Planning the New Citrus Orchard in the Lower Rio Grande Valley
Texas Agricultural Experiment Station

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Planning the New Citrus Orchard in the Lower Rio Grande Valley

Many growers, whose faith in the citrus industry in the Lower Rio Grande Valley was not shaken by the damaging freezes of 1949 and 1951, will reset their orchards as soon as possible. It is hoped that they will profit by the research and experience of more than 25 years of citrus production in the Valley which is summarized in this bulletin.

Actual research results on many problems are lacking. In these cases, careful observations of practices and experiences of the more successful citrus growers are cited.

SITE SELECTION

Soil Drainage

An ideal citrus soil is deep and well drained. It has a subsoil free from tight clay layers. Soils of this type contain enough sand to keep them from being heavy when wet and to allow rapid absorption of water. The free water table should not be closer than six feet to the surface.

The first two or three feet of a soil may appear ideal as an orchard site, but frequently layers of tight clay occur at lower depths. These clay "lenses" hinder water from moving down, and local areas of high water table are formed. Under this condition soluble salts accumulate and eventually such spots will become too salty for good growth of citrus.

Only the best soils should be planted to citrus. If a poorly drained area exists within a good block of land, it should be improved by installing subsurface tile drainage along with a properly designed irrigation system. An experienced drainage and irrigation engineer should be consulted in designing a drainage or irrigation system.

Generally, the lighter textured soils—classified as the Brennan, Willacy, Delmita and Hidalgo series—will be good citrus land, although clay lenses often occur at four, five or six-foot levels in some of these soils. Good citrus production is possible on Laredo, Harlingen, Raymondville and other soil series of heavier texture where drainage conditions are favorable. Careful selection of land for a new grove including a soil profile study will result in greater profits. Grow citrus on well-drained soils; other crops will do better than citrus on the less well-drained lands.
Water Sources

In selecting a site for a new orchard, be sure there is plenty of good water. Rio Grande water is always of usable quality; however, water rights should be investigated to be sure of an adequate year-round supply. Drainage ditches should not be considered as a source of water supply for orchards. Well water is satisfactory as long as the boron concentration is less than one part per million (p.p.m.) and soluble salts are below 1,200 p.p.m. Of the soluble salts, the quantity of sodium should not be greater than 60 percent of the total bases. These bases are calcium, sodium, potassium and magnesium. Total chlorides should be less than 250 p.p.m. Conditions may exist where water with slightly higher salt concentrations than just mentioned could be used but such situations should be thoroughly investigated before an investment is made. Always consider the possibility of wells getting low after long use, especially where there are a large number of wells in the area.

Water can be tested for its suitability for citrus by several commercial chemists in the Valley.

Soil Fertility

Soil fertility is important in profitable citrus growing. Natural soil fertility, however, need not be a major point in selecting an orchard site because Valley soils respond readily to good soil management practices.

Select an orchard soil on its texture, drainage and topographical characteristics rather than on its natural fertility.

Topography

Avoid planting citrus in low places. Surface, subsurface and air drainage are poor in such areas. Cold air is heavier than warm air and settles in the lower spots to form frost pockets. Ridges and gentle slopes are better for orchard sites because the cold air drains from them more readily and decreases the frost hazard.

The topography of the orchard land should influence the selection of an irrigation system. When the land is nearly level, rectangular pans can be laid out with permanent borders. On more sloping land, contour benching with permanent borders should be practiced even though a sprinkler system is to be used. Properly designed and installed irrigation systems will save water and labor.

Windbreaks

The 1950-51 freeze has increased interest in windbreaks for the Valley. Protection from high winds that bring cold temperatures, blow sand and whip branches is worth thinking about.
When selecting the new orchard site, consider the possibilities of using windbreaks to help decrease cold damage and to aid in the production of highest quality fruit.

**IRRIGATION MANAGEMENT**

A citrus grove is a long time investment. Maximum returns will be received from this investment only when the best possible irrigation management is used. A properly designed and installed system combined with a suitable cover crop program is essential to satisfactory irrigation management for any grove in the Valley.

The application of irrigation water to a soil usually introduces a hazard to its productivity. The topographic features and drainage characteristics of Valley soils make this especially true. Haphazard watering and improper soil management can rapidly destroy soil structure and bring about the development of salt spots.

Proper land preparation is necessary for good irrigation management. Practically all of the citrus land in the Valley requires some mechanical treatment, especially leveling, before it can be irrigated properly. The leveling operation in some cases is expensive, requiring the use of heavy earth moving equipment, but later returns will more than justify this initial expense.

Three systems of irrigation are recommended for the Valley. Two of these make use of flooding with permanent borders, the other of sprinkler equipment. Permanent borders are used to lay out systems of rectangular pans on nearly level land and contour benches on the more rolling areas. Sprinkler equipment may be used on any orchard, but is especially recommended for the rougher areas that cannot be contour benched effectively. This system is recommended for these areas because the rate of water application can be regulated nearer to the infiltration rate of the soil.

The systems making use of permanent borders hold and distribute rainfall which aids in leaching accumulated salts.

**Rectangular Pans**

A system of rectangular pans, such as shown in Figure 1, is recommended on nearly level land to insure more uniform water distribution throughout the run. The operation and maintenance costs of this system are low. Permanent borders are easily constructed and may be spaced at any desired interval, depending on tree spacing. After the borders are constructed, the intervals between them should be leveled before the trees are planted. Water is conveyed to the closed borders by permanent underground concrete pipe lines or open surface ditches, each row having an outlet or turnout.
Figure 1. A permanent border system of irrigation for a citrus grove. The borders are constructed about 12 inches high, with a base width varying from 6 to 12 feet. The area between borders is level for efficient distribution of irrigation water. This picture shows a summer cover crop of grain sorghum between borders. Hubam clover is a good fall and winter cover crop for citrus land. Photo courtesy of the San Antonio Evening News.

Contour Benches

A contour bench system with permanent borders and level benches, as shown in Figure 2, is an excellent way of applying water on rolling land. This system makes possible the utilization of rough land that could not be irrigated by rectangular pans. The permanent borders are constructed on the contour, and the benches between them are leveled. This provides a uniform distribution of water. Irrigation water is usually conveyed to each bench by underground concrete pipe. Open ditches for a system of this type on sloping, sandy land are not recommended because of the difficulty of water control and ditch maintenance.

Sprinkler Equipment

Many citrus groves in the Valley are irrigated successfully with sprinklers. Such equipment, as shown in Figure 3, is used to good advantage in applying water to groves on rough land that will not permit satisfactory irrigation by flooding methods.
Other local uses are in areas where water is obtained from wells or small reservoirs, and for irrigating light sandy soils where the infiltration rate is very high. Sprinkler irrigation can be used successfully to control the rate of water application. It is important that the rate of water application by a sprinkler unit be adjusted to the infiltration rate of the soil for maximum irrigation efficiency. When the rate of application exceeds the infiltration rate of the soil, run-off and ponding will occur.

**Basins**

The basin system of irrigation has been practiced to a large extent in the Lower Rio Grande Valley for many years, but is more expensive to maintain and is less efficient than the systems recommended. It involves the construction of temporary cross borders around the trees to permit flooding in small basins. When one of the basins is filled with water, the border is broken and water flows to the next basin. Water is carried to the borders by outlets mounted on underground concrete pipe line or by temporary surface laterals.

This system has been used because of the lack of land preparation at the time the citrus trees were planted. With a basin system, it is impossible to obtain an equal distribution of water. It has contributed to many localized drainage problems that can now be prevented with good land preparation and the use of

![Figure 2. A contour bench system of irrigation for citrus. The contour borders are parallel and the area between them is level, allowing even distribution of irrigation water. Each bench or pan has an individual outlet for water application. Photo courtesy of the Soil Conservation Service.](image-url)
Figure 3. Irrigating a young citrus grove with sprinklers. This method of irrigation is used effectively in rough or rolling country. Irrigation water is conveyed to the pumping unit through underground concrete pipe. A permanent grass sod culture is being practiced. Photo courtesy of the Holt Equipment Company and the Caterpillar Tractor Company.

properly designed systems. A large amount of tractor work and labor is required to construct the temporary borders and to irrigate by this system. After trees attain considerable size and their roots extend toward the row middles, frequent rebordering cuts many roots and restricts the root absorption zone.

The basin system does not afford satisfactory control of water from heavy rainfall. Soil erosion and loss of needed water from slopes, causing ponding in low areas, frequently result when this system is used on rolling land.

General Problems

The soil management program for the permanent level border and contour bench systems should include a permanent sod of grasses and legumes. Field crops or vegetables are sometimes interplanted as a source of income until the trees are large enough to produce profitable fruit crops. Good judgment must be exercised in the selection of crops for interplanting to avoid cultural practices that are detrimental to the young trees. Caution should be exercised at all times to avoid root pruning and
interplanting should not be practiced to the detriment of the
grove. Where sprinkler irrigation is used, vegetative cover is
preferable to clean tillage with heavy implements.

A stalk cutter or a mower can be used to control the height
of the vegetation. A good mulch on the surface will increase
infiltration, reduce evaporation and maintain lower soil temper-
atures during the summer.

The quantity of water needed and the frequency of application
will depend to a great extent upon the type of soil and the age
of the citrus trees. Young trees with shallow root zones will not
require heavy applications of water. As the trees increase in
age and size, the quantity of water per application should be
increased. The moisture content of the soil in the root zone
should be maintained at such a level that water will be readily
available for plant use. Moisture used by the trees and losses
from evaporation are more rapid in the spring and summer than
during the fall and winter, therefore, more frequent and slightly
heavier applications of water are required in the warmer months.

The nutrient absorption zone for citrus trees is usually
confined to the first two feet below the surface. Where soil
moisture is maintained properly, a small percentage of roots
will be found at the three to four-foot level. These deeper roots
help supply moisture in a prolonged drouth. The moisture con-
tent of the root zone can be determined from an examination
of the soil. If the soil in this zone is moist enough to hold to-
gether when pressed lightly in the palm of the hand, the mois-
ture content is usually sufficient.

Owners of citrus groves may obtain additional information
and technical assistance for the actual planning and installation
of a properly designed system of irrigation, including a soil
management program, from county agricultural agents and local
technicians of the Soil Conservation Service.

SPECIES AND VARIETIES

Each grove owner must make his own decision as to the
species and varieties of citrus to plant. This section gives some
basic information on the more important varieties and strains
of each species.

Grapefruit

The consumer’s preference has been for seedless varieties of
grapefruit. Since citrus growers in the Lower Rio Grande Valley
derive the major portion of their income from fresh fruit sales,
they should consider this preference in their planting programs.

The red grapefruit, which has helped make the citrus industry
of the Valley famous throughout the world, is probably the
number one variety to be considered. Numerous bud sports were
Figure 4. Citrus in the Lower Valley
discovered on many Thompson or Pink Marsh grapefruit trees in the Valley from 1929 to 1935. Fruit from these sporting branches showed a red pulp, far deeper in color than any of the fruit from Thompson trees, and a red blush on the rind.

Eight of these red strains are being propagated commercially. Several of the bud sport owners claim differences in quality of one sport over another, but all the fruit characters involved are apparently affected by soil and climatic conditions. Until these bud sports are planted in the same grove and records are taken on the trees and fruit over a period of years, it will not be known whether any economical differences exist among them. Such a strain planting is now underway on the Lower Rio Grande Valley Experiment Station at Weslaco.

The red grapefruit generally reaches market maturity from the middle to the end of October and is shipped from that time until the following June. The interior color frequently starts fading about the beginning of February. In many instances, it will fade until it is near the initial color intensity of the Thompson grapefruit by the end of the season.

The Thompson or Marsh Pink variety has had limited planting in the Valley. It originated as a bud sport on a white Marsh tree in the grove of W. B. Thompson at Oneco, Florida. The pink color, which is apparent only in the pulp of the fruit, generally fades to amber in February and March. It matures about the middle of October and the shipping season extends until May or June.

Foster Seedless is another bud sport or strain that has been planted to a limited extent. It was discovered on a Foster tree near Mission, Texas, in 1938 by Joseph Hollerbach. It differs from the Foster grapefruit by being nearly seedless, but the interior and exterior color is about the same as the Foster. The red color of the Foster grapefruit is not as deep in the pulp as the other strains of red grapefruit; therefore, it is doubtful that this strain will become important commercially.

The original Marsh variety (uncolored or "white") was the number one grapefruit of the Valley at one time, but it has been superseded by the red varieties and strains in most of the new plantings. It is thought to have originated from a seedling tree grown on the farm of William Hancock at Socrum, Florida. Marsh has many excellent qualities. It is one of the best white grapefruit varieties and probably will always have a place in the Valley citrus industry. In Texas, it matures in October and the shipping season extends to May or June. Some of its desirable characteristics include relatively seedless fruit, excellent flavor, medium size and large annual yields where good management practices are followed.

The Duncan variety was planted in the early development of the citrus industry in the Valley. It originated as a seedling tree
in the old Snedicor or Davy grove near Safety Harbor on the Pinellas Peninsula of Florida. The seed from which this tree originated was thought to have been planted by Don Phillippe in the early 1800's. Under Texas conditions, Duncan generally matures in October. It bears a heavy crop of fruit, has excellent flavor, attains large size and is especially desired by processors for juice and segments. The disadvantages of Duncan for sale on the fresh fruit market are extreme seediness and white color. There have been relatively few new plantings of this variety in the Valley during the past 10 years.

**Oranges**

**Early Varieties**

The principal early orange prior to the freeze of February 1951 was the Hamlin or Norris. The Hamlin variety was found in 1870 near Glenwood, Florida, in a grove belonging to Mrs. Mary H. Payne. It is considered a seedless variety, and the season for maturity in Texas is generally October or November. It is shipped from October until about the middle of January. Some disadvantages of this variety under Texas conditions are lack of flavor, pale interior color, drying out quickly after maturity and small fruit. Its good points are early maturity, relatively seedless fruit and a large yield per acre.

Another new strain of early orange which is attracting considerable attention in the Valley is the Marrs. This strain is a bud sport from a navel tree discovered by O. F. Marrs of Donna, Texas. It matures in October and November under Texas conditions and is marketed from October to January. This strain is being studied closely to determine its characteristics.

**Navels**

Another group of oranges grown commercially in the Valley are the varieties and strains of Navels. Navel oranges generally reach maturity in October and are shipped from October to December. The Texas Navel has been widely planted, but it has been a shy bearer. Low yields per acre have been the main disadvantage in the production of Navels in the Valley. There are several promising local strains of the Washington Navel which are being propagated by Valley nurserymen. The Navel orange is very good in flavor and appearance. It is rather high in sugar and low in acid. Its large fruits are especially popular with gift fruit shippers.

**Mid-season Varieties**

Joppa and Jaffa are mid-season varieties of seedless oranges. The Joppa was brought into California from seed imported from Palestine by A. B. Chapman of San Gabriel, California. The Jaffa, also a Palestine orange, was brought into Florida by General Sanford around 1883. Both mature in late October or
November under Texas conditions. The trees generally do not bear quite as heavily as the Hamlin trees, but the fruit is superior to the Hamlin in flavor, size and keeping quality on the tree. These varieties seem to be increasing in commercial plantings in the Valley.

The Pineapple orange is an early to mid-season variety which has been grown extensively in the Valley. It originated near Citra, Florida, and was first propagated in 1876 in the Bishop, Hoyt and Company groves. The Pineapple orange bears very well under Texas growing conditions and generally matures in late October or November. The fruit has a very attractive appearance and the quality is excellent. The main disadvantage of this variety is the seedy nature of the fruit.

Late Varieties

The Valencia is the late variety of orange grown in the Valley. It was first introduced into California by A. B. Chapman and George H. Smith in 1876 from the Thomas Rivers Nursery, Sawbridgeworth, England. The exact origin of the Valencia orange is unknown, although there are varieties growing in China, Sicily and Brazil that appear to be almost identical to it. Valencia is grown in almost all of the citrus sections of the world and is the most important late-maturing variety of oranges.

Under Texas conditions, Valencia bears well, is considered a seedless fruit, has excellent quality and, with proper care, the fruit is medium to large. The fruit reaches maturity in January and February, and the shipping season extends for several months. The fruit will remain on the tree several months after it reaches maturity without much deterioration.

Tangerines, Tangelos, Tangors and Lemons

Tangerines, tangelos and tangors are grown mainly for gift fruit shipments. Only a small acreage in the Valley is planted to these fruits.

Tangerines

The tangerines, or Mandarin oranges, mainly grown in the Valley are Clementine or Algerian, and Dancy.

The Clementine tangerine originated from a seedling tree discovered in Algeria in the garden of the orphanage of Misserghin. It was first introduced into the United States in 1909 by W. T. Swingle of the U. S. Department of Agriculture. Under Texas conditions, it matures in October and November, but it dries out very quickly. Its fruit has an excellent flavor, is small to medium in size and it is a heavy yielder.

The Dancy tangerine originated from a seedling grown at Buena Vista, Florida, in the grove of Colonel George L. Dancy.
In Texas, it matures in late November and December and is shipped mainly during the Christmas season. Its fruit does not dry out as quickly as the Clementine, and its flavor is slightly more acid. The quality of the fruit is excellent, it is small to medium in size, and the trees produce good crops.

**Tangelos**

Tangelos are hybrids developed by crossing a tangerine or mandarin orange with either grapefruit or pummelo. Almost all of these crosses were made by W. T. Swingle at Eustis, Florida, in 1897 and by H. J. Webber in 1898 in investigations of the U. S. Department of Agriculture. The tangelos showing the greatest promise in the Lower Río Grande Valley Experiment Station variety block are Lake or Orlando, Mineola and Thornton. Under Valley conditions, these tangelos have the disadvantage of being alternate bearers.

Lake or Orlando tangelo is a hybrid of the Bowen grapefruit pollinated with the Dancy tangerine. The fruit is attractive. It has the shape and size of a large tangerine. The rind is smooth. When the fruit is fully mature, the rind and pulp are orange in color. Although it is classified as a seedy fruit, it does not have excessive seeds. The fruit is low in acid and has a sweet flavor. This variety matures in Texas from the last of November until the first of January. This makes it an excellent Christmas trade fruit.

The Mineola tangelo shows promise under Valley conditions. It has the same parentage as the Lake or Orlando tangelo. The fruit is shaped like a medium-large flattened orange with the stem end slightly raised but not distinctly necked. The rind of the mature fruit is deep reddish-orange and the pulp is a deep orange color. The fruit has excellent flavor and an attractive appearance. The season of maturity extends from the middle of January to near the end of February, which is decidedly later than the Lake or Orlando tangelo.

The most commonly grown tangelo in the Valley is the Thornton. It is a hybrid of the grapefruit crossed with the tangerine. The fruit is oblate to obovate in shape, and is medium large. The rind and pulp are a light orange color when fully mature. Lack of acid and a sweet flavor are characteristics of the fruit when mature. The period of maturity extends from the first of December through the middle of January. Disadvantages of the Thornton tangelo are its rough, coarse appearance, soft puffy fruit and poor shipping quality.

**Tangors**

Tangors are hybrids of tangerines crossed with the sweet orange. Most of these crosses were made in 1931. Very few of the tangors have been named. Since they resemble the tangelo in appearance, they often are incorrectly called tangelos.
The only tangor of commercial importance in the Valley is the Temple tangor, or as it is commonly called the Temple orange. The exact origin of the Temple tangor is unknown. The fruit is a deep orange to reddish color and is very appealing to the eye. It matures in Texas during December and is popular in gift packages. The acid flavor of the fruit is enjoyed by many people.

Lemons

Lemons are of very limited commercial importance in the Valley citrus industry. One of the main reasons for the small acreage grown is the lack of cold resistance of most commercial varieties.

A few growers have been successful with the Meyer lemon. This variety was obtained by Frank N. Meyer, agricultural explorer of the U.S. Department of Agriculture, at Fengtai, near Peking, China. It has more cold resistance than other varieties. The fruit of this variety is not as acid as other lemons; it is nearly globose in shape and is very juicy. It does not ship well due to the thin rind and tender pulp. The trees bear heavy crops in the Valley and are easily grown from cuttings or as a budded tree.

Other Citrus

Other species and varieties of citrus which have been grown successfully in the Valley are limes, kumquats and various ornamental hybrids, such as the calamondin and citrangequats.

This group is mainly of ornamental or dooryard importance, with the exception of a few small plantings of limes. It is doubtful if any of these species and varieties will attain much commercial importance in the Valley.

PLANTING CONSIDERATIONS

Nursery Trees

With the site and varieties decided upon, high-quality nursery trees should be selected carefully for planting.

Diseases and Insects

The nursery trees purchased should be relatively free from insect pests. Nursery trees planted out with an initial heavy infestation of scale, for example, are handicapped from the start.

The citrus root nematode is another pest to be considered. It is widely distributed in old orchards in the Lower Rio Grande Valley. It is highly desirable to plant nematode-free trees on new land. To insure trees free of nematodes, nursery stock should be grown on land that has not been previously planted to citrus.

Nursery trees having areas of exposed wood on the trunks, as a result of freeze damage or mechanical injury, should be
avoided. The original wound at the bud union line should be partially healed over. Profuse gumming or bleeding in the trunk, particularly in grapefruit, should be viewed with suspicion as a possible indication of Rio Grande gummosis.

Assurance of freedom from psorosis or scaly bark, is the most important consideration in the disease category. Such a disease is not apparent in nursery trees except to the trained observer at brief stages of early growth. The only way to be certain of getting psorosis-free trees is to buy registered stock, the budwood of which came from virus-free parent trees.

A registration system for reliable virus-free parent trees is now in effect in the Valley under the supervision of the State Department of Agriculture. With this system of parent tree registration, scaly bark disease can be eliminated in new orchard plantings. If all new plantings were made from psorosis-free nursery stock, the disease could be eradicated in 20 to 25 years.

Rootstocks

Sour orange has been the principal rootstock for nursery trees in the Valley because of its compatibility with the commonly used citrus varieties and because of its resistance to cotton

Figure 5. Staking a young citrus tree in the nursery, following budding, to protect it against the wind and to insure a straight trunk. Photo courtesy of the Lower Rio Grande Valley Chamber of Commerce and the Texas Citrus Commission.
root rot, Phytophthora foot rot and Rio Grande gummosis. However, in South Africa, Java, South America and California, the varieties budded on sour orange rootstock proved highly susceptible to tristeza or quick decline diseases. Trees in affected areas on sour orange died while those on resistant stocks survived.

There has been a sharp increase of interest in other rootstocks because of the possibility of these diseases getting into Texas citrus. The U. S. Department of Agriculture, working at Campinas, Sao Paulo, Brazil, has tested over 200 varieties of rootstocks for susceptibility to tristeza. A USDA agency cooperating with the Lower Rio Grande Valley Experiment Station is devoting full time to research on citrus rootstocks in an effort to find one that has all the advantages of sour orange and is also resistant to tristeza.

The most promising rootstock under study appears to be Cleopatra mandarin, which has proved to be safe where tristeza is present. According to reports from other citrus areas, Cleopatra (or "Cleo") produces a good tree and high quality fruit, perhaps a little slower in coming into bearing than sour orange, but eventually equally or more productive. It has the additional advantage of being more salt tolerant. Growers will have the
choice of continuing with sour orange, which is still safe so far as present production is concerned, or of using Cleo, which is resistant to tristeza or quick decline diseases.

Tree Size and Form

A sound, clean, straight-trunked nursery tree about five-eighths to one inch in diameter just above the bud-union line is preferred for planting. A half-inch tree is too small and generally will be retarded in growth and initial bearing. Trees larger than one inch lose much of their feeder root system when dug and balled and may be slow in starting; however, they generally will come into bearing as soon as trees of the recommended size.

Trees are headed back in the nursery and are received by the buyer in this form. In ordinary practice, such heading has been rather high, to develop the framework branches at about 20 to 24 inches from the ground. Observations following the disastrous freezes of 1949 and 1951 indicate that heading lower, so the framework branches can be covered with soil at banking time, may be an advantage. If killed to the bank in a freeze, a tree so banked will recover more quickly and with better form than one that has to be cut back to the trunk. Also, with a low head, banking can be continued for several years. Buyers desiring low-headed trees should place their orders with the nursery well in advance of planting.

Trees, as received from the nursery, should be dormant, or should be held for a few days until new growth has hardened and some degree of dormancy is obtained. Balled trees may be held upright, closely grouped together, for weeks without serious injury from delay in planting, provided they are watered daily in dry weather to prevent the outer roots from drying. If the holding period is unduly long, the soil around the outer margin of the groups of trees should be banked to prevent too much circulation of drying air through and between the balled plants.

Spacing

Citrus orchards have been grown successfully in the Valley with various tree spacings. Most groves were planted approximately 20 by 25 or 25 by 25 feet. Some orchards were planted at a very close spacing of about 15 by 20 feet with the intention of removing half of the trees when the orchard was about 10 or 12 years old. Close spacing gives a large number of trees per acre and heavy yields of fruit in the early life of the orchard. However, there is a temptation not to remove the extra trees at the proper time, thereby reducing yields as the orchard becomes older. Observations made after the freezes of 1949 and 1951 have indicated that in some close-spaced orchards there was less cold damage than in groves spaced 25 by 25 feet. The actual spacing decided upon will depend on grower preference and land topography.
Wide middles should be provided at intervals throughout the grove to permit the use of trucks at picking time.

**Planting Dates**

Most trees should be planted from October through December. This enables the roots to make sufficient growth to establish the tree well in the soil without too much new top growth. If early top growth occurs, there usually is time enough before the first frost for it to become hardened. Normally-cool December and January weather will prevent active growth of the tops. Such fall-planted trees should be banked for protection against a possible freeze.

Spring planting may be done from February to May. Even June plantings have been strikingly successful. Spring plantings will be only a little behind those made in the preceding fall.

**Fertilizer Practices**

Valley soils are sufficiently fertile and it is not necessary to fertilize a new orchard for at least 6 months. A regular fertilizer schedule can be set up at that time. A schedule that has proved

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Figure 7. A field being set to young grapefruit trees. Photo courtesy of the Lower Rio Grande Valley Chamber of Commerce and the Texas Citrus Commission.
satisfactory is one pound of 33 percent ammonium nitrate per tree per year, or the equivalent, applied in late January and May for the first 2 or 3 years.

**WINDBREAK CONSIDERATIONS**

In planning the new orchard, some means of protection from the persistent winds in this area should be considered. Since very little research has been conducted in the Lower Rio Grande Valley on permanent windbreaks, observations here and research conducted in other areas, must be relied upon.

A good windbreak should materially decrease blowing sand, mechanical injury to leaves, scarring of fruit, drying of leaves and fruit by hot, dry winds, and freezing when high winds occur.

If a permanent windbreak is planned in connection with a citrus orchard, it should be considered as a part of the orchard and not as something which is planted, irrigated once or twice and then forgotten. If proper management practices are not used in growing a windbreak, it will become a nuisance. A windbreak should be irrigated and fertilized regularly. In some cases, systematic root pruning should be undertaken. In all cases, some management of the top growth should be practiced.

Many windbreaks of introduced tree species have failed because of being unadapted to the soil and climatic conditions of the Valley. Diseases and insects have also caused many windbreak plantings to fail.

Athel or salt cedar, (*Tamarix articulata*) has proved to be well adapted to the Valley. It is easily propagated, grows rapidly, attains sufficient height, is cold resistant and makes a dense growth. These are characteristics of good windbreak tree species. Athel has the disadvantage of being a vigorous feeder, extending its roots several times its height into adjoining cultivated areas. The roots of athel can be pruned with deep subsoiling tools or specially constructed root-pruning equipment. Fertilizer and irrigation water applied to the windbreak will lessen competition with adjoining citrus for water and nutrients. The top should be pruned frequently to encourage branching and dense straight growth. Athel can be propagated very easily from cuttings. These cuttings should be spaced four feet apart in the windbreak row.

Closely-planted *Washingtonia* fan palms gave some protection to adjoining orchards during the 1951 freeze. If palms are to be used, two rows should be planted four feet apart, with the plants spaced alternately in the rows at from three to four feet intervals in each row. Palms used as windbreaks should not be trimmed other than initially to lessen the fire hazard.

Where heating is planned, a good windbreak on all sides will increase the efficiency of the heaters, especially during high
winds. Without heaters, damage may be caused by frost pockets formed on still nights between two good windbreaks. Frost pockets may be avoided in unheated orchards by using wider spacing in the windbreak row and by leaving the lowest side of the orchard open to allow proper air drainage.

Windbreaks should be laid out to run perpendicular to the direction of the damaging winds. This cannot be done in many instances because most of the Valley orchards are laid out on a north to south, or east to west plan. If protection from the prevailing southeast winds is desired, a windbreak should be planted along the south and east sides of the orchard. If protection from the northwest wind is desired, a windbreak should be planted along the north and west sides. Additional windbreaks to be planted at advantageous intervals throughout the orchard should be considered. Each grove will present individual problems. Therefore, a very thorough study of all the factors involved should be made before planting a windbreak.

Care should be taken to insure continuity as missing trees in a windbreak will cause the wind to be funneled through the opening at an increased velocity.

To be most effective, windbreaks should be planted on a community basis. This is especially the case in the northern sections of Hidalgo and Willacy counties where blowing sand may accumulate in isolated windbreaks.

Caution should be observed in planting windbreaks close to property lines as legal complications may result.