old wood on the outer periphery of the tree which is in adequate sunlight. Shoots will not flower and produce fruit if in full shade. Hence, crowded trees will lead to shading and lack of production. Orchards are often planted closer than normal with temporary trees which are taken out as

the permanent trees mature. Recently there have been trees planted in hedgerows to allow for mechanical harvesting. Harvest method, variety and tree size will affect a prospective grower's decision on tree spacing. Typical spacing for most varieties is 30 ft x 30 ft or 48 trees per acre. Smaller statured varieties like Arberquina and Arbosana could be pushed to 25 'x 25' or 70 trees per acre. Hedgerow trees are planted anywhere from 5 to 11 feet in the row with rows 13 to 22 feet between rows.

Olive trees are typically sold as own rooted containerized trees. Since olives root fairly easily under mist they are grown by nurseries from cuttings. These cuttings usually spend two to three months in rooting beds and then are transferred to gallon containers or plastic tubes and grown for 12 to 18 months in the nursery. Such trees usually have a single trunk about 3 to 4 feet tall. The ideal time to plant the trees is in early spring after the danger of spring frost has passed. The hole needs to be large enough to accommodate the root ball and should be at the same depth as the tree grew in the container. The tree needs to be thoroughly watered at planting and a regular schedule followed to assure tree establishment. Sunburn on the trunk can be an issue on young trees, so some sort of protection is in order. Many growers use tree shelters or "grow tubes". Young trees should be tipped at 30 inches upon planting to stimulate lateral branching in order to select 3 to 5 scaffold branches the first growing season.

Cultivation

The olive is drought tolerant, but grows best when it has sufficient water. Overwatering should be avoided. Water regularly, but do not allow waterlogging to take place. An ideal water amount to apply would be an inch of water a week. It is critical to continue to water mature trees as the crop is maturing. Some elect to cut back on water at this time to possibly produce better quality oil. However, if one does this and a deluge of rain is received the quality of the fruit will be worse than if the trees had continued to be watered. Also realize the maturation process is a huge drain on the tree and water is necessary to allow the tree to



Three-year old olive tree.



Mature, bearing olive grove

mature the fruit and also store reserves for a potential crop next year.

The olive is very efficient at extracting nutrients from the soil, and nitrogen is usually the only element which must be applied. Mature trees need from 1/2 to 2 pounds of actual nitrogen per year, depending on tree size. Deficiencies of potassium and boron are rare but possible. Fertilize in the spring when new growth begins. Additional fertilizer may be

added in the summer months if growth is poor. Excessive nitrogen will stimulate growth at the expense of fruiting; also luxuriant growth is more susceptible to freeze damage.

Pruning should be delayed until early spring. Because the tree does not go dormant, any increase in temperature after pruning will stimulate growth which might be damaged by freezing temperatures. The olive is pruned by thinning out dead or otherwise unproductive wood. It should not be topped. An exception to this rule is the use of the olive as an ornamental hedge. It will form a dense, attractive hedge if topped and trimmed. To avoid being killed by subfreezing temperatures, olive trees should be mounded with soil up to about 1-1/2 feet on the trunk until they are about five years old. Mound up the soil in late November and remove it in late March. If possible, cover the foliage when temperatures of 17° F. or below are predicted. If the tree is damaged by cold weather, wait until new growth appears in the late spring before removing dead or damaged parts.

Competition from weeds or grass should not be allowed. Options include mulch and/or herbicides. Mechanical cultivation is not recommended.

Bacterial and Fungal Pathogens

Stress has been the main culprit of tree death to date, as opposed to bacterial and fungal pathogens. However, there are numerous potential problem diseases of which cotton root rot (*Phymatotricopsis omnivora*) would be one of the most important. Olive trees are quite susceptible to cotton root rot and many trees have been lost to this soil-borne fungus in Texas. This disease is prevalent in high pH soils in the southwest where olives are climatically best adapted in Texas. Because cotton root rot more readily affects plants that are not adequately supplied with water, it is essential to keep the area around the tree weed free to reduce water stress from competition. Mechanical damage from weed eaters has led to girdling and death of trees. *Verticillium* wilt has been identified as a problem in prime olive growing areas around the world, but has not been implicated in cases in Texas yet. Olive knot, caused by the bacterial pathogen *Pseudomonas syrin-*

gae, pv.savastoni has been found on other species in Texas, but not on olive. Fruit and foliage diseases have minimal as well, but wet springs and summers can hinder fruit set and potentially lead to foliage and fruit issues.

Insects and Vertebrate Pests

Even though scale is the most important olive insect problem with numerous species attacking the tree, it has not been a serious problem so far in Texas. Lesser problems have been associated with nematodes, borers and thrips. The main injury has come from the feeding of leaf and/or stink bugs. Unfortunately there is no control other than to plant trap crops like millet, black eyed peas or other beans. Once these plants are infested with stinkbugs, they can be sprayed. However stink bugs as other insects are cyclic in nature meaning they may not always be a problem.

Deer have been a serious deterrent to tree growth in many areas, making high fences a necessity for commercial production.

Varieties

Numerous varieties have been tried in the state with cold hardiness being the key selection factor. The varieties which have the most success to date with survival and production will be highlighted here. Not all varieties perform the same at all locations. It may be that one variety does well for your neighbor, but just across the street at your farm it does horribly. Differential varietal performance has been noted among adjacent orchards. Most of the olives grown in Texas have been pressed for oil. However, various growers and hobbyists have produced table olives by bringing them as well.

‘Arberquina’ – is probably the most planted cultivar in Texas to date. It originates from Spain and is widely planted there. It has very good cold hardiness, is self fertile, and reaches 12 to 15 feet at maturity. The fruit is quite small but the trees tend to produce fruit which yields oil that is very sweet with a delicate almond overtone. The fruit could be brined as well.

‘Arbosana’ – has done well in many locations though it only has moderate cold tolerance. It originates from Spain and is pollinated by Arber-

quina. Trees get 12 to 15 feet tall and the fruit can either be pressed for oil or processed.



‘Arberquina’

‘**Frantoio**’ – originates from Italy and only has low cold tolerance, however the trees have grown well in many areas of Texas. Still in some areas the trees have been productive and in others only a handful of olives produced per tree. It is self fertile with trees reaching 20 plus feet in height, and the fruit is used for oil.

‘**Manzanilla**’ – also came from Spain, but is widely planted in the US and Middle East in addition to Spain. The fruit is primarily used as a table olive and has moderate cold tolerance. Most canned black olives are of this variety, though it can be pressed for its oil. The tree requires a pollinizer, but if you have a series of varieties in the orchard fruit set should not be a problem. Manzanilla fruit are usually pressed for oil in Texas.



‘Manzanilla’

‘**Mission**’ – was developed in the United States and has good tolerance to cold. It is self fruitful

with a tree height under 20 feet. It can either be processed into oil or brined for table olives.

‘**Pendolino**’ – is a universal pollinizer variety from Italy with moderate cold tolerance, however to date it has performed poorly in many areas. Trees can get 20 feet tall or greater, and it is used for oil. The only reason to plant this variety to date would be to have an exclusive pollinizer for Manzanilla.

‘**Picual**’ – is the number one planted variety in Spain for oil. The tree is vigorous and adaptable with moderate cold tolerance. Even though the fruit is larger than some of the other varieties, yields in Texas have been disappointing to date. The oil tends to be quite pungent, with a long shelf life.



‘Picual’

Harvest

Olive harvest typically begins in mid to late September or early October. The maturity of an olive at harvest can be anywhere from completely green to totally black, depending on variety. Most are harvested as fruit begins to color. Harvest is delayed to allow the crop to reach the desired size and weight, however crop value will be lost if one waits too long to harvest. In most cases the crop is removed from the tree by hand though mechanical harvest of the fruit is a necessity in larger operations. The challenge of mechanical harvesting is to remove the fruit from the tree without damaging the tree or fruit.



Coloration in maturing olive fruit

With hand harvest, the fruit are removed by moving one's cupped gloved hand down the limb in a milking action. Fruit either drop into a picking bag or fall to the ground on a sheet spread around the tree. Vibration produced by a mechanical shaker is required to dislodge the fruit mechanically. The fruit removal rate by hand harvesting is about 95 % with about 5 % cullage whereas with shaking it is only about 75 % with up to 20 % cullage. If using hand harvest growers must have a well trained labor force to get the fruit off the trees in a two week period. Regardless of how the fruit is removed from the tree, it needs to be processed promptly as the fruit can deteriorate rapidly.

Most of the olives grown in Texas have been pressed for oil. However, various growers and hobbyists have produced table olives as well.

Economic Considerations

The high cost of olive oil in the grocery stores and the great health benefits associated with eating olive oil has led many to believe that producing "Extra Virgin Texas Olive Oil" is financially lucrative. However, the costs to produce olive oil are high and the competition fierce. It takes anywhere from 75 to 125 pounds of olives to produce one gallon of oil depending on the cultivar. To make matters worse "extra virgin" is a term that is loosely defined. Typically in the U.S., if the oil is solely made from olives, it can be labeled as extra virgin. Such oil is pressed from the fruit without using heat; hence the oil is not "altered".

For More Information

Ferguson, L, G.S. Sibbett, and G.C. Martin. 1994. Olive Production Manual, University of California Publication 3353, Oakland, California.

<http://aggie-horticulture.tamu.edu/fruit-nut>