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# Citrus Tree Pruning Principles and Practices[1]

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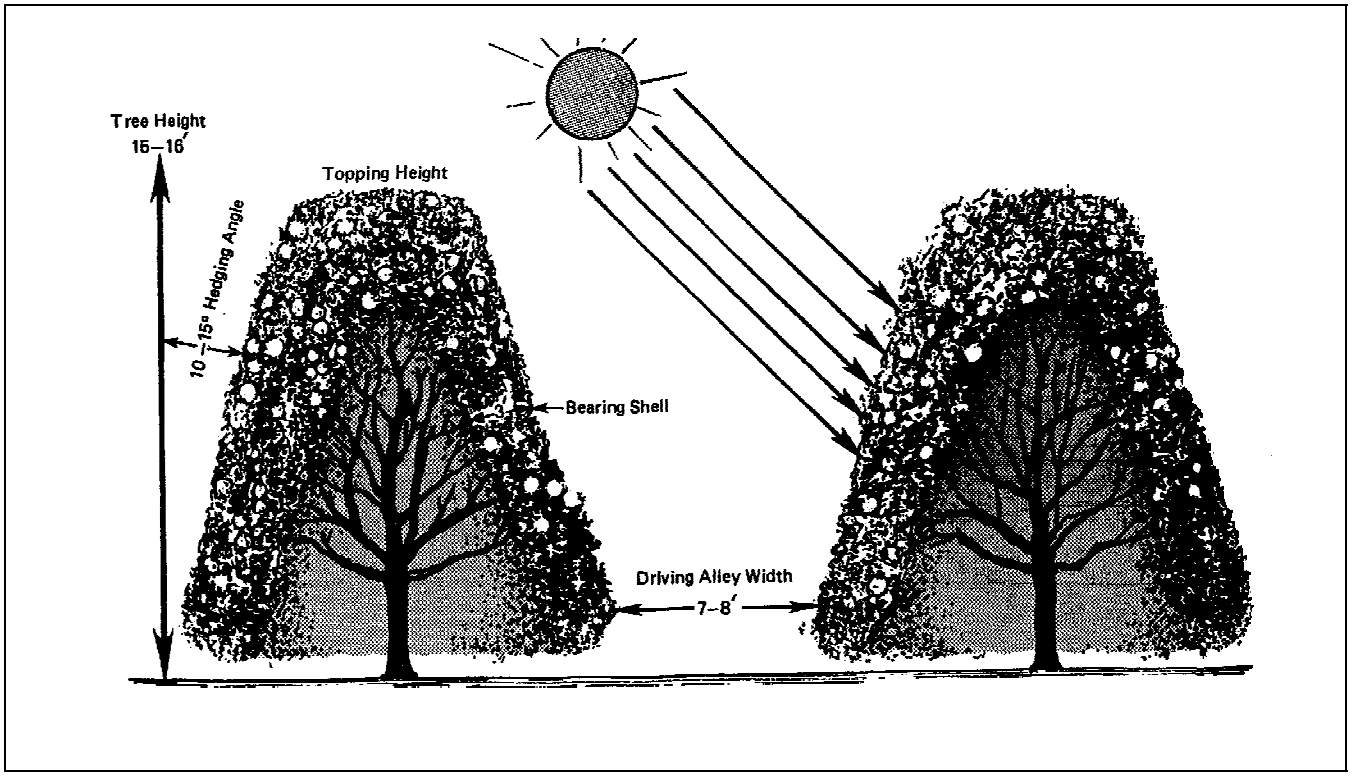


**Figure 1.** Pruning for Canopy Bearing Surface of Citrus Trees.

Pruning healthy, mature citrus trees usually reduces yield in proportion to the amount of foliage removed and can delay fruiting of young, nonbearing trees. Pruning should therefore be limited to that required for future canopy bearing surface development and for the conduct of efficient cultural and harvesting operations (Figure 1). The pruning process 1) adjusts tree shape and the ratio of

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framework to fruit bearing shell of the canopy, 2) alters the top/root ratio, and 3) changes the carbohydrate (food storage) status of the tree. Proper control of vegetative growth is essential for the maintenance of healthy, productive citrus groves. Most groves in Florida must be pruned at some time during their development to avoid problems associated with overcrowded, excessively tall trees. When pruning should begin will depend to a large degree on the initial tree planting density. Crowded conditions result in poor light accessibility, loss of lower foliage and bearing wood, relocation of fruiting to the upper tree canopy areas and reduction in fruit yield, size, and external quality. Good management therefore dictates the need to prune before the occurrence of these undesirable effects.

The response to pruning depends on several factors including variety, tree age and vigor, fruiting habits, growing conditions, and production practices. As no one system or set of rules is adequate for the numerous situations encountered in the field, growers are encouraged to gain a clear understanding of the principles involved in pruning and to take advantage of research results and knowledgeable colleague and custom operators' observations.

## SUNLIGHT, PHOTOSYNTHESIS, AND FOOD STORAGE

The importance of sunlight intercepted by the tree canopy on the production of high yields of good quality fruit cannot be overemphasized. Light provides the energy for photosynthesis in which carbon dioxide from the air and water from the soil are combined in the leaves to form the basic foods upon which trees live, grow, and bear fruit. Light becomes a limiting factor in crowded groves and pruning improves light access. Adjustments must be made in tree height, row middle width, and hedging angle to maximize sunlight impingement on the tree canopy. Sunlight not only influences flowering and fruit set but also enhances fruit quality and color development.

In citrus, carbohydrates are stored in leaves, twigs, and branches with only a minor amount going to the root system. The maximum amount of stored food is reached in spring just before the onset of growth flush activity. The foliage of citrus trees therefore acts as an important food storage area, and heavy pruning causes the tree to produce vegetative growth at the expense of fruit production.

## HORMONAL RELATIONSHIPS AND APICAL DOMINANCE

While hormones occurring in the citrus tree affect fruit set, the effects of pruning on their action is not well understood. Suppression of lateral bud growth by the terminal bud is known as apical dominance. Apical dominance explains many of the growth characteristics of trees and their responses to pruning. Branching is influenced by an auxin produced in the terminal bud which moves down the system to inhibit lateral bud break. Removal of the terminal bud destroys apical dominance so that one or several lateral buds will commence to grow and branching results. Vigorous shoots called water sprouts or suckers show extreme apical dominance with no side-branch development. Apical dominance varies somewhat with vigor and variety.

## BEARING HABITS

The balance between tree growth and fruitfulness appears to depend, to some extent, upon a relationship between carbohydrates and nitrogenous compounds within the tree. When both are adequate, moderate growth and high yields occur. When both are low, citrus trees grow and fruit poorly. A tree low in carbohydrates and high in nitrogen tends to produce vigorous vegetative growth at the expense of fruit production. Since carbohydrates are manufactured and stored in the leaves, heavy pruning which removes a large portion of the leaf area can result in this condition. Too much nitrogen after severe pruning can aggravate the problem, causing thick and puffy fruit peel. Nitrogen applications should therefore be adjusted to the severity of pruning. Reducing nitrogen applications avoids an imbalance when heavy pruning is done. Omitting a nitrogen application before heavy pruning and possibly after will reduce both costs and excessive vegetative growth. The length of time this limitation should continue will depend upon the severity of pruning and the rate of top recovery. Light maintenance pruning should not affect fertilizer requirements.

Some citrus groves tend to have a bearing habit with alternating high and low yields. A heavy crop of fruit tends to deplete carbohydrates and results in a small crop and increased vegetative growth the following year. Pruning after a heavy crop additionally stimulates vegetative growth the following year because the carbohydrate supply has been somewhat depleted and the capacity to resupply has

been reduced. Poor fruit quality may also result from this practice. Pruning after a light crop and before an expected heavy crop should help reduce alternate bearing.

The orientation of branches in space has a marked effect on growth and fruiting. A decrease in growth rate and an increase in flowering occurs when branches bend to a horizontal position. A possible explanation for this phenomenon is a change in the distribution of growth substances and carbohydrates. Favoring horizontal branches over upright ones should result in better growth control and more fruit production.

## BASIC PRUNING CUTS

Heading back and thinning out are the main types of pruning cuts and are used for somewhat opposing objectives. Heading back removes the terminal portion of a shoot or branch, destroying apical dominance and stimulating lateral bud breaks. This tends to produce a more bushy, compact tree. Mechanical hedging and topping are forms of mass heading back. As the individual tree or hedge row increases in size, internal wood may become less productive and eventually die. Thinning out involves the removal of complete branches to laterals or to the main trunk and is done by selective pruning with hand-held equipment. It encourages longer growth of the remaining terminals and can result in a larger, more open tree. This type of pruning may be done for better light penetration into the tree, but is generally considered too labor intensive and not much practiced in Florida.

## RESPONSES TO SEVERE PRUNING

Severe pruning stimulates vigorous new vegetative growth, especially when done before a major growth flush. This happens because an undisturbed root system is providing water and nutrients to a reduced leaf area. The larger the wood that is cut, the larger the subsequent shoot. Vegetative response to pruning is greatest where the most severe cuts are made, resulting in a strong tendency for pruned trees to resume their natural shape. Severe pruning reduces fruiting and increases fruit size and juice content, decreases soluble solids and acid, with usually no change in the soluble solids/acid ratio. Such pruning of a severely crowded grove typically results in a crop reduction the first year, recovery of previous yield the second or third year, and higher yields thereafter, although this can vary with tree vigor, grove conditions, and the size of the previous crop.

## SUGGESTED PRUNING PRACTICES

### Young Trees

Severe pruning and training of young, nonbearing trees tends to delay fruit production and should be avoided. Most trees usually need no pruning for the first few years in the grove except for removal of sprouts on the trunk. These can be easily brushed off when young and tender and the wounds will be small. Larger sprouts should be cut off flush with the trunk. Sprouting on the trunks of young, nonbearing trees can be greatly reduced by using a commercial sprout inhibitor containing naphthaleneacetic acid. While protective wraps around the trunk will reduce sprouting, careful observation is required to avoid insect and disease problems under the wraps. Occasionally, a vigorous sucker will dominate a weak tree or a sucker may arise from the rootstock. These should be removed early before they compete with more desirable growth. Selection of permanent scaffold branches during the first few years is rarely successful since the natural growth habit of these trees is so unpredictable. New growth may occur at unexpected places and become dominant over selected branches. When the tree is 3 or 4 years old, depending on its growth, branches that are too closely spaced or are crossed and entangled may be removed. This pruning should be light, just sufficient to establish a desirable framework without stimulating excessive vegetative growth. Optional pruning during the next several years should be limited to removal of water sprouts, dead wood and occasional branches which interfere with the growth of scaffold limbs.

### Mature Trees

These require little pruning until trees approach containment size. Deadwood may be removed every 3 to 5 years, depending on the amount present and on the labor supply, since it can scar fruit and be a source of melanose infection. This can be done at any time when labor is plentiful and particularly following freezes. Growers need only remove dead branches of 1/4 in. in diameter or larger since smaller dead wood is often broken off in harvesting and other grove operations. All cuts should be made into live wood, flush with a larger branch or at a lateral.

When a grove is laid out, each tree is allotted a unit of space in which to grow. When this space is

exceeded crowding occurs resulting in inadequate light conditions, loss of foliage and fruit production in the lower portion of the tree. Cultural and harvesting operations are also adversely affected.

## Hedging

Hedging, which consists of cutting back the sides of trees to prevent or alleviate crowding, is a common practice since the development of mechanical equipment for this purpose. Hedging leaves numerous cut wood surfaces along the side of the tree canopy from which new sprouts arise eventually developing into a wall of new foliage. Middles (alleys) between tree rows should be sufficiently wide to accommodate grove equipment and provide adequate light access to the sides of the trees. Middles are usually hedged to a width of 7 to 8 ft.

Hedging should be started before crowding becomes a problem so that only cutting of small branches is necessary and minimal crop reduction results. The closer the spacing and the more vigorous the trees, the sooner hedging is required and the more frequently it needs to be done. Removal of a large portion of the tree may be required when pruning is deferred until severe crowding occurs. Excessive vegetative growth and a drastic reduction in subsequent yield may result. Hedging of severely crowded groves aids in the eventual restoration of the tree skirts and opens them up for passage of grove equipment. However, heavy cutting is more expensive, an initial crop reduction can be expected, and brush disposal is more troublesome and costly.

Hedging is usually done at an angle, with the boom tilted toward the tree tops so that the middles are wider at the top than at the bottom, allowing more light to reach the skirts of the tree. Hedging angles being used vary from 0 to 25 degrees from vertical, with 10 to 15 degrees being more commonly used and more satisfactory. Greater hedging angles result in longer exposure of the sides to sunlight and delayed overgrowth of the skirts by the more vigorously growing shoulders of the trees. With wide angles, topping can sometimes be done with one pass of the boom instead of two or can be eliminated entirely if the trees come to a peak at a suitable height. Other advantages of hedging at wider angles may be better spray coverage, particularly aerial, and more efficient harvesting since a higher percentage of the fruit is accessible to pickers on the ground. Possible disadvantages of extreme angles are a greater initial yield reduction when they are imposed on older trees, greater stimulation of long, undesirable shoot growth and greater exposure of fruit to possible cold injury. Although more yield reduction may occur if considerable foliage is removed when a greater hedging angle is first imposed, yields tend to differ little, if any, between angles in subsequent years.

Few groves are now cross hedged to maintain space between trees in both directions as this operation is difficult or impossible in bedded groves. Cross hedging provided no increase in yield or fruit quality in several experiments in both ridge and flatwood groves. In older, widely spaced groves, cross hedging facilitated movement of pickers between trees and placement of fruit containers. It also maintained fruit-bearing surfaces on all sides of the trees, but does not necessarily increase canopy bearing volume per acre. It is not recommended in closely spaced groves and for bedded planting systems. A 15 ft in-row spacing seems to be the lower limit for cross hedging. Where trees are closely planted in the row, cross hedging between every two or more trees is more practical than cross hedging to maintain individual trees. This allows those between to grow together as units of foliage. The distances between cross hedging cuts should be consistent with harvesting needs. Perhaps a more practical alternative would be the removal of every third or more trees, depending on tree spacings and other considerations. This allows groups of two or more trees to grow together as units of foliage while providing the desired spacing and reducing pruning requirements. Trees to be removed could be progressively cut back to allow normal growth of the permanent trees and taken out when they will no longer return a profit. Trees may be removed by pulling with a front-end loader cutting them off at ground level. Cross hedging or tree removal results in resumption of vigorous weed growth in previously shaded grove floor areas and a disruption of irrigation systems.

Most groves are hedged in one direction so that hedgerows are maintained. Where pickers complain because of difficulty in moving between trees and insufficient space for fruit container placement, a change in harvesting practices may be justified for hedgerow plantings. However, the great majority of new plantings which are designed to provide a continuous hedgerow as rapidly as possible, are apparently being successfully managed and harvested.

### Topping

Topping should be done before trees have become excessively tall and should be an integral part of a maintenance program. Long intervals between topping will increase costs of the operation due to heavy cutting and more brush disposal. Excessively tall trees are more difficult and expensive to harvest and spray. Topping trees will increase light penetration into trees thereby stimulating intense growth and flush. It will also reduce harvesting costs, enhance pest and disease control due to better spray coverage, and increase fruit quality and size. Yield reduction due to light topping is usually not great if trees still have their lower skirt areas, especially since fruit density is generally greater in shorter trees. However, if the trees have lost their lower canopy bearing wood, a large reduction in yield will occur in the first year since much of the fruit-producing wood and foliage would be removed. Topping these trees would still be beneficial in the long run since it would help them regain their skirt areas and bring them to a more manageable height. Since topping usually increases fruit size (by reducing crop load), fresh-market fruit from topped trees may have a higher packout.

Some trees are flat-topped, especially if they are small or narrow or have been hedged at a wide angle. Closely-spaced rows and those with a sufficient hedging angle can be flat-topped with a single pass of the boom. However, more are topped at angles which may vary from 15 to 30 degrees from horizontal, resulting in a peak which is 2 or more ft higher than the shoulders. Angles between these extremes are commonly used. The slope aids machines in sweeping brush from the tops.

Optimum tree height depends on the distance between trees, the hedging angle and tree width. Topping height may vary from about 10 to 20 ft, but is usually about halfway between. Some common topping heights are 12 to 14 ft at the shoulder and 15 to 16 ft at the peak. Lower heights are sometimes used for training trees, increasing fruit size or rejuvenating declining trees. Taller trees are sometimes maintained when they are vigorous and widely spaced. Trees in the flatwood areas are generally topped lower than those on the ridge because the more limited root systems will usually not support as much top growth. Topping should be started before heavy cutting is required. If heavy cutting is required, in older groves the initial cuts should be low enough to avoid cutting heavy wood in subsequent topping operations. Retopping is generally done just above the old cut.

## PRUNING PROGRAMS

A pruning program should begin before any heavy cutting is necessary and should be continued at appropriate intervals so that desired tree (hedgerow) size and shape can be maintained at low cost and with minimum loss of canopy. Regular maintenance hedging and topping removes only small portions of the canopy. A regular pruning program eliminates the necessity for large cuts, avoids excessive vegetative growth, maintains good fruit production, and simplifies brush disposal. Maintenance hedging between rows should begin as soon as trees begin to encroach on the designed 7 to 8 ft middle width so that not more than a foot of foliage is removed from each side. By avoiding the stimulation of excessive vegetative growth on *Alternaria* fungus susceptible varieties, such as 'Dancy','Minneola', and 'Orlando', the severity of this disease is lessened.

Hedging programs can vary considerably with variety, tree vigor, spacing, and grower preference. Groves on a 2-year program are hedged in one middle one year and the other middle the next. A 3-year program might consist of hedging one middle the first year, the other the second and topping in the third year. A 4-year program may be quite adequate for less vigorous trees or those planted at a wide spacing. The possibilities for hedging and topping schedules are numerous and should be decided on an individual basis. As older groves are replaced using more closely spaced trees with permanent low volume irrigation systems, cross hedging is no longer feasible. However, where older widely spaced groves still exist without above ground irrigation lines, cross hedging may be incorporated into the schedule. Groves in which trees are maintained as hedgerows may also be on a 1-, 2-, 3-, or 4-year pruning program. Here, the grower can hedge every middle every year; hedge alternate middles every year; hedge every middle every other year; hedge alternate middles for 2 years and top the third year; hedge alternate middles every other year; or hedge all middles every 4th year. Annual or biennial maintenance hedging is preferred for most groves of average to high vigor in order to reduce excessive encroachment into middles, shading of tree skirts, and brush disposal problems.

The best time of year to hedge depends on variety, location, severity of pruning, and availability of equipment. Since hedging is usually done after

removal of the crop, early maturing varieties are generally hedged before those which mature later in the season. Many prefer to hedge early before bloom, but they may also get more regrowth which may or may not be desirable. Hedging could begin as early as December in warmer areas. For colder locations, it is best to wait until the danger of freezing temperatures is past. January, February, and March are the preferred pruning months for many growers. Moderate hedging can be done until July with little or no crop loss and perhaps less regrowth. Light maintenance pruning can be done throughout the summer and until early fall with little or no loss in fruit production. Hedging should not continue into the fall in freeze-prone areas as trees with tender regrowth are more susceptible to cold injury.

Hedging 'Valencia' orange or late harvested grapefruit presents a special problem because of overlapping crops. Hedging has usually been done in late spring after the old crop is harvested and the new crop is set. Fruit harvest should be scheduled early in the season for 'Valencia' groves that are to be hedged. Good results have been obtained when annual hedging has been done in late winter with the old crop still on the tree and before bloom. The first cut is usually done after harvest and then the grove is rehedged annually in January or February. When this is done annually at the same width, the wood and foliage removed contains few fruit and there is little or no reduction in yield. The key to this program is consistency.

Topping should not be started in cold areas until after the threat of freezing temperatures is past to avoid possible cold injury. Heavy topping should be completed in time for exposed limbs to be covered with new growth before the advent of hot, dry weather in the late spring and summer. Adequate soil moisture at the time of topping aids recovery. Topping in April or May without good soil moisture is not recommended. Timing of light topping is not as critical if little fruit is removed, but in freeze-prone areas it is best not to top in the fall to avoid possible cold injury to new growth and exposed internal scaffold wood. Regrowth is more vigorous when topping is done before a major growth flush. Topping before the spring flush results in new growth that is more leggy than when it is done at other times. Maintenance topping may be done in the late summer when regrowth should be less vigorous.

## Closely-spaced Groves

Many citrus growers have turned to closer tree spacings as a way of achieving higher early and sustained fruit yields. Favorable results have usually been obtained in early years but problems of over-crowding, excessive regrowth following pruning, and reduced yields will develop if hedging and topping are not started as soon as trees reach containment size. Pruning vigorous trees in a closely-spaced planting can lead to a perpetual problem of excessive vegetative growth at the expense of fruit production unless properly carried out. Severe cutting should be avoided as much as possible. The more vigorous the trees and the closer the spacing, the sooner pruning should be started and the more frequently it should be done. Thus, only light cutting is necessary and crop reduction is minimized. Slow-growing trees respond more favorably to pruning and are easier to maintain at a given size and shape without sacrificing yield. Tree vigor can be controlled to some extent by proper selection of rootstock and scion and by moderating nutrition levels, especially nitrogen. Growers with closely-spaced rows of relatively vigorous trees often have a problem with multiple exposed cut surfaces from hedging. Pickers dislike them and they are often struck by equipment with mutual damage. This may be avoided by more frequent hedging of less mature wood.

## Pruning Effects on Crop Load, Fruit Size, and Quality

Fruit size is very important in fresh fruit operations, with small sizes often resulting in a reduced pack-out and lower prices. In some cases larger fruit are spot-picked and the rest of the crop is never harvested unless it sizes up sufficiently. In more severe cases with some mandarin varieties, an entire crop may be left on the tree because it is not economically feasible to harvest. Some cultivars grown for fresh fruit tend to set very heavy crops of small fruit in some years and very light crops the next year. Pruning after a heavy crop can increase alternate bearing and result in a small yield of poor quality fruit the next year. Hedging and/or topping after a light crop and before an expected heavy crop can reduce the number of fruit with a corresponding increase in fruit size and also reduce alternate bearing. The grower may elect to speculate and prune before an expected large crop is set or wait

until after fruit-set so that the amount of fruit-set can be more accurately determined. The latter should be done before the fruit has attained appreciable size since later fruit removal could result in a crop reduction without a compensating fruit size increase.

### Skirt Pruning

Pruning to raise tree skirts has become a more widely accepted practice. Until relatively recently little such pruning was done because of possible yield reduction and added expense. With low tree skirts the movement of herbicide booms and other equipment is impeded, and the inspection of irrigation systems is more difficult. Fruit and limbs near the ground are often damaged by the passage of such equipment by herbicide spray and fertilizer contact. Low tree skirts may also increase the incidence of *Phytophthora parasitica*, the causal agent of footrot, because of poor air circulation under the tree canopy. Lower canopy fruit is also more susceptible to brown rot, the result of *Phytophthora citrophthora* infection under certain environmental conditions.

### Pruning after Freeze Damage

Corrective pruning should be delayed until the full extent of freeze damage can be determined. Sufficient time should be allowed for new growth to take place and for dieback to cease. Premature pruning can result in removal of some sound wood and not removing some which will continue to die back, both of which can slow tree recovery. Injury to foliage and tender shoots usually becomes visible within a few days but twigs and small limbs may show little or no sign of cold damage for 4 to 8 weeks or more. It may be several months before severe injury to larger limbs can be fully determined. Therefore, pruning of mature trees should not be done for a least 6 months after severe cold damage has occurred. Where melanose fungus produced on dead wood is expected to be a problem on new growth, and the cold-damaged canopy areas are clearly defined, earlier pruning may be advised. All pruning cuts should be made into living wood below all serious bark damage and at crotches, or to a point where vigorous new shoots are growing. Further light pruning may subsequently be done when needed to aid in forming a new framework.

### Rejuvenation

Loss of tree vigor in older groves results in thinning of the foliage and low yields of small fruit, and is usually accompanied by dieback of twigs and small branches. This decline may be due to age, disease, soil pests, water induced root damage, and other causes. The cause of decline should be determined and corrected if possible; otherwise, response to rejuvenation pruning will be temporary. If the trunk and basic scaffold limbs of trees are not structurally sound due to disease, heart rot, and cold cankers, such rejuvenation procedures are not justified. A limited root system due to a high water table, a hardpan or poor subsoil can result in early tree decline with trees being more readily stressed by drought. When this occurs, the top becomes out of balance with the more limited root system with consequent insufficient uptake of water and nutrients by the roots. Topping these trees should temporarily restore them to a more favorable top to root ratio, but not alleviate the long-term problem. The severity of pruning for rejuvenation will depend on the cause and degree of decline. Skeletonization, the removal of all foliage and wood smaller than 1-1/2 in. in diameter invigorates the tree and results in production of fruiting wood throughout the remainder of the tree. However, it is costly and the crop is lost for a year. Buckhorning, cutting back the scaffold limbs to a height of 5 to 6 ft above the ground, is the most severe form of rejuvenation pruning. It greatly reduces tree size and results in vigorous regrowth. Large wounds remain and production is lost for about 3 years.

It is advisable to paint large cut surfaces on or near the trunk but it is too costly and unnecessary to cover wounds higher in the tree which result from hedging and topping. A white latex paint that is non-phytotoxic appears to be quite satisfactory.

Severe topping for rejuvenation or following a freeze which exposes large limbs and trunks that have grown in the shade may result in severe sunburn when done during or shortly before hot, dry weather. An application of white latex paint using a power sprayer is more efficient where large numbers of trees are involved.

## PRUNING EQUIPMENT

Pruning equipment is available for purchase or use through custom operators. While small equipment may be more economical for light pruning and in tight areas, for large equipment heavier cutting will do better at a lower cost. No matter what

equipment is used, blades should always be kept sharp as they do a better job and require less power.

### Hand-Held Pruners

Hand-held equipment may be used for selective pruning where relatively few trees are involved. The simplest and least expensive pruning tools are powered by hand, and include hand shears, long-handled loppers and pruning saws. The saw blades are generally curved, cut when pulled, and fold for easy carrying. Hand pruning has been made easier with loppers or saws powered by air, electricity, or hydraulics. It is important that the power source is adequate to meet the demands placed upon it; otherwise, the operation may be slower and repairs more frequent. The cutting blades are usually at the ends of poles of various lengths which extend the reach of the operator. Platforms for reaching higher in the tree include ladders for manually-powered tools and mobile platforms for small power tools. Special one-man machines are marketed by several companies, and other tree fruit growers have mounted platforms on trucks and tractors. *With all this equipment, good safety mechanisms and operator training are absolutely essential.*

Hedging machines vary considerably in size and design, ranging from a tractor-mounted vertical boom with a row of belt-driven circular saws to rather large machines with two booms mounted on a self-propelled or tractor-pulled chassis. Some have straight booms with a row of saws on each boom. Others have booms with rotating cross arms with a saw at the end of each. The larger machines can do heavy cutting more easily and rapidly. The booms on many machines can be adjusted to the desired width and angle. Topping machines also vary from tractor-mounted booms to larger machines that are self-propelled or tractor-drawn. They also have straight or rotating booms which can be adjusted to the desired topping angle.

Preparation for hedging or topping should include having the ground as level as practical so that the machine will not be slowed by ruts or other impediments, and adequate turn areas should also be provided. Before topping, risers of overhead sprinklers must be taken down and prior hedging is sometimes needed to facilitate movement of the machine through the grove and to allow the brush to fall into the middles. While machines will work in bedded plantings their operation is more difficult, time consuming, and hazardous. Hazards to be considered include guy wires, fences, ditches and roadways.

### Spread of Disease by Pruning

Certain virus diseases can be spread by pruning equipment, particularly hand-held equipment. Caution should therefore be exercised when moving equipment from a suspected virus infected block to one assumed to be clean. As with any grove equipment, good sanitation procedures will reduce the incidence of pest and disease movement.

## BRUSH DISPOSAL

The brush that results from heavy pruning often presents the greatest problem and expense. Brush disposal can be handled in several ways depending on amount and size. No special operation is necessary when brush is rather small since it will decay where it falls or be shredded in routine mowing operations. Good weed control in row middles is suggested before pruning as removal of brush entangled with heavy weed growth compounds the problem. Rotary mowers which have been widely used for many years are quite adequate when neither the amount nor size of the brush is great. The mowers being used are designed for heavy cutting and are often further reinforced for added strength. Safety precautions must be taken to avoid injury by flying debris. This type of equipment has been used on citrus brush up to 3 or 4 in. in diameter, but larger wood should be removed from its path. The mower should go over the brush on the day it is cut or the operation should be delayed until the brush is brittle. Large, self-propelled brush shredders were developed which could shred wood up to several inches in diameter by means of heavy steel hammers or teeth. These machines were useful in heavy brush situations, but are no longer used in Florida due to the high operational costs.

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