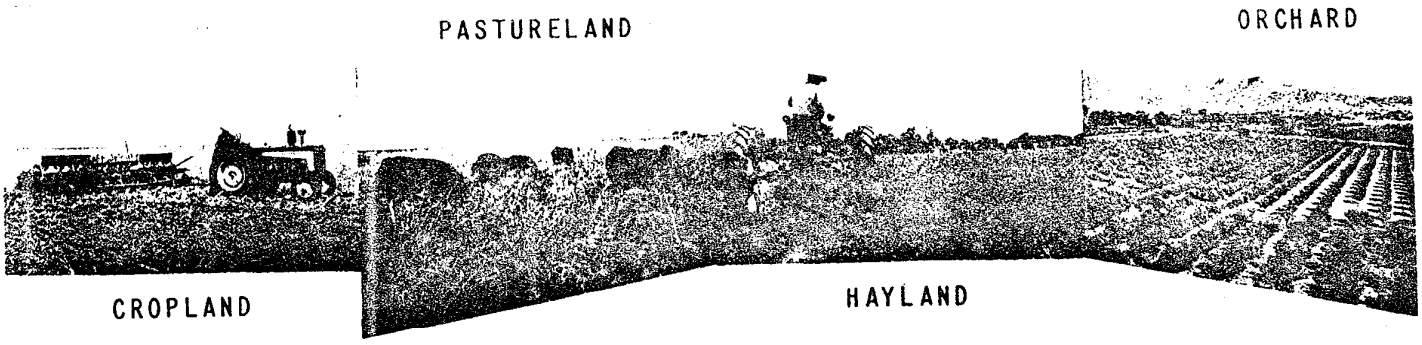
CONSERVATION AGRONOMY TECHNICAL NOTES



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ORCHARD MANAGEMENT GUIDELINES

by

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ORCHARD MANAGEMENT GUIDELINES

GENERAL

Orchard Management is a complex topic, due to the different requirements for various fruiting species. However, there are some things which are common to most types of orchards. These are: a need for weed control, particularly around young trees; proper pruning techniques; disease and insect control; knowledge of pollination requirements; the benefit of cover crops between the trees; and proper irrigation water use.

Weed Control

Two types of weed control are available for use - mechanical and chemical. Many farmers use both. They mechanically control weeds with some type of shallow tillage tool in the spaces between the trees and then chemically control the area around the base of the trees. There are several tillage tools especially designed for orchards which allow tillage to go right up to the tree an then swing around it. This eliminates the need for further control measures around the base of the trees.

It is imperative to control vegetation around the base of the trees. If vegetation is left around the trees, rodents move into the area due to a lack of cover anyplace else in the orchard. In the winter, when food is scarce, they often knaw the bark which girdles, or partially girdles, the trees. This can cause substantial damage, particularly in a young orchard. There are many chemicals on the market which are satisfactory for weed control in orchards. However, due to the frequency of changes, and the differences between species, check with the local County Extension Office for the latest information. New Mexico State University has a publication, No. 400 A-15, Chemical Weed Control Guide for 1987, which is available at any local extension office. This publication is updated regularly as new chemicals enter the market.

Mulching with wood chips, plastic covered with gravel or chips, straw, grass clippings, or other organic material is also an effective method of weed control as well as a moisture conserving practice. Except when using plastic and gravel, a bare area should be left around the tree trunk to prevent attracting rodents. This area will need to have the weeds controlled manually. The use of cover crops can also greatly reduce the need for weed control.

There are numerous benefits when cover crops are used in orchards. This topic is covered in detail in Agronomy Technical Note 38, Cover Crops in Orchards and Vineyards.

Irrigation Water Management

Each irrigated orchard should have an irrigation plan. A New Mexico Irrigation Guide can be found at each Soil Conservation Service office in the state. Assistance is available at the local SCS office to develop an irrigation plan for each orchard. The plans are based on type of irrigation system, available water, type of soil, the age and species of trees to be watered, and type of cover crop, if one is used. Since there are so

many variables involved, no other information will be discussed here. It should be noted that without adequate water at the proper time poor crops will result, and if too much water is applied, expenses will rise. A good irrigation plan will result in the right amount of water being applied at the right time and for the most economical cost.

Establishing Young Orchards

Orchards should be established on deep, well drained, fertile soil with a good water absorbing capacity, with no salinity or alkalinity problems and with a good organic matter content. Fine textured soils are not desirable for orchards; particularly for stone fruits. Nearly level or gently sloping land is the most desirable for an orchard.

The more the site varies from the above description, greater problems, lower expected yields, and higher costs of production are to be expected.

In New Mexico a commercial or home orchard will require irrigation for adequate production. In some areas, fruit trees might exist under dryland conditions. However, dependable fruit yields will require an adequate supply of good quality irrigation water.

In New Mexico there is another important factor to be considered when planting an orchard; and that is the site location. Spring frosts shortly before, during, or after bloom constitute a tremendous hazard to fruit production. Cold air which is heavier than warm air, tends to settle into low spots. On a still frosty night, cold air will drain into the low spots. A 100 foot difference in elevation can result in a 2-10^{0} F difference in the minimum temperature encountered(3). A preferred site would be one which will allow cold air to drain away.

Planting

When planting young trees, dig a hole large enough to accommodate the roots without crowding. Any broken or diseased roots should be removed. Dig the hole at least six inches deeper than the intended planting depth and then refill with topsoil leaving a slightly higher mound in the center. Place the tree in the hole, spread out the roots, and cover with soil. Place the trees about 1-2 inches deeper than the nursery planting depth, except dwarf trees which should be planted at the same depth as the nursery or slightly higher. Tamp the soil firmly to eliminate air pockets and insure good root-soil contact. Water well at the time of planting and keep damp until the tree is well established. Do not fertilize at planting time.

It is best to plant in the fall when the trees are dormant although early spring planting is also satisfactory. Late spring or summer plantings result in greater shock and a higher percent death loss. Occasionally, a newly planted tree will fail to leaf out at the expected time. Scrape the bark with a thumbnail. If the inner bark is green, the tree is still alive and may eventually recover from the transplanting shock and develop normally. If the inner bark is brown, the tree is dead and should be removed and replaced as soon as possible. Be sure that the roots do not dry out during transplanting. If bare-root nursery stock is received with dry roots, the roots should be soaked in water for a day or two prior to planting.

After planting, the top should be pruned in proportion to the amount of roots destroyed during the transplanting operation. A loss of roots always occurs during transplanting. If the trees are single stems, 3-4 feet high, prune them back to about 30 inches. Lateral shoots should be cut back to short stubs having one or two buds each. This brings the top into balance with the root system and forces the tree to form stronger shoots(1). Spacing between trees depends on the type of tree. Dwarf apple trees may be planted 10 to 12 feet apart and will reach 8 to 10 feet tall, semi-dwarf trees should be planted about 20 feet apart and will reach 12-15 feet in height while standard trees will be over 20 feet tall and need even more space. Dwarf pear trees should be 15-18 feet apart(2). Peach trees should not be set closer than 20 x 20 feet and 24 x 24, or 20 x 25, is more to be preferred(1). The following table provides information on tree spacing for apples(3).

Tree spacing	Trees per acre	Yield required per tree to reach production goals per acre			Years required to reach expected yield
		1000 bu. per acre	1500 bu. per acre	2000 bu. per acre	
Feet	No.	bu. per tree	bu. per tree	bu. per tree	
30x30	48	20.8	31.2	41.7	15 to 20
18x24	101	9.9	14.8	19.8	12 to 16
14x20	156	6.4	9.6	12.8	8 to 12
12x18	201	5.0	7.5	10.0	7 to 12
10x16	272	3.7	5.5	7.4	6 to 10
8x16	340	2.9	4.4	5.9	5 to 10
6x14	519	1.9	2.8	3.8	4 to 8

Until the trees begin to form a canopy, normally about 4-5 years, the areas between the rows of trees can be used to produce a cash crop. This lessens the economic loss of the orchard area until the trees start to reach their mature bearing age. The intercrops should not be planted closer than 5-6 feet from the trees. In pecan orchards in New Mexico, it is common to plant twice as many trees as desired in the mature orchard. When a solid canopy develops in 8-12 years, every other tree is transplanted to allow space for the remaining trees to develop.

Transplanting such large trees is normally not practical. However, with pecans a successful procedure has been developed. Trunk diameters are normally 5-8 inches. All of the limbs are pruned back to 12-18 inch stubs and the tree is moved with a tree spade. New shoots quickly form and by proper pruning a well shaped tree can be developed. Recently, it has been found that if a single shoot is left uncut on the tree to act as a leader, the trees recover more quickly than if all of the branches are pruned back. A 20 to 30 year old pecan tree will have a limb spread that is 40 to 60 feet in diameter. Closer spacing will result in competition for sunlight and the trees will grow tall and produce weak lateral branches. Some growers plant trees on a 30 x 30 feet spacing and then prune them annually to prevent crowding(4).

Pistachio orchards require a spacing for mature trees of not less than 24 feet. Since pistachios are slow growing and don't reach maturity for 12-15 years, some growers use closer spacings to increase production until crowding begins to occur. At this time, the trees will be thinned to the proper spacing for mature trees(5).

Pollination Requirements

An additional very important spacing factor should be considered when planning an orchard and that is pollination requirements for the species grown. In most instances, apple varieties are not sufficiently self-pollinating to be dependably productive if planted alone. Trees should not be farther than two tree rows from pollinizer varieties. It is also generally preferable to have all of the trees in one row of the same variety. This facilitates harvesting operations or spraying if different varieties have varying spray schedules(3). Some types of plums, cherries and pears also require pollinizer trees while some are self-pollinated. Nursery catalogs, or the nurseryman, can provide this information so that proper varieties can be obtained and planted to insure proper pollination.

Pecan trees normally produce large quantities of pollen, and the flowers are wind pollinated. However, the staminate and pistallate flowers mature at different times within the same variety. A single variety orchard normally produces low yields due to poor pollination. Varietal cross-pollination also produces more nuts and larger nuts with heavier kernels than self pollination(4). Interplanting two or more varieties in commercial orchards helps to insure high yields of good quality nuts.

Pistachio trees have male and female flowers borne on separate trees. Some orchards contain at least one male tree for every 10-12 female trees. However, the more common ratio is 1 to 8. This is accomplished by placing a male tree in the center of a 3 x 3 block of female trees. This has each of the 8 females next to the male in the center of the block(5).

Fertilization

Fruit and nut trees generally have totally different fertility needs from field crops. Their deeper rooting systems, ability to store nutrients, and their perennial growth habit sharply contrast with the nutrient needs of field crops. Profitable orchard fertilization frequently depends on recognizing various deficiencies as expressed by leaf and growth patterns, fruit symptoms, and chemical composition and analysis of the leaves(7).

Nitrogen

Nitrogen is the element most often deficient in orchard soils. A lack of nitrogen results in smaller, pale green leaves, lack of terminal shoot growth, small highly colored and early maturing fruits, and an early fall coloring and loss of leaves. Excess nitrogen may cause poorly colored fruits, retarded ripening and poor fruit quality(7).

It is usually undesirable to add mineral fertilizer before the tree has become established and started growth. Following growth initiation, 0.1 of a pound of nitrogen in a 3-foot circle around the tree should be beneficial the year of establishment. About one-tenth pound of nitrogen per year of age per tree is usually satisfactory(3).

Pecans react differently than fruit trees. Differences in yield quality of nuts may not be observed until the second or even the fourth growing season after annual applications are started. Differences in tree growth and yield, however, are cumulative with annual application(4). The rate is also higher than with fruit trees. For bearing trees, apply 1/4 to 1/3 of a pound of actual nitrogen per inch of trunk diameter measured three feet above ground level. For mature trees, 100 to 150 pounds of nitrogen per acre is recommended(4). Do not apply nitrogen after June. Fertilizing after June will delay nut maturity and encourage vegetative growth which is susceptible to winter injury. If cover crops are grown, their needs should be considered separately.

Pistachios require even more nitrogen. One pound of actual nitrogen per tree applied in the early fall, or as a split application in fall and early spring, should provide the needs for bearing trees(5).

The time of fertilizer application depends on several factors. When there is a program of continuous nitrogen fertilization, the application time is not too critical(7). However, in general, spring applications appear better than fall, and split applications, particularly on lighter soils, are better than a single large spring application(8).

Phosphorus

Fruit trees, unlike crop plants, are seldom deficient in phosphorus, appearing to get enough from the soil even when soil tests show very little available phosphorus. Field tests have shown that fruit trees will grow very well in soils where annual plants die without phosphorus fertilizer. This element is rarely needed as an applied nutrient for western orchard trees (7)(8). Leaf analysis in midsummer showing a phosphorus content of only 0.1 percent was obtained from trees showing satisfactory growth. A purpulish bronze leaf color has sometimes been associated with phosphorus deficiency(7). An exception to the above occurred in a peach orchard established on freshly cleared land containing less than five pounds of soluble phosphate per acre. Here phosphate fertilization resulted in increased tree growth, better fruit quality, and more marketable fruit.

Potassium

In contrast to phosphorus orchard trees need potassium. This has been demonstrated with practically all fruit tree species. Many New Mexico soils are high in potash. However, investigations have shown that potash deficiency is more common than realized(7).

Potassium correction in soils of western orchards generally require massive applications of potash fertilizer. This is due largely to high fixation in the surface soil, absence of tree roots near the surface in summer, and overabundance of calcium and magnesium. These massive applications are frequently effective for five or more years. Small amounts applied annually seem to be ineffective(7). The following table provides a guide to leaf symptoms of potash deficiency and a leaf sampling schedule for six major fruit crops.

A Guide: To Potash Hunger Symptoms and Leaf Sampling Schedule(7)

Crop	Symptoms of K Hunger	Place to Take Sample	When to Sample	Hunger Evident
Apple	Leaf scorch first on basal shoot or spur leaves, progressing toward younger leaves as season advances. With continued deficiency, leaves become small, trees remain stunted, fruits fail in size.	Matured leaves on spurs, or leaves near base of current year's growth.	June 15 to July 15	When sample leaves analyze less than 1.0% K.
Apricot	Leaves tend to roll upward, lacking dark green color. Foliage tends to be sparse, shoot growth reduced. Marginal scorch frequently results. Die-back in severe cases. Yields and fruit size reduced. Threshold value higher since apricot leaf contains more K than other stone fruits.	Matured leaves on spurs, or leaves near base of current year's growth.	June 1 to July 15	When leaves, analyzed by standard procedure, show less than 2.0% K.
Prune and Plum	Leaf scorch on both Japanese (P. salicina) and European (P. domestica) types. Excessive bearing (especially in prunes) intensifies severity of leaf scorch and resultant die-back. Fruits small and poor in color. For complete correction, control of cropping must sometimes be considered in addition to potassium applications.	Matured leaves on spurs or leaves near base of current year's growth.	June 15 to July 15	When sample leaves analyze less than 1.0% K -realizing symptoms and leaf analysis can fluctuate markedly with alternate of light & heavy crops.
Peach	Generally not evident until late summer, intensified by heavy bearing. Longitudinal upward rolling of leaf most evident on terminal growth. First few basal leaves on a shoot frequently normal. Rolling more definite & distinct with proximity to terminals. Leaves pale green, showing some scorch along edges when rolling severe. Fruits small, poorly colored, ripen earlier than on normal trees.	Matured leaves near base of current year's growth.	June 15 to July 15	When sample leaves analyze less than 1.0% K.

Crop	Symptoms of K Hunger	Place to Take Sample	When to Sample	Hunger Evident
Pear	Leaf rolling combined with silver brown discoloration of exposed underside of leaf. Leaves smaller, pale green. Tree sparse, shoot growth weak. Distinctly smaller fruits mature earlier. Leaf symptoms may not be distinct until harvest time.	Matured leaves on spurs, or leaves near base of current year's growth	June 15 to July 15	When sample leaves analyze less than 0.7% K.

Micronutrients

Of the 16 essential plant nutrients, 7 are known as micronutrients. These are copper, chlorine, zinc, iron, boron, manganese and molybdenum. Micronutrients are as important as the major nutrients. A deficiency of any one of these nutrients will limit plant growth and production even if all other essential nutrients are available in adequate quantities(10).

Due to the high pH of many soils in New Mexico, these minor elements are often held in a form unavailable to the trees and deficiency symptoms are common. When the pH is lowered, these elements again become available. The following table shows the soil pH needed for maximum availability of essential elements including the micronutrients(9).

Soil pH for Maximum Availability of Essential Elements

Essential Elements	pH
Nitrogen	6 to 8
Phosphorus	6.5 to 7.5
Potassium	6 to 9
Sulfur	6 to 9
Calcium	7 to 9
Magnesium	6.5 to 9
Iron	below 5 to 6
Manganese	5 to 6.5
Copper and Zinc	5 to 7

Extremely small amounts of these elements are required. At only slightly higher levels than the minimums required, some of these micronutrients become toxic. Consequently, caution must be used when applications are made. Due to the extremely small amounts needed, many of these elements are applied as foliar sprays.

Leaf sprays are more likely to cause injury due to slight excesses than are soil applications. There is a very narrow margin between sufficiency and toxicity with sprays. The manufacturers' recommendations should be followed very closely(11). Chelate compounds are normally used to provide the missing nutrient when soil applications are made. These compounds are less subject to being tied up in the soil and the nutrients are more available to the plant than other nutrient containing compounds. Chelates

can also be applied as foliar sprays. Plant response may take several months with soil application although in many cases results are obtained in a month or less(11).

Iron - Iron chlorosis in plants is characterized by yellowing of the leaves while veins and mid-ribs remain green. The yellow is caused by a failure of the chlorophyll to develop normally. Mildly affected plants become unsightly and grow poorly. Severely affected plants fail to grow, flower, or fruit. Very severely affected plants die from a lack of iron(12).

In New Mexico soils, the greatest problem in iron deficiency arises from high soil pH (10). Large applications of soil sulfur, 2500-5000 pounds per acre, have corrected iron chlorosis in several peach orchards for 3-5 years (7). This lowers the soil pH and consequently frees the iron so that it becomes available for plant use. Excess water or excess lime may also result in tying up the iron so that deficiency symptoms occur.

If you have decided on soil treatment to control chlorosis, treat the soil in winter or early spring while the plants are dormant. Treatment at this time is safer and more effective than treatment during the growing season(12). Depending upon the type of soil treatment applied, follow the directions on the package closely to avoid mistakes which could damage the trees.

Boron - This nutrient plays an important role in plant growth and is associated with cellular activities that promote maturity and increase flower set, fruit yield and quality. It is also essential for germination of pollen gains and growth of pollen tubes as well as seed and cell wall formation. It is also an important element in sugar translocation and protein formation within the plant(10).

There are generally narrow limits between adequate levels of boron and toxic levels. Boron toxicity can occur when irrigation water contains more than 1-3 ppm boron. Pecans, plums, pears, peaches, apples and cherries, all have a low tolerance to boron. Boron toxicity symptoms are similar to deficiency symptoms of copper and manganese. Consequently, it is advisable to analyze both soil and leaf tissue before applying corrective measures (10).

Once boron is taken into the plant and incorporated into a compound, it remains at that location in the plant. Consequently, a continuous supply is required to fill the plants needs. Because of its unique role, a deficiency in fruit trees may result in lower fruit quality rather than reduced plant growth. The following table provides some of the symptoms for specific fruits and the suggested treatment to correct the deficiency(14).

Fruit	Symptoms	Suggested Pounds Boron per acre
Apples	Pitting, skin discoloration, cracking, corking.	1 to 3
Pears	Blossom blast, pitting, internal corking, bark cankers.	1 to 2

Fruit	Symptoms	Suggested Pounds Boron per acre
Grapes	"Hen and Chick" symptom, dead main shoots.	1.5 to 3
Apricots	Twig dieback, failure of fruit to set.	2 to 3
Plums-Prunes	Fruit cracked, beads of gum internally or on skin.	2 to 4

Copper - This nutrient is generally found in soils in adequate amounts to provide plant needs. General copper deficiency symptoms include stunted growth, dieback of terminal shoots, poor pigmentation and wilting and eventual death of leaf tips (10, 15).

Again copper must be continually supplied to the plant as it is immobile once it has been used by the plant. It is an activator in several enzyme systems, protein synthesis and chlorophyll synthesis(10). The following table provides more specific visual symptoms for some fruits(16).

Fruit	Visual Symptoms
Apple	Terminal shoots which have been making vigorous growth die back. Terminal leaves develop necrotic spots and brown areas, followed by withering and death of shoot tips; the following season, growth is resumed by buds below the point of death. Repetition of the dieback over a period of years causes affected trees to have a bushy, stunted appearance.
Apricot	Terminal branches die back from tips, preceded by cessation of terminal growth; there is rosette formation and multiple bud growth on terminals.
Peach	The first symptom of copper deficiency is the occurrence of unusually dark green foliage. As the deficiency becomes more acute, the leaves turn yellowish green between the small veins, giving the appearance of a green network on a whitish green background; malformed leaves develop at the tips; these leaves are long and narrow, with irregular margins. Terminal branches die back, starting at the tips. This is preceded by cessation of terminal growth; there is rosette formation and multiple bud growth on terminals.
Pear	There is death and withering of the terminal leaves and current shoot growth, from tips toward points of origin. The following year, one or more shoots may develop from buds below the dead part of the previous year's growth; these may grow normally for a time, until the dieback is repeated. In severely affected trees, terminal growth is stunted, leaves are small, the trees are not fruitful and the recurrent dieback and renewal of growth may cause a bushy, "witches-broom" appearance. The bark of the twigs and trunk is rough.

Plum	Early growth in the spring is normal, but about two months following full bloom, the terminal buds die and the terminal leaves turn a yellowish color. Eruptions and gumming of the bark occur.

Deficiency symptoms for copper are easily confused with those of other micronutrients. Consequently, suspected deficiencies should be confirmed by tissue analysis before attempting any corrective treatment.

Manganese - This nutrient works as an enzyme catalyst in several reactions in the plant. It also functions in the formation of riboflavin, ascorbic acid, carotene and chlorophyll formation. The latter produces its most visible deficiency symptom, a yellowing between the veins of the leaves. With a severe deficiency the entire leaf becomes yellow and dead spots may drop out resulting in a shot hole appearance (7, 10, 13). Poorly drained soil may result in a build up of manganese in the plant sufficient to cause toxicity symptoms. These are characterized by a puckered appearance of the leaves between the veins and a speckling of older leaves. Apple trees will show an internal bark necrosis(10). Tissue tests should be made prior to treatment.

Molybdenum - This nutrient is essential for protein synthesis within the plant. It is also essential for other functions which are not yet fully known. Deficiency symptoms on broadleaf plants are leaf cupping and marginal chlorosis. In some fruits, chlorotic spots appear on the leaves(10). However, soils with pH values greater than 6.0-6.5 rarely require molybdenum and since most soils in New Mexico are well above this level, it is rarely required as a nutrient supplement.

Zinc - This is the most important micronutrient in western orchards(7). Zinc is involved in the formation of plant growth hormones and is needed for chlorophyll production. It also aids in protein synthesis, hastens plant maturity, plant height and seed formation (10). Stone fruits such as peach, cherry and plum and nut trees such as walnut and pecan are extremely susceptible(13).

Deficiency symptoms include the yellowing of interveinal areas of the leaves starting with the older leaves first. Plants are often stunted with shortened internode growth. Symptoms can easily be confused with those caused by other micronutrients. However, only a lack of zinc results in a chacteristic rosetting or little leaf clustering of leaves at the top of the branch while the stem is largely bare (4, 7, 10, 13). In final stages of the disease, the shoots die back from the tips. Usually the dieback is confined to the current year's growth. Seriously affected pecan trees rarely bear nuts. Nuts that are formed are usually small and poorly filled. Fruit trees bear little fruit, often misshapen and of poor quality (17). The following table again provides the deficiency symptoms for common orchard crops (10).

Fruit	Deficiency Symptoms
Apple	Leaves developing in spring characterized by whorls of small, stiff, and sometimes mottled leaves near tips of current season's growth. Except for terminal rosettes, twigs are bare for some time. Later, branches may arise below twigs and produce

almost normal leaves early that later become mottled and misshappen. Fruit bud formation is reduced. Developing fruits are small and malformed. Twigs may die back after first year.

Apricot — Leaves show interveinal yellowing and "little leaf" and other symptoms described under "Peach."

Cherry — Interveinal yellowing, "rosetting," and leaf malformation result from zinc deficiency. In severe case, dieback of leaders occurs.

Grape — Yellowing occurs between veins of leaves, "little leaf" shows up in early summer, "hen and chicken" and barrenness of fruit stems result.

Peach — Leaves show interveinal yellowing with mottling progressing upward from lowermost leaves. Leaves are narrow and more or less crinkled. Twigs are short, and internodes near tips produce rosettes of leaves. Defoliation progresses upward. Fruit bud formation is drastically curtailed. Fruits are few, misshapen and worthless. Fruit drop may occur without the appearance of other symptoms.

Pear — Shoot growth is dwarfed, and internodes become progressively shorter until leaves are only carried as bushy rosettes on terminal growth. Leaves are small and narrow and may show some interveinal yellowing. Fruit is severely dwarfed.

Pecan — Leaves show a yellow mottling between veins; the regions along margins and veins may remain green. Sometimes only one or two branches are affected. Later, leaves may show bunching because of the shortened axis at twig ends, giving rise to pecan "rosette." Older leaves may have mottled areas which turn reddish-brown and die, thus causing many small holes in leaves.

In summary, there is a distinct possibility that orchards in New Mexico will exhibit deficiency symptoms for one, or more, micronutrients. Due to the similarity of the symptoms, it is almost impossible to determine which micronutrient is missing without testing. It has also been determined that tissue testing of leaves is most reliable in determining the presence of the nutrient in the plant in sufficient quantities. However, a soil test will determine the amount of nutrients in the soil as well as determining the pH. By using both soil and tissue testing, fertilizer applications can be made with more precision and with less chances of developing a toxic level in the soil.

Disease & Insect Control

For commercial production in orchards, disease and insect control is essential. Insect and disease problems vary between orchards, varieties, and the objectives of the individual grower. Due to these differences, and the rapid development of new pesticides, the control of insects and diseases in commercial orchards should be studied continuously by individual growers(18). Insects can severely damage the fruit and weaken or kill

trees. The grower must be watchful for insect infestations throughout the year and should be prepared to apply control measures as soon as they are needed.

The success or failure of a spray program is not only due to the application of the proper chemical, but also to a number of management practices. Keeping trees healthy by watering, fertilizing and proper pruning is a major part of insect control. Weak trees attract wood-boring insects and are not able to recover from insect attacks as well as healthy trees. Prunings and all dead wood should be destroyed. Branches that die or become weak during the growing season should be removed at once or at least marked so they can be recognized during normal pruning . Do not water or fertilize late in the growing season as young tender wood is easily damaged by cold and then attracts borers. Proper timing of spray applications and a thorough coverage are essential for quality fruit production. Spray coverage may be improved through good pruning practices. Spraying failures are often due to improper application. To summarize: For good pest control, apply the right amounts of recommended pesticides in enough carrier to give thorough coverage, at the right time, and keep your orchard clean and healthy (18, 19, 20).

There are a large number of insects which can cause damage to fruit trees in New Mexico. The following table lists the major damaging insects and the type of fruit which they normally damage(4, 18, 19, 20):

Apple & Pear

Codling moth (apple worm)
Apple aphids
Leafrollers
Apple leafhoppers
Buffalo tree hopper
Three-cornered alfalfa hopper
Fall webworms & tent caterpillers
Cutworms

Peach, Plum, Apricot & Nectarine

Peach twig borer
Green peach aphid
Green June beetle
Pear or cherry slugs

Pecan

Black pecan aphid
Black-margined aphid
Fall webworm

All Stone Fruits

Peach tree borer
Shot hole borer
San Jose scale

All Fruits

Spider mites (several species)
Plant bugs (box elder bug, stink bug, lygus bug, leaf-footed bug, etc.)

For detailed information on specific insecticides, time and method of application, etc., numerous publications are available to provide guidance. Depending on the fruit where control is needed, a grower can easily determine the required information to insure adequate insect control.

There are also a large number of diseases which can damage fruits in New Mexico. The following table lists some of the major diseases and the fruit they damage(1, 18, 19, 21, 22, 23, 24).

Apples or Pears

Apple scab
Powdery mildew
Cytospora canker
Fire blight
Crown gall
Collar rot
Root rot
Blister bark

Pistachio

Verticillium Wilt
Crown rot
Root rot

Peach, Apricot, Plum & Cherry

Brown rot
Bacterial canker
Cytospora canker
Scab
Bacterial spot
Peach Leaf Curl
Crown gall
Root rot
Little Peach
X-Disease
Phony disease
Peach mosaic

Numerous publications are available to provide guidance for detailed control of specific diseases. Due to the numerous changes in chemicals used for disease control, check with the County Extension agent or pesticide dealer for the latest information available.

For commercial fruit production, a regular schedule of spray applications is required to insure disease free fruit without insect damage. These normally include one or two sprayings while the tree is dormant to control certain insects and diseases and then, starting in early spring, with regular spray applications until close to harvest. These regular applications are called "Cover" sprays. Most applicators try and select an insecticide which is compatible with a fungucide and both are applied at the same time.

As an example, apple orchards require a cover spray every 10-14 days. In apples, it is important that sprays be applied at specific points during bud development. These development points have been given specific names which are commonly referred to in the literature. Figure 1 gives these names and provides a picture of the stages of development(21).

Most applicators keep detailed records of the dates a spray was applied along with the amounts and types of chemicals. If at harvest time a specific disease or insect has caused damage, they can then review the data and make any needed changes.

Pruning

Pruning has been described as "Removing certain parts of the tree in order to modify and utilize its natural habits so that more and better fruit can be obtained at less cost and over a longer period"(25). Pruning is one of the most puzzling management practices to many fruit growers. When you understand the reason for pruning, the decisions may become easier.

Young non-bearing trees should be pruned to develop a strong framework (scaffold) which will be able to support the fruit crop as the tree matures. This is called "Training" pruning. Pruning older bearing trees is done to thin out crowded branches, control the height of the tree, and maintain fruiting wood within the established framework developed by the training pruning(26, 27).

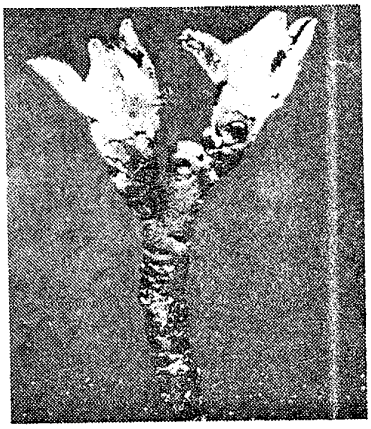
FIGURE 1 (21)

Stages of Apple Bud Development

Dormant

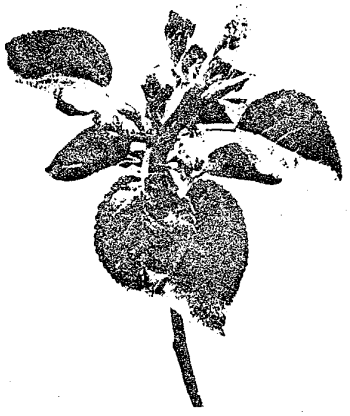
Silver-tip

Green-tip



Delayed-dormant (½" green)

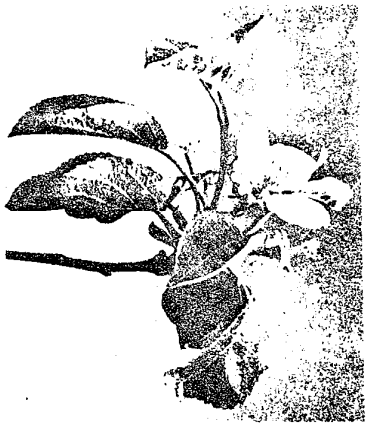
Tight-cluster



Open-cluster

Pink

Full-bloom



Petal-fall

Limbs that grow at a wide angle from the trunk, about 45 to 75°, are much stronger and will carry more fruit without splitting than a limb with a narrow angle from the trunk. Most pruning is done during the dormant season, just before active growth begins in the spring. At this time, pruning wounds heal fast, flower buds are easily recognized, and injury from low winter temperatures may be avoided(78).

Pruning Young Trees

There are two major types of pruning generally in use today, the leader type and the modified leader type. The leader type of tree is one in which a central trunk is maintained. The leader should be at least 12 inches longer than the scaffold limbs. Branches that are out-growing, or equal to, the leader should be cut back(27).

In the modified leader system, the main trunk is allowed to grow until the third or fourth season when the scaffold limbs have been established. Then the leader may be cut back above the topmost scaffold. Most apples are pruned in this manner as are many pecans and walnuts.

The first pruning should be done at the time the trees are planted. A new tree may have numerous branches on it. Select three or four branches that are evenly spaced around the tree for balance, and with at least four inches vertically between branches. Remove the other branches. When branches are selected at the same vertical location on the trunk, a much weaker scaffold is developed than if there is a short vertical distance between scaffold limbs.

Pistachio trees require a more strict pruning system than most other fruit and nut trees. Training generally starts the second year after planting. New trees are generally staked up and the first scaffold branch should be at least 36 to 40 inches from the ground to enhance mechanical harvesting. A modified leader system having three well spaced scaffold branches is the ideal framework structure for pistachios(5).

After the second spring and until the tree is in a bearing condition, only a light "thinning out" pruning should be needed. Delayed bearing may result from overpruning young trees. The lighter the pruning of young trees, as long as a proper framework of scaffold branches is formed, the sooner the tree will become fruitful.

Pruning Bearing Trees

A certain amount of pruning is needed each year to insure a constant renewal of fruit wood, to thin out crowded branches, and to control the height of the tree. A properly thinned tree also allows for easy to complete spray coverage. Thinning also allows light into the interior of the tree which results in fruit bud formation. Without sufficient light in the interior, all of the fruits are borne on the outer perimeter of the tree.

Most fruit buds are borne on either comparatively long shoots of the past-season one year wood or on comparatively short shoots called "spurs." Most spurs grow less than four inches in a season. Some spurs are short to medium lived, lasting from one to eight years, while long lived spurs will live from 10-20 years. Figure 2 shows some typical spurs with fruit

FIGURE 2 (25)

Fruit and leaf buds on:

Apricot

The fruit spur on the left is two years old, that on the right, one year. Bud scale scars are shown at W; scars where fruits have been produced at X; fruit buds at Y; leaf buds at Z.

Plum

Fruit spurs are, left to right: Robe de Sergeant (European), Wickson (Japanese), Yellow Egg (European). The small, roundish fruit buds on the Wickson are characteristic of Japanese plums. The Robe de Sergeant has a more compact spur system than most European plums.

Pear

A terminal fruit bud is seen at A on this three-year-old portion of a pear spur. Two lateral leaf buds are marked B. Fruit was produced at C during the season preceding that when buds A and B were formed. Growth of B buds will give rise to characteristic branching of older pear spurs.

and leaf buds identified for several common species. To be able to prune fruit trees intelligently, one must know the fruiting habits of the various species. The following table shows where the fruit buds develop for several species(25):

Portion of the Crop Borne on Buds in the Various Positions.

Fruit	Lateral on long shoots	Terminal on long shoots	Lateral on spurs	Terminal on spurs
Apple	Minor	Very minor	-	Major
Apricot	Minor	-	Major	-
Cherry, sour	Major or Minor	-	Minor or major	-
Cherry, sweet	Minor	-	Major	-
Nectarine	Major	-	Minor	-
Peach	Major	-	Minor	-
Pear	Minor	Very minor	-	Major
Pecan	Minor on young trees	Major on young trees	Minor on mature trees	Major on mature trees
Persimmon	Major	Minor	-	-
Pistachio	Major	-	-	-
Plum, European	Very minor	-	Major	-
Plum, Japanese	Minor	-	Minor	-

Studies in California have shown that the pistachio does not respond to conventional pruning procedures. Since the fruit buds are borne laterally on shoots, new growth must occur each year for maximum nut production. On unpruned trees, this results in a continual spreading until eventually all of the production is at the perimeter of the limbs which are bent out of position by the weight of the nuts. However, a bearing pistachio tree produces only a few lateral vegetative buds. Consequently, when a branch is headed back in pruning to force new growth, with no lateral vegetative buds present, the portion remaining dies back to a lateral branch. Removal of all terminal buds by the heading-back type of cut is necessary to stimulate renewal growth from the scaffold branches(5).

Occasionally, a situation arises where a tree has not been pruned for a number of years and large branches need to be removed to properly shape a tree. To prevent damage to the tree, the first cut on a large limb should be on the underside about six inches past the desired removal point. Cut about a fourth of the way through the branch or until the saw starts to bind. The next cut should be two to three inches farther out on the branch. When the weight of the limb causes the branch to break, the cut on the underside will prevent bark, or large splinters, from peeling back down the trunk.

This will leave a short stub which can then be removed with a final cut. The final cut should be made perpendicular to the limb direction just past the slight swelling that normally is apparent around the base of the limb. This swelling around the base of the limb is called the "collar" and it is made up of cells which will form a protective callus "scar" over the wound.

In New Mexico, there is no need to treat pruning wounds. In more humid areas, where wood decay fungus organisms are prevalent, a fungicide is used to prevent decay organisms from entering the tree. Any other treatment only slows the formation of the callus tissue.

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