

PRUNE CULTURE IN CALIFORNIA¹

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Prunes are grown in nearly every part of California.³ Some of the most important considerations affecting the choice of a location are given in this circular. The oldest and most important prune sections are located in the central coast counties. Increased acreages of this fruit are yearly being brought into bearing in the central districts and in the great interior valleys. In the mountain districts, immediately upon the coast, and in the extreme southern part of the state, however, the commercial production of this crop is not of much importance.

Prunes are grown on a variety of soils. The chief requirements are that the soil be reasonably fertile, easily worked, and preferably at least six or eight feet deep. On the fertile valley soils the trees eventually grow to larger size than on the shallow soils often found in the foothills. Hardpan closer than six feet from the surface is often indicated by stunted trees which have a tendency to mature their leaves and fruit comparatively early.

An unfailing source of water for irrigation is of utmost importance. Formerly prunes were grown in many districts without irrigation, but this practice is being rapidly superseded by a cultural system that includes at least one or two waterings during the growing season. Without water during the growing season, the crop runs to small sizes, particularly when the set is heavy.

The prune requires a long season of clear warm weather for proper maturity. Foggy regions adjacent to the ocean or to San Francisco Bay are not, as a rule, suited to its needs. The location should be free from late spring frosts and early fall rains. Local observations by old residents are often of great value in considering these factors. Late spring frosts may seriously reduce the crop, although this danger is not so great with prunes as with other tree fruits which blossom early. In a few districts subject to late spring frosts, but otherwise adapted to growing prunes, orchard heaters have been used successfully to

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³ For a complete discussion of prune-producing districts in California, see: Shear, S. W. Prune supply and price situation. California Agr. Exp. Sta. Bul. 462:1-70. 1928.

reduce the damage from this cause. Early fall rains interfere with the picking and drying operations. Dehydraters are now coming into use where fall rains may be expected. In some sections the growers are using dehydraters to cure the entire crop.

CHOICE OF NURSERY STOCK

Fully mature, one-year-old trees are best for general planting. They should be free from insects and disease. Trees affected with crown gall, indicated by warty swellings on the roots, should not be planted under any circumstances. Data secured at the University Farm by the Division of Pomology show that the medium-sized tree, calipering one-half to five-eighths of an inch just above the union is the ideal deciduous fruit tree to plant. Smaller trees, if well grown and not diseased, may also be planted with success. Larger trees which measure an inch or more in diameter at the crown, with a corresponding development of lateral branches, do not make so satisfactory trees the first season as do the smaller sizes. Later observations showed that in many cases the smaller trees had actually surpassed the larger ones in diameter at the end of the second season.

Prunes are grown principally on three kinds of rootstocks: the myrobalan, the almond, and the peach. As a result of inquiries made by the Division of Pomology among the nurserymen of the state, it was found that in the years 1923 to 1929 the proportion of prunes propagated on the various stocks varied from 54.5 to 75.4 per cent on myrobalan; 16.5 to 38.2 per cent on peach; 2.3 to 9.6 per cent on almond; and 1.0 to 5.7 per cent on apricot. In addition a few trees on Davidiana were propagated in each of several years during this period.

The myrobalan stock is preferred for deep soils, such as generally occur on the valley floors. It has a wide range of adaptation and is successfully used on many different soil types. This stock is also considered to be adapted to locations where, at times, there may be too much water. The peach and almond stocks, as a rule, are considered best for the drier, gravelly soils. Peach stock is often preferred in the shallow foothill soils and in some of the sandy loams where the peach is known to do well.

The common varieties of prunes now being grown, with few exceptions, make strong unions with the foregoing stocks. Reports indicate that the Robe de Sergeant does not show a strong affinity for either the peach or almond root. Furthermore, certain varieties of prunes are apt to make a poor union with apricot rootstocks.

PLANTING AND CARE OF YOUNG ORCHARDS

The ultimate necessity of irrigating the prune orchard should be carefully considered before planting. Young prune orchards in many districts are often grown successfully without irrigation for the first four or five years. For the bearing orchard, however, the long dry California summers make irrigation imperative in most sections. The orchard should, by all means, be prepared for irrigation before the trees are planted. The alfalfa grower does not wait until after the crop is planted before leveling his land. Why should the prune grower not prepare his land before planting? Water does not run uphill in a prune orchard any more than in an alfalfa field. Proper preparation before planting means a great saving in money and labor in the end.

Prunes are usually planted on the square system, from 22 to 25 feet apart. The shorter distance is used where the soil is shallow or of a sandy nature. The size of mature trees under similar conditions affords the grower an indication as to whether or not this distance is right. On the deep, fertile soils, 25 feet should be the minimum. Some growers prefer 27 or even 30 feet, under the latter conditions. With the hexagonal system, where each tree is equally distant from all immediately surrounding trees, about 15 per cent more trees may be planted than with the square system. The number of trees per acre for the square and hexagonal systems is as follows:

Distance apart in feet	Trees per acre, in square system	Trees per acre, in hexagonal system
20 x 20	108	124
22 x 22	90	104
24 x 24	76	87
25 x 25	70	80
26 x 26	64	74
28 x 28	56	64
30 x 30	48	55

Trees should be planted as soon as the winter rains have moistened the soil to a depth of 2 or 3 feet. January and February are the best months. Planting may be done as soon as the trees are received from the nursery and the ground is in suitable condition. Prunes have been planted successfully as late as March or even the first of April, but such late planting is not advisable if it is possible to do the work earlier. It is important to have the young tree established and capable of supplying water to the leaves as soon as the latter begin to develop. Often late planted trees make a short growth which later withers and

dies. This growth is made at the expense of the stored food reserves in the buds and twigs. When this reserve is exhausted no further growth can be made unless the roots have become established and are able to replenish the supply.

As soon as the trees are received from the nursery they should be removed from the bale and "heeled-in" in a sandy, well drained spot convenient to the orchard. A trench 12 to 14 inches deep and about 16 inches wide is suitable for this purpose. One side is left sloping at a slight angle to the perpendicular. The trees are spread out and laid against this sloping side and loose soil is worked down between the roots. The entire root system is then covered to a depth sufficient to prevent drying.

In planting, the hole is dug large and deep enough to hold the roots conveniently. The tree is usually planted so that it will stand at about the same depth at which it grew in the nursery. Many trees have been injured by too deep planting, especially where the soil is heavy. If the soil is light and there is danger of the wind blowing the soil from the roots, the tree should be planted slightly deeper. The soil should be worked between the roots and firmly tramped. Success in planting depends largely on setting the trees firmly. The top two or three inches of soil should be left loose. The use of dynamite is unnecessary, except, possibly, where there is an impervious layer a few feet below the surface. After setting and straightening the young trees they should, if straight whips, be cut off 24 to 30 inches above the ground. Whitewash applied immediately after setting is a valuable measure against sunburn.

A convenient method of planting trees to secure straight rows is by means of a planting board. The planting board is simply a piece of scantling about five feet long and four inches wide. Notches two inches deep are cut in the middle of one side and in the middle of each of the ends. The apexes of these notches then lie in a straight line bisecting the board from end to end. The field is staked, placing a stake for each tree to be planted. The planting board is then placed with the notch in the side held snugly against the tree stake. A second and a third stake are next driven in the ground in the apex of each end notch, taking care to set each one firmly so that there can be no movement of the board between them. The board is then removed, the tree stake pulled up, and the hole dug. In planting, the board is replaced between the end stakes and the trunk of the tree is held in the notch formerly occupied by the tree stake. With the roots in the proper place, the tree is planted and the board removed. The tree is

thus planted in the position formerly occupied by the tree stake, and consequently in line with the other trees.

Intercrops may be used in the young orchard. The trees do not need all the space between rows for several years. Intercropping is desirable from the standpoint of producing an income before the trees come into bearing. The crops used for this purpose are usually strawberries, peas, tomatoes, or some other truck crop. The intercrop should not be planted closer than four feet from the row the first year, or closer than six feet thereafter. Grain or hay is undesirable. Very few instances of growing young trees in alfalfa have ever been successful. Intercropping should not be practiced, as a rule, more than three years. At the end of this time the trees need more room, and, furthermore, cast so much shade that the intercrops do not grow well.

Effort should be made to keep the young trees growing vigorously. The plowing and subsequent cultivations for the intercrops are usually sufficient for the trees. Where berries are the intercrop, the frequency of irrigation and the tramping of the ground, when wet by the pickers may cause the soil to puddle or run together. This condition should be avoided if possible by irrigating soon enough after one picking to allow the soil to dry out before the next picking. Diseases and insects should be held in check, as described later in this circular.

CARE OF MATURE ORCHARD

Mature prune orchards are usually plowed in the spring shortly before blossoming. The exact time depends upon the season, danger of attack from thrips, amount of rainfall, and the equipment available to the grower. After plowing, the orchard is ordinarily worked with the harrow and disk until the surface soil is loose and fine. Cultivation is practiced at intervals throughout the season whenever necessary. The work is done either by horses or by tractors. In recent years several satisfactory orchard tractors have been perfected, and these are coming into extensive use. A thorough cultivation is usually given after each irrigation. Immediately before harvest the ground is either planked or cultivated with a fine-toothed implement to make the surface as even as possible to facilitate picking, which usually begins in August.

The harvest season usually extends into October. As soon as possible after the last picking, the best growers give the orchard an irrigation. A cover crop is then sown as soon as the land can be worked. Various cover crops are used. Some growers simply let the native vegetation grow. Others use vetch, field peas, bur clover, *Melilotus*

indica, barley or rye. *Melilotus indica* gives evidence of being the best crop to grow if it can be seeded early. Otherwise barley, rye, or barley and vetch are sometimes used. Vetch is often attacked and stunted by aphid.

The various cover crops are seeded at approximately the following rates per acre: vetch, 60 pounds; bur clover, 20 pounds; field peas, 80 pounds; *Melilotus*, 20-30 pounds; barley, 50 pounds; rye, 50 pounds; barley and vetch, 20 and 40 pounds, respectively.

There is a difference of opinion among growers as to the value of commercial fertilizers in prune orchards. Furthermore, there are few definite, reliable experimental data on the subject. Barnyard manure is used whenever available. Its effect is usually very marked on the cover crop, and undoubtedly it improves the physical condition of the soil. Actual increases, however, in crop or growth of the trees, particularly in old orchards, may not be noticeable until after several yearly applications have been made. The only recommendations which can be made at this time are that the grower who believes his trees need fertilizer lay out a small block of trees and note the effect of the various fertilizers for a few years in comparison with trees not so treated.

Pruning is usually begun when the leaves fall and is continued throughout the winter whenever the weather permits. Oil sprays, when used, are best applied during January and February. If lime-sulfur is used, it is put on in early spring before the buds swell.

TOPWORKING

It is often desirable in caring for an old orchard to change the kind and variety of fruit grown. This is accomplished by grafting and is commonly spoken of as topworking. Almonds, peaches, and even apricots may be grafted with prunes, or one variety of prunes may be changed to another. The success of such an operation will depend upon the general condition of the trees to be grafted and the skill of the man doing the grafting. The first of these is by far the more important of the two. It is usually easy enough to secure the services of a competent grafter, or the grower may do the work himself. A careful inventory of the trees to be grafted should be made. The number of missing trees, as well as the old and the dying trees, should be noted in order to determine whether it would be better to graft or to pull out the old trees and replant. Ordinarily, almond and apricot trees may be grafted over profitably up to 15 or 20 years of age, pro-

vided they are in good condition. It is doubtful whether it would pay to graft peaches that are much over 10 years of age.

Topworking may be accomplished by grafting or budding. The former is the more common method, except where peaches are to be worked over. Peaches are best changed over by cutting back heavily and budding into the new wood. Usually the cleft or the bark graft is used. With young trees the whip graft, usually employed in nurseries, may be used. In budding, the top of the old tree is cut off. The buds are then inserted in the young growth that grows out from below the cut.



Fig. 1.—The cleft is made with a grafting chisel.

The procedure in grafting over an old tree is briefly as follows:

Select the branches to be grafted. These should show straight growth and should be preferably not more than 2½ inches in diameter. The number to be grafted on each tree will depend upon its size. With a tree 6 or 7 years old, 3 or 4 branches will be sufficient. With older trees, it will probably be necessary to use a larger number and to graft higher up than in the case of younger trees.

The selected branches are sawed off. With a grafting chisel, a cleft is made as shown in figure 1. The cleft is held open by the wedge on

the chisel (fig. 2). The scions are then cut wedge-shape as shown in figure 3. The cut surface of the scion should be about $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long for the usual sized scion and should be a true flat surface. The scions are then inserted, one at either end of the cleft (fig. 3), with the thin green cambium of the scion in contact with the cambium of the stock. Some grafters set the scions slightly on a slant to make certain that the respective cambiums touch. When the wedge is removed, the scions are tightly gripped in the stock. All cut surfaces of stock

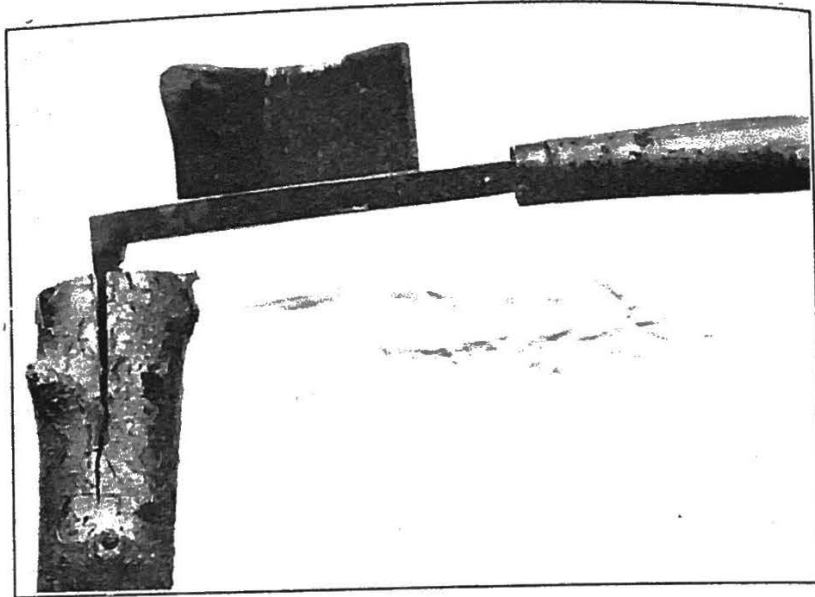


Fig. 2.—Wedge inserted to hold the cleft open until the scions are cut and placed in position.

and scion are then completely covered with grafting wax (fig. 4). Instead of splitting large branches (those 3 to $3\frac{1}{2}$ inches in diameter), it is best to notch them with a coarse saw, setting the scions one inch apart to facilitate healing of the wound.

At the end of the first season, if more than one of the scions on the stock grow, the superfluous ones are cut back to stubs an inch long. These greatly help the healing process where the old branch was cut off. The growth made by the scions is thinned out lightly the first year, and thereafter, and the cut surfaces carefully rewaxed or covered with asphaltum until healed.

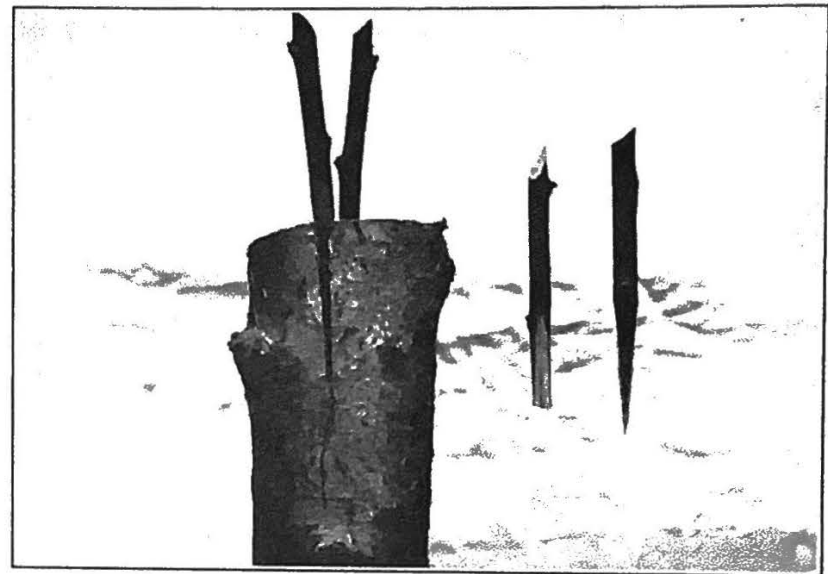


Fig. 3.—Scions in place and ready for waxing. Scions (on right) cut and ready for insertion.

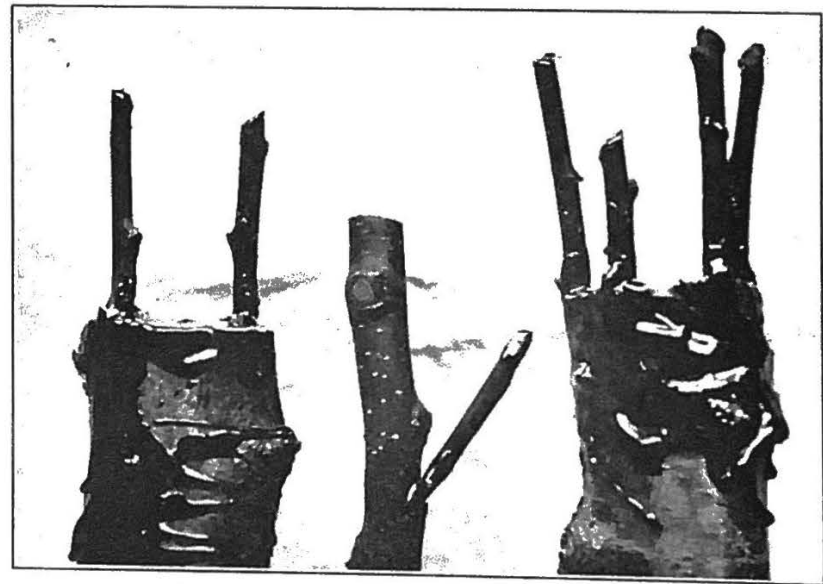


Fig. 4.—Different forms of grafts after waxing.

Not all prunes make strong unions with all stocks. French prunes usually have a strong affinity for myrobalan, almond and peach, but sometimes do not grow well on apricot. The Burton seems to unite well with the same stocks which make a strong union with the French.

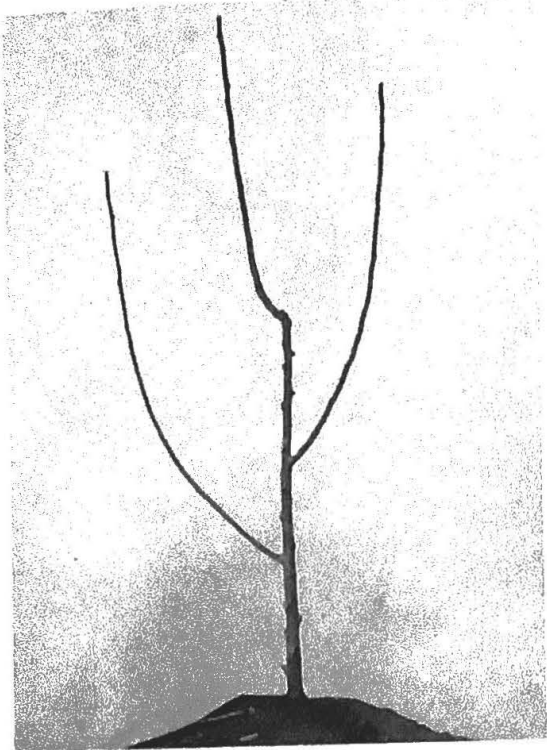


Fig. 5.—Branches should be spaced up and down on the trunk to avoid weak crotches.

The Sugar prune is reported as doing well on the myrobalan, almond, and apricot, but not always on the peach. The Imperial does well on myrobalan, but is uncertain on the other stocks. No rootstock has been found that is entirely satisfactory for Robe de Sergeant.

PRUNING

The young prune tree as received from the nursery is usually a straight whip without lateral branches. After planting, this whip should be cut back to the point at which the head is to be formed. The

best point at which to make this cut is from 24 to 30 inches from the ground. This pruning permits the formation of a low-headed tree with ample space between the main scaffold branches. The position of the head is largely determined by this first pruning. If the cut is made too high, a high-headed tree will result; if too low, the main scaffold branches will be too close together. A few nursery prune trees have lateral branches developed. The head may be formed from these

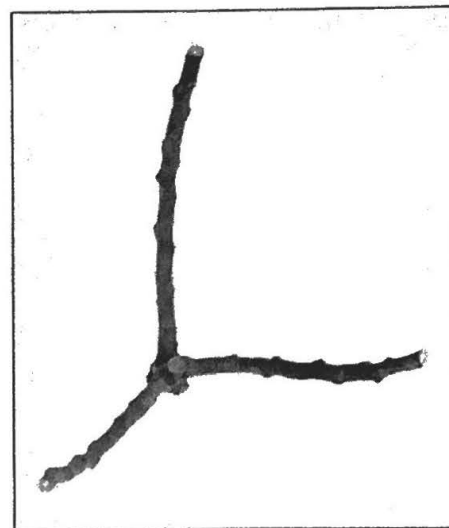


Fig. 6.—The young tree should have the branches evenly spaced around the trunk. This photograph, taken from directly above the tree, shows an ideal arrangement.

laterals at once if they are suitably located on the trunk. For spacing these branches, the directions given in the following paragraph for pruning one-year-old trees should be followed:

During the first season, time may be saved in shaping the tree by proper spring pinching. This pinching is solely for the purpose of training the young tree. It should not be confused with the summer pruning sometimes given to mature trees, which has for its purpose an attempted correction of the bearing habit. Summer pruning of the young tree should be restricted to pinching back undesirable branches early in the season. It is a distinct advantage to suppress branches at this time which, if left, would have to be removed in the winter

season. Moreover, growth is encouraged in the branches selected to remain. The method of pinching back certain branches in young trees is used solely for the purpose of hastening the process of building up the framework in the shortest possible time. Top worked trees during the first season should be pinched back in a manner similar to that just described for young trees.

The pruning given the first winter season determines the form of the young tree.⁴ Where no summer pinching has been given, the first shaping is done. If the tree has been summer pruned, however, the work at this time is materially lessened. The scaffold branches chosen at this time ordinarily remain throughout the life of the tree. The utmost care should be used to prevent mistakes. Generally, three scaffold branches are used (fig. 5). Some growers use four or even five branches, but in most cases this method brings the branches too close together, necessitating the removal of one or more large limbs later. It is desirable to have the first branch 12 to 15 inches from the ground, with the remaining two successively 6 to 8 inches above the one below. If possible these branches should be evenly spaced around the trunk so that no two come out from directly above, the three branches looking down upon the tree from directly above, the three branches should divide the space evenly (fig. 6). The three branches chosen to remain should be cut to 15 to 30 inches from their point of attachment to the main trunk. Branches not used for the framework should be cut off, except the short growths on the lower parts of the tree which should be left to shade and protect the trunk from the sun. No further cutting back, as a rule, should be done after the first winter.

Formerly the grower was advised to cut the tree back for two or three years in order to make it "stocky." Experiments at the University Farm show that this is not advisable. Prune trees which were not cut back were larger in diameter and had greater spread than those which had been cut back annually. Summer pruning, consisting of the removal of water sprouts from the center of the tree and of suckers from around the base, is advisable during the second summer. Winter pruning, during the second winter, should consist of cutting out branches where too close together and the removal of crossing or rubbing branches (figs. 7 and 8).

⁴ For more detailed directions for pruning see: Tufts, W. P. Pruning young deciduous fruit trees. California Agr. Exp. Sta. Bul. 313:1-44. 1919.

Tufts, W. P. Pruning bearing deciduous fruit trees. California Agr. Exp. Sta. Bul. 386:1-48. 1925.

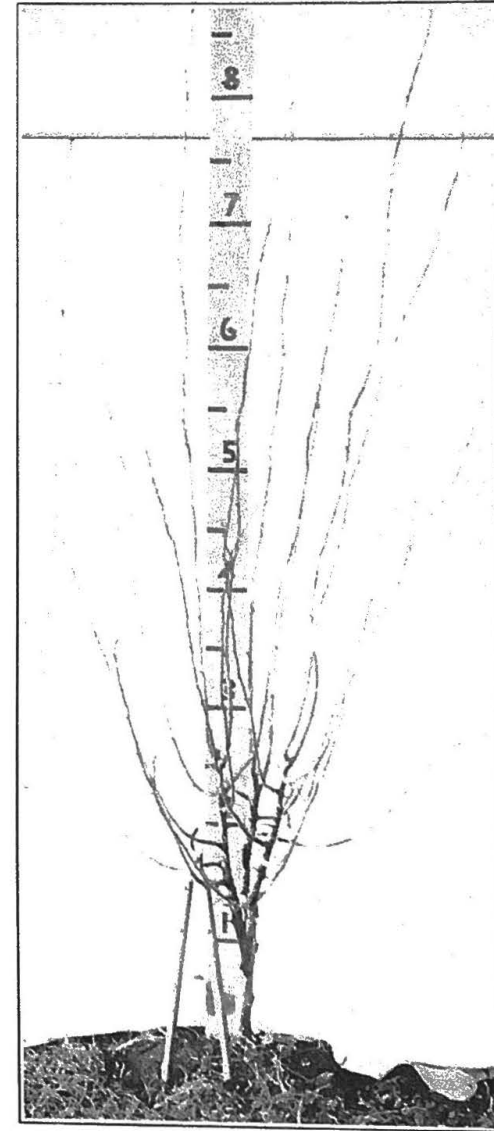


Fig. 7.—Two-year-old French prune tree which was cut back the first winter. (See fig. 8.)

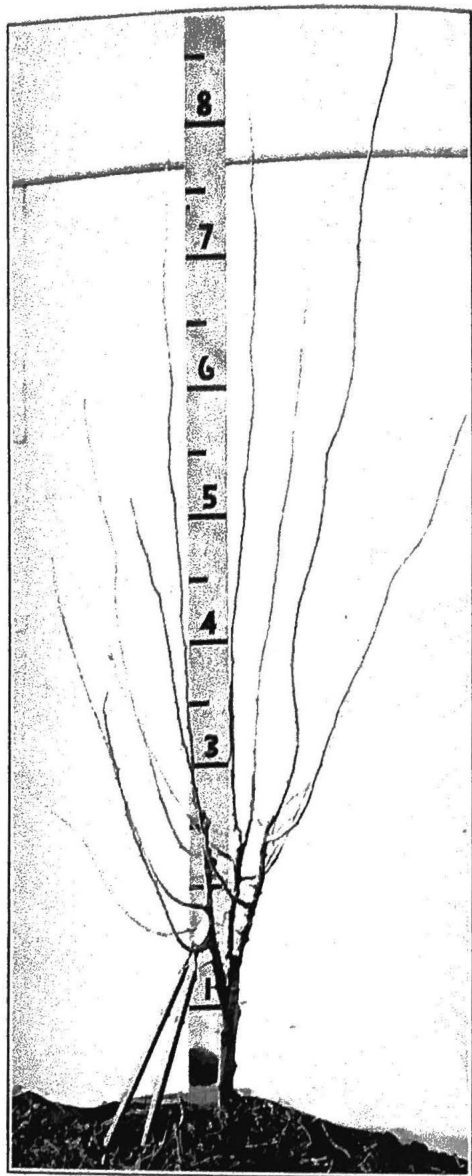


Fig. 8.—The same tree as in figure 7, after pruning by thinning out branches where too thick. This method of pruning is best with French prunes.

Pruning during the third and fourth seasons should be a process of thinning (figs. 9 and 10). Consideration should be given to the location and room allowed for development of each branch. Correction of wayward limbs should be made by cutting to a lateral growing in the desired direction. Care should be exercised to prevent the top from becoming too dense. Sunlight is essential for growth and for development of fruit spurs on the main branches. On the other hand it is not necessary to maintain the top of the prune tree as open as in the case of apricots or peaches.

After the first few years, the tendency among many growers is to practically cease pruning (fig. 11). No ill effects are noticeable from this practice for several years. In the meantime the spurs in the interior portions of the tree are killed by lack of sunlight, and the bearing area is forced outward until most of the fruit is produced by a comparatively thin shell of bearing wood on the outside of the tree. A severe pruning must then be given to admit light to the interior portions of the tree in an effort to reestablish bearing wood in those portions. This process is commonly spoken of as "opening up" a tree, and is unnecessary if the tree is given proper pruning from the start.

The pruning of mature prune trees is essentially a thinning process. Prune trees may be kept in bearing and sufficiently open to admit sunlight by a very small amount of pruning. This pruning, however, must be consistent and done annually. At the University Farm a small block of French prunes have been pruned in this way for a number of years (fig. 12). The amount of wood removed each year is small, yet the spurs in the interior portions of the trees are vigorous and thrifty. Furthermore, this pruning has been done by removing branches which did not average more than one-half inch in diameter. No large cuts are necessary.

A certain amount of new growth each year is desirable. Without it the bearing area is constantly diminished. Some spurs are lost each year through injury or natural causes. It is known also that the young spurs are more productive than the old. Consequently new growth upon which spurs are produced is essential to continued maximum production. The exact amount of new growth needed cannot be stated definitely. The grower may be safe in assuming that when the new growth on a majority of the growing points falls below 3 to 6 inches for several seasons something should be done to bring about greater growth. Longer growth may be obtained by a comparatively heavy thinning and by cutting back the leaders to laterals arising from the 3 and 4-year-old wood.

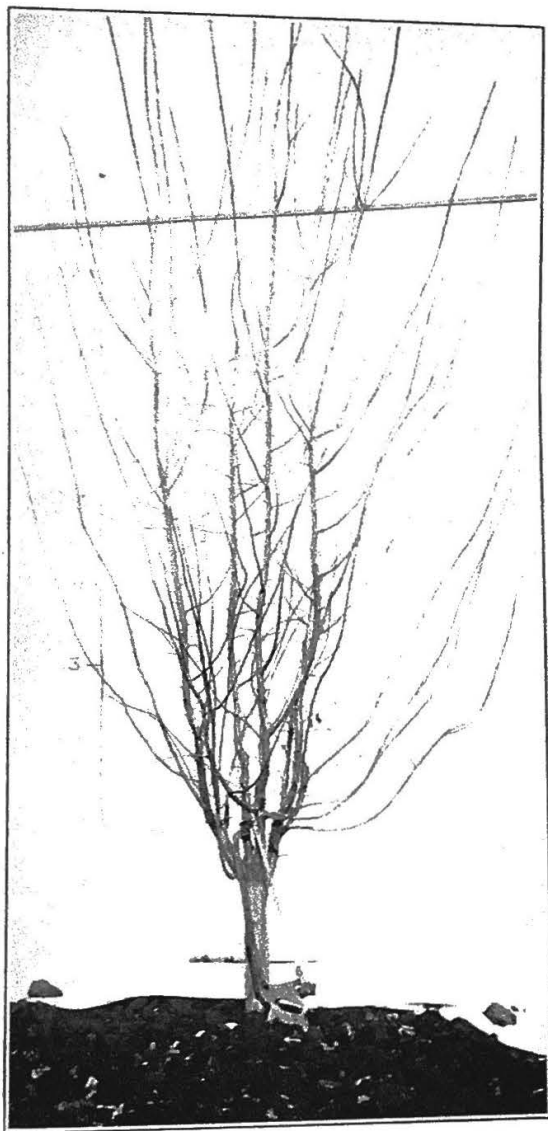


Fig. 9.—Three-year-old French prune tree which had been thinned the previous winter. Note the fruit spurs already formed on the main branches. (See fig. 10.)

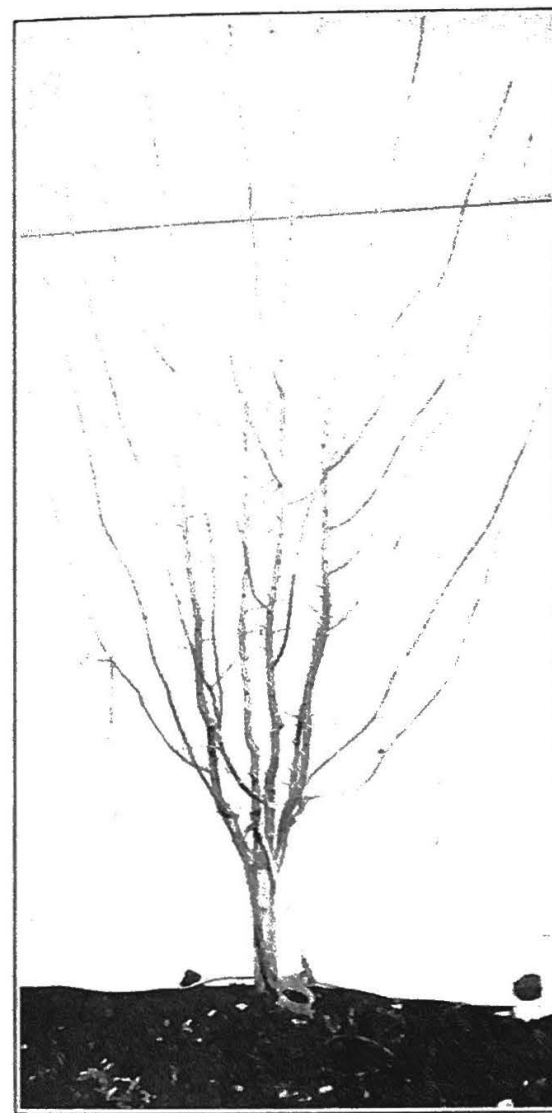


Fig. 10.—This three-year-old French prune tree (see fig. 9) was thinned to permit of full development of remaining branches.



Fig. 11.—Twelve-year-old French prune tree which has not been pruned for six years. The top is too dense and the spurs in the interior are losing their vigor.

REJUVENATION OF OLD ORCHARDS

Through one cause or another, old orchards sometimes reach a condition where production is so low that they are no longer profitable. The question which then confronts the grower is what can be done to bring them back into profitable production. If the trees are apparently sound, that is, not affected with heart rot or otherwise growing under adverse conditions, such as shallow soil underlain with hardpan,



Fig. 12.—Twelve-year-old French prune tree which has been thinned lightly each year. The top is open enough to admit sunlight to the central portions, prolonging the life of the spurs on the main branches.

lack of irrigation water, or severe infection of crown gall, they may sometimes be rejuvenated by proper cultural methods. Sometimes a thorough spraying, as discussed later, will destroy the parasites which are stunting their growth. If the bearing area is much reduced, a more or less heavy pruning may also be necessary. This pruning, in some cases, should consist of a removal of dead wood and a heavy thinning of the remaining branches. Satisfactory results in rejuvenation of old prune trees that were not in a dying condition have been secured by a careful thinning out of entire branches and parts of branches all over the tree, especially at the top, so as to admit light to the interior.

Rejuvenation of old orchards on shallow soils where irrigation facilities are lacking is more difficult, or may even be impossible. If, upon examination, crown gall is found to be serious, it is unlikely that any method of attempted rejuvenation will be successful. Most old orchards that have been neglected will be found to be infected with the various heart rots, and will also show evidence of more or less sunburn. Both troubles very greatly shorten the life of the trees. A rather careful census of the orchard should be taken to determine the extent of these troubles before a rejuvenation program is adopted. No rules can be laid down for the general rebuilding of old orchards. Each case must be decided on its own merits, giving due consideration to the factors outlined above.

IRRIGATION

Irrigation practices with prunes vary greatly in the different sections of the state. Most growers who have the facilities, irrigate one or more times before the crop is harvested. Many have also adopted the plan of giving an additional irrigation as soon as possible after the last picking. The number of irrigations during the growing season is influenced by the date of the last effective spring rain, character and depth of the soil and size of trees. Ordinarily, with mature trees, the practice is to irrigate two to four times before picking. Large prune trees use the readily available soil moisture in the upper 5 or 6 feet of loam soils in from four to six weeks. This interval may be used as a guide in most cases on this type of soil in planning an irrigation schedule. The last irrigation before picking is usually applied at a sufficient interval before harvest so that the soil may be cultivated and smoothed to facilitate gathering the fruit.

Irrigation water is applied to some orchards during the winter, but this practice is not effective, in districts where the rainfall is sufficient to wet the soil to a depth of 5 or 6 feet. An early spring irrigation is given by some growers, but, as a rule, an equal amount of water applied later in the growing season when the trees were showing signs of wilting would be more effective except in cases where a heavy cover crop was allowed to grow late in the spring and use some of the water that would otherwise be used by the trees. In general the irrigation schedule should be so arranged that the trees do not suffer for lack of available moisture for too long a period at any time during the growing season. The fall irrigation should be applied as soon as practicable after the last picking. Inasmuch as the harvest season extends over a

period of six weeks or more, the available moisture in the top 6 feet of soil is exhausted in this period and the trees are able to extract little, if any, moisture after this period, unless water is applied.

Many prune orchards are located in foothill areas where no irrigation is practicable. The trees in these orchards, as a rule, are smaller and the crops lighter than is the case where water can be applied.

Tree props may be rendered unnecessary by installing a system of wire braces in the trees. A No. 14 galvanized wire should run from each branch to a stout ring in the center of the tree. The wires are made fast to the branches with small screw eyes. These are quickly grown over and do not pull out.

The October irrigation before the leaves fall is of great value for the succeeding season's crop. Part of the large crop of 1919 was undoubtedly due to the heavy rains of the previous September. Bud studies by the Pomology Division have shown that under favorable conditions, such as are brought about by early fall irrigation, differentiation of leaf buds to fruit buds continues throughout October and November and even into December. The value of water applied in the fall is shown by the regularity in production.

Irrigation water is usually applied to prune orchards by the basin or check method. Under certain conditions the furrow or the contour check system may be preferable. A common mistake in irrigating is to regulate the amount of water put on the land by an estimate, rather than by actually measuring the depth to which the water penetrates. Most irrigators would be surprised if they knew the comparatively shallow penetration of average irrigations. To be effective over a period of time an irrigation should wet the soil to a depth of at least 5 or 6 feet. From lighter irrigations too large a proportion of water applied is lost by evaporation from the top layers of soil and not enough reaches the roots.

POLLINATION

The status of prunes as regards their ability to set fruit with their own pollen is fairly well known. The French and the Sugar prunes are self-fertile and bear abundant crops when growing in large blocks of one variety. The Imperial and Robe de Sergeant are self-sterile and should be interplanted with another variety. Any combination of the four principal prune varieties is satisfactory for pollination purposes. Experiments have demonstrated the value of bees in the prune orchards of the state. These experiments are amply substantiated by local observations in practically every orchard section.

In two years' trials the Burton seemed to be self-sterile. The Double X (Coates 1418) seems to be self-fertile. Both of these varieties set abundantly when pollinated by French and by Sugar.

DISEASES

Brown Rot.—This disease sometimes occurs on prune trees, but ordinarily is not serious. This fungus has long been known as a disease of stone fruits, and serious outbreaks have occurred from time to time principally on cherries and apricots. The best method of control is to spray the trees with Bordeaux (5 pounds copper sulfate, 5 pounds stone lime, 50 gallons of water) early in the spring when the first few buds are showing white.

Crown Gall.—Crown gall is a bacterial disease working on the crown and roots of most tree fruits. It is severe on all stone fruits, although almond and peach stocks are usually considered somewhat more susceptible than myrobalan. Being a root disease, it is difficult to eradicate. The organism which causes it is probably present in the soil of all our fruit sections. Nothing can be done to keep it from attacking trees already planted. Fortunately, after a tree is well established a certain amount of crown gall appears to do but little damage. In fact, in some cases fruitfulness is indirectly caused by it. Severe infections are shown by stunted growth and unthrifty appearance of the tree. If the galls are large and near the surface on the large roots, they may be chiseled off and the wounds painted with Bordeaux paste. Young trees, however, should be carefully examined for galls, and if any are found the tree should be rejected for planting. In this way the young tree, even if planted in soil where the organism exists, is enabled to secure a good start before being handicapped by the disease.

Heart Rots.—Decay of the heart wood of prune trees may be caused by several different fungi. These organisms must first gain entrance to the heart wood through some exposed wound. Old pruning wounds are the chief starting points. After the fungus has once gained entrance, it is practically impossible to stop its spread. Sooner or later the large branches break down under heavy loads or strong winds. Prevention is the only method of control. All wounds over one inch in diameter should be covered with asphaltum, roofing paint, or some other material that adheres well.

Oak Fungus.—Oak fungus⁵ is one of the most serious diseases the prune grower has to face. It is known by other names, such as root rot, toadstool disease, and *Armillaria*. The causative organism is a fungus known as *Armillaria mellea*, which works underground on the roots, and which is supposed to have its origin on the roots of infected oak trees that formerly occupied the ground.

The first indication of its presence is usually the death of a tree, often in midsummer, apparently from no cause. In succeeding seasons more trees die. The infected area is usually circular in form. The disease works rather slowly, but in time completely. In a few years it may destroy trees over a quarter of an acre of land.

Roots of trees which have been killed by this fungus show a white fan-shaped mycelium under the bark and are characterized by a pronounced musty odor. On the surface of the roots slender brown or purple strands may often be seen. The extension of these hyphal threads is one method by which the disease spreads.

These hyphal threads or rhizomorphs are able to push through the soil for a considerable distance, possibly several feet. The disease is also spread when infected roots come into contact with healthy ones. This manner of infection from root to root and tree to tree accounts for the circular spread of the disease. During the winter or early spring after the heavy rains the presence of the fungus is often shown by a clump of toadstools which are pushed up near the trunk of the infected trees.

Isolation of the infected area is one method of fighting this disease. Roots from infected trees or those thought to be infected must be kept from coming into contact with those of healthy trees. A trench dug around the area to be isolated is the best method. This trench need not be very wide and just deep enough to be certain it is below the root area but it must be beyond the infected region. The trench should be dug so there is at least one row of healthy trees between it and the diseased area. This should preclude any danger of finding diseased roots already crossing into the area to be guarded. In most cases a depth of 5 feet will be sufficient if the trench is dug at least 12 feet from a row of trees.

This trench may be left open, or it may be refilled. If refilled, it should be reopened every alternate season and the roots which have entered it again cut off. Some growers prefer, after the trench is opened, to build a concrete wall around the diseased area. If no

⁵ Hendrickson, A. H. Oak fungus in orchard trees. California Agr. Exp. Sta. Cir. 289:1-14. 1925.

diseased roots have crossed the line thus established, the concrete barrier should effectively stop further spread. The chief objection to the concrete wall is its cost. On the other hand, a ditch left open occasions great inconvenience in irrigation and cultivation.

From time to time experiments have been tried in disinfecting the soil with various substances having fungicidal properties such as formaldehyde, copper sulfate, and iron sulfate, but none of these have been markedly successful. The ultimate solution of the problem seems to be a rootstock resistant to this fungus, and the Deciduous Fruit Station of the University of California is giving a great deal of study to this possibility. From the very nature of the disease it is evident that positive results from this work cannot be expected for many years.

The grower is then confronted with the problem of what to do with the infected areas. All the common rootstocks of the prune are affected by this disease. Myrobalan is perhaps somewhat more resistant than peach or almond, but conclusive data on this point are lacking. Replants of prunes on any rootstock adapted to them are practically certain of infection within a very few years after planting. There are three fruits, however, which are considered resistant. The experience of many growers indicates that the northern California black walnut, the pear on French root, and the fig are resistant.

Rust.—Rust is of but minor importance on prunes. It appears as a reddish brown mass on the underside of the leaves. Usually it is not noticeable until late in the season, after the crop is picked. Ordinarily no control measures are necessary, as the leaves begin to fall normally a few weeks later. Should the disease be severe earlier in the season, when defoliation would be serious, the tree should be sprayed with Bordeaux mixture (4 pounds copper sulfate, 5 pounds stone lime, 50 gallons of water).

Gummosis.—This disease is often serious on prune trees. It is sporadic and is much worse in some years than others. The usual symptom is copious gumming, often followed by death of the infected branches and, in some cases, loss of the entire tree. The disease may attack nearly any part of the tree, but is generally found on the trunk and large branches. In other cases, small masses of gum are distributed over the entire branch. The disease is caused by one or more bacterial organisms working in the bark or outer sapwood. All varieties of prunes, as well as other stone fruits, are attacked, but the Robe de Sergeant seems to be the most susceptible. No satisfactory methods of control are known.

Diamond Canker.—The presence of this disease is first indicated by the appearance of rough swellings on the trunk or large branches. The bark on these swollen portions often cracks in such a manner as to leave diamond-shaped areas from which the disease takes the common name. Diamond canker seems to be almost wholly confined to the French prune. It works slowly and gradually weakens the diseased parts of the tree. No satisfactory control is known.

INSECTS

Insects injurious to prune trees, with one exception, have not been hard to control. The exception is the thrips, but with sprays and more recently with nicotine dust even this troublesome pest can be controlled.

In general, the insect pests of prune trees can be divided into two classes, the chewing insects and the sucking insects. The former are controlled by some form of poison spray, usually arsenate of lead. For the latter a contact spray such as lime-sulfur or oil emulsions must be used. Borers, however, cannot be controlled by either of the above, and must be dug out with a knife or stiff wire or treated with paradichlorobenzene.

Three factors essential for a successful fight against these pests are: suitable material; thoroughness; and application at the right time. The first two factors are well understood. The third is often disregarded, with the result that the expense is wasted and the grower loses confidence in the operation. Ordinarily, for each insect there is a time, as described later, when it can be effectively controlled. Spraying earlier or later than this is often of little or no value.

In this circular only the insects of common occurrence on the prune are described.

Mealy Plum Aphis.—These insects are very small, light green in color, and usually covered with a whitish mealy substance. They hatch in early spring from small black eggs laid the previous fall on the limbs of the tree and immediately begin working on the under side of the leaf. If unchecked, they soon cause the leaves to curl, making spraying very difficult. A honeydew is exuded which causes a blackening of the leaves and branches and, in severe cases, a cracking of the fruit and stunting of the trees. For control the following spray should be used when the insects first appear: soap, 4 pounds; 40 per cent nicotine sulfate, 1 pint; water, 100 gallons. This must be applied thoroughly, wetting the underside of the leaves. A second application may be necessary in badly infected parts of the orchard.

Peach Tree Borer.—The young borers, from eggs laid during the summer months, principally from June to September, enter through the bark of the tree. The work of the borer can be detected by the gum and frass (a sawdust-like material which passes through the body of the insect) that is usually found on the trunk between the main roots and the surface of the ground.

Formerly, the only method of control was by digging out the borers with a knife or hooked wire. This operation often resulted in serious injury to the cambium layer when it was necessary to remove several borers from one tree. Of late years the principal method of control has been by the use of a soil fumigant known as paradichlorobenzene, and commonly called P.D.B. The soil around the tree is first smoothed and a ring 2 to 3 inches wide of paradichlorobenzene is sprinkled around the base of the tree with the inner edge of the ring 2 or 3 inches from the bark. Soil is then mounded up around the tree to a depth of 6 or 8 inches, and the mound slightly compacted with the back of the shovel. Care should be taken to see that this material does not actually come into contact with the tree. For mature prune trees from 1½ to 2 ounces is the usual dose, and for smaller trees a lesser amount should be used. The most effective control is usually secured when this method is applied from about the middle of August to the middle of October. The soil should be fairly dry when the application is made, as experiments have shown that poor results are obtained on wet soils. As a rule only one treatment a year is necessary.

Flat-headed Apple Tree Borer.—Young prune trees are also attacked by this insect. The larvae or worms feed in the sapwood at or near the crown. Older trees are often infested where sunburned or injured by the plow or cultivator. The oval shape of the burrows is due to the flattened head of the borer. The trees, particularly when young, should be watched carefully and the borers dug out. The burrows are indicated by discoloration of the bark. Whitewash is a good repellent. Light colored tree protectors are specially recommended to prevent infestation.

Cankerworms.—These insects are also known as measuring worms. They are variable in color and usually appear early in the growing season. When present, they may often be seen, particularly after a heavy wind, hanging suspended from the tree by a silken cord. Since they eat the foliage of the tree, they can be controlled by a poison spray. Neutral lead arsenate at the rate of 8 pounds of paste or 4 pounds of powder to 200 gallons of water should be applied as soon as the worms appear. It is advisable to add 4 pounds of slaked lime

to the spray before applying. Only basic or neutral arsenate of lead should be used. Pyrethrum or buhach, 5 pounds of dry powder soaked overnight in cold water and further diluted to 200 gallons, applied as a spray is particularly effective in killing cankerworms. If the orchard has been troubled with these pests for several years, banding the trees is often advisable. Tanglefoot, if kept fresh, will prevent the female from crawling up the trees to lay her eggs.

Red-humped Caterpillar.—This insect is named from the red hump on the fourth segment or division of its body. When full grown it is from 1½ to 2 inches long. It is a serious pest in some sections, and is often found in the central part of the state. It is found chiefly in colonies and may defoliate entire branches in a very short time. On young trees the colonies may be picked off by hand or the infested branches clipped off with pruning shears. For larger trees, spraying with arsenate of lead, as recommended for cankerworm, is advised. Fall cultivation close to the trees aids in killing the dormant insect.

Leaf Roller.—This insect, like the two described in the preceding paragraphs, also feeds on the foliage. It is readily distinguished by its habit of rolling itself up in a leaf while feeding. A spray of arsenate of lead, as recommended for cankerworms, should be applied when the worms first appear and the foliage is still small. A thorough spraying with miscible oil in late winter or early spring will kill the eggs.

Red Spider or Mite.—Red spider injury is generally shown by a yellowing and premature dropping of the leaves. Severe attacks cause still further injury, such as small size of fruit, weakness of fruit buds, and death of the terminal growth.

There are two species of red spider commonly found on prune trees, the so-called almond mite and the summer or Pacific mite. The almond mite is about the size of a pinhead and red or reddish-brown in color. The eggs are minute and red in color and are laid on the twigs and branches of the tree. It is somewhat easier to control than the latter or summer mite. A crude oil emulsion, as recommended below for Italian pear scale, effectively controls this pest in most districts. Lime-sulfur, 1 gallon to 9 gallons of water, is also widely used, although it does not appear to be so effective as the oil spray. The best time for application of the spray is late winter or early spring.

The Pacific or summer mite winters in the ground or under the bark. Its control, therefore, is almost entirely a summer measure. These mites appear during the first few weeks of warm weather. They

work on the under side of the leaves, on which they spin a delicate web which protects them and their eggs. The rate of increase is very rapid.

Control measures must start as soon as the mites appear. Satisfactory results have been obtained by using a very fine dry sulfur at the rate of from one-sixth to one-third of a pound to a tree. Some growers who use a power duster prefer to dilute the sulfur with about 50 per cent of air-slaked or hydrated lime to prevent injury to the foliage. In case of severe infestation, dusting should be continued at intervals of from ten days to two weeks until it is apparent that the insect has been controlled. In young orchards or in windy locations the use of dry sulfur has not always been successful, because the flames liberated by the sulfur do not remain concentrated enough to kill the insects.

Where dusting cannot be employed, lime-sulfur, sulfur paste, or some form of "wetttable" sulfur will have to be used as a spray. Lime-sulfur solution ordinarily should not be used stronger than 1 gallon to 75 gallons of water. Even this dilution sometimes causes injury to the foliage, particularly if the spraying happens to be followed by a period of high temperature.

In late years the highly refined commercial oils diluted to from 1 to 2 per cent have given remarkably good results in the control of red spiders on fruit trees. At this time they are preferred to all other sprays for this purpose.

Scale Insects.—Two scale insects are of special concern to the prune grower, the brown apricot scale and the Italian pear scale. The former is a rather large hemispherical scale easily seen on the twigs and smaller branches. The latter is not so conspicuous, but is much more harmful. It is about the size of a pinhead, and is usually found on the larger limbs and branches, where it is often afforded protection by lichens and moss. By scraping away the moss, the small white, flat covering of the scale can be easily seen. Under this are the red or dark red bodies of the insects themselves. The presence of this scale is generally shown by the flattened appearance of the branches and limbs. This condition will be found principally on the north side of the limbs, where the moss is thickest. This scale causes the death of many limbs in badly infested orchards.

The brown apricot scale is easily controlled with a 5 per cent distillate emulsion, a miscible oil, or a 12 per cent crude oil emulsion. On young trees the first two sprays are usually preferred, as there seems to be some tendency to sunburn when the heavier oil is used.

The Italian pear scale is best controlled by the use of any of the heavier dormant oil sprays. A 12 per cent emulsion is found satisfactory in most localities, but a few are still using a 15 per cent emulsion. Where moss and lichens are troublesome, the addition of from 6 to 8 pounds of caustic soda will easily remove them. Lime-sulfur at the rate of 1 gallon to 9 gallons of water is still used in some orchards, but it is not quite so effective as the oils. Where lime-sulfur is constantly used, however, the Italian pear scale seldom becomes serious.

December to February is the best time for spraying for scale. Spraying too early in the winter, when the trees are dry, is often the cause of oil injury to the buds. Trees must not, however, be sprayed when wet, as immediately following a rain for example, for the spray will run off and not kill the scale. Ideal conditions are when the trees are slightly damp. If spraying is thoroughly done, it is not necessary under ordinary conditions, to spray oftener than every second or third year.

Thrips.—The thrips or pear thrips, as it is often called, is in many ways the most serious insect pest with which the prune grower has to contend. In its different stages, this insect is often responsible for the scabbing of the fruit or the loss of the crop.

The adult thrips is a winged insect, very small, slender, and almost black. It appears late in February or early in March when the prune buds are beginning to swell and open. If the thrips are numerous, many buds may fail to open, or, if they do open, the flowers appear scorched. They do further injury by inserting their eggs in the stem of the young flower. This injury may cause the flower to fall or the fruit to drop before maturity. The young thrips or white thrips hatch and are most abundant during the early part of April. This form of the insect, in feeding on the young fruit, causes what is known as "scabby" prunes. The thrips later drop to the ground, where they work into the hard soil below the surface mulch and remain there until the following spring. Pupation begins about September and continues until all have changed to the adult or black form.

Thrips may be combated with a liquid spray, usually a 1½ per cent oil emulsion, to which is added 1 pint of 40 per cent nicotine sulfate to every 200 gallons of spray, or with any of the new highly refined oil sprays, or by dusting with a 5 per cent nicotine dust. Applications of sprays or dusts should be made when the first black thrips appear in the spring. Ordinarily from 5 to 8 gallons of spray and from one-third to one-half pound of dust will be sufficient for an average prune

tree. More than one dusting may be necessary, depending on the number of thrips present. The best time for application is between 9 A.M. and 6 P.M. The dust volatilizes best when the temperature is fairly high. A power duster is capable of dusting 20 to 40 acres a day, while from 3 to 6 acres may be covered with the ordinary hand duster.

Other methods have been found helpful in thrips control. An irrigation immediately after the crop is harvested kills many of the hibernating thrips. In the spring some growers leave the cover crop until after the trees have blossomed. This practice seems to reduce thrips injury. It should be remembered, however, in connection with this latter practice, that a late-growing cover crop materially reduces the amount of moisture in the soil available for the trees, and it should therefore not be followed except where irrigation is possible.

VARIETIES OF PRUNES

French (Prune d'Agen, Petite Prune).—The French prune is the most important commercial prune in California. In speaking of prunes, the French prune is meant unless other varieties are specifically mentioned. For all around adaptability, regularity of productiveness, and vigor and strength of trees, it is unsurpassed in California. Its chief defect is lack of size. During some seasons, and particularly under stress of heavy loads in unirrigated orchards, the smaller sizes predominate. The marketing possibilities of the larger prunes have been strikingly shown during the past few seasons. In addition to the excellent qualities of the tree, the French prune is easily handled in the dry yard. Several so-called improved "strains" of the French prune have been introduced in the past few years. Some of these have much promise.

Robe de Sergeant.—This variety is extensively planted in some of the interior valley sections. When dried it resembles the French, and is usually sold as such. The tree and fruit, however, are distinctly different from the French. The leaves are a dark glossy green, as distinguished from the yellowish green foliage of the French. The fruit is not distinctly necked, as is the latter, and is darker in color when fully ripe. This variety, furthermore, is self-sterile and should be planted with the French or Imperial to secure fertilization of its flowers.

Imperial.—The Imperial is grown to some extent. The fruit is large and of excellent quality, but the tree is a notoriously shy bearer,

except in a few favored localities. It seems to produce well in the counties north of San Francisco Bay. The tree when mature is a rather weak grower. Spurs are usually borne in abundance and the blossoming is profuse. The set, however, is usually light. The branches are rather stiff and rigid, but are brittle and break easily. The slow growth in old trees may be corrected by somewhat heavier pruning than is usually given the French variety. This variety is also self-sterile and should be interplanted with either the French or the Sugar variety. Because of its size, it does not dry so readily as the French and requires special attention in the dry yard. When dried, the fruit is usually of such large size that it commands a higher price than most prunes.

Sugar.—The Sugar prune is grown in certain sections, especially the warm interior valleys. The tree grows vigorously when young, but requires liberal pruning to maintain adequate wood growth and prevent overbearing as it grows older. The wood is brittle and breaks easily under the weight of ordinary crops, often in spite of propping. Heavy bearing may be said to be one of its greatest faults. In some sections it is necessary to thin the crop in order to save the trees. However, it has, in some sections, a pronounced tendency to alternate bearing. The dried fruit is often large but of mediocre quality, being somewhat coarse and stringy. As it ripens a week or ten days earlier than the French, it is favored in some sections where trouble is experienced in drying the late pickings of the latter variety. The Sugar prune is self-fertile and may be planted without regard to cross-pollination by other varieties.

Coates 1418 (Cox, Double X, Saratoga).—This variety which is sold under several names is supposed by some to be a bud sport of the French prune. As the original tree on which the sport was thought to have originated died before an accurate record of it was obtained, the exact origin of this variety will probably remain uncertain. In growth characteristics the tree is similar to the French prune. The fruit, when ripe, is the same color, has approximately the same shape, but is larger in size than the French prune. The pit is rather large and rough. It has been planted to a limited extent in many prune sections.

Burton.—This variety originated on the ranch of R. E. Burton, near Vacaville. The tree seems healthy and vigorous. The fruit is large, rather long in shape, dark blue in color when fully ripe, with a moderate amount of gray bloom. The flesh is yellow in color, a little coarse in texture, but in general good to very good in quality.

SUN-DRYING AND DEHYDRATING⁶

Formerly most prunes grown in California were sun-dried. In recent years, however, an increasing proportion are being dried in dehydraters until at the present time approximately 20 per cent of the crop is dehydrated and the remainder sun-dried.

Whether sun-dried or dehydrated, the handling of the crop is the same up to the point of placing the prunes on the trays. The prunes are generally allowed to fall to the ground and are then picked up and put into lug boxes. Four or five pickings during the season are usually sufficient. In some of the interior valley sections it is necessary to shake the fruit from the trees when it is ripe. When this is done, fewer pickings are the rule.

After picking, the prunes are first taken to the dipper, where they are immersed in a hot solution of lye. For sun-drying the strength is usually about 1 pound of lye to 20 gallons of water. The time of immersion varies from a few seconds to nearly a minute, depending upon the strength and temperature of the "dip." Most growers aim to keep the solution at or near the boiling point for French prunes and slightly lower for Imperials. The dip should remove all the bloom or wax from the surface of the fruit and slightly check or crack the skin. Severe checking is undesirable and causes a shriveling of the fruit. Observation will quickly indicate whether the prunes have been checked sufficiently. If the solution is too strong or the immersion too long, the skin may be entirely removed. If it is too weak or cold, the skin of many prunes may not be checked at all. Such prunes will not dry properly and will become "bloaters" or "chocolates." Imperial prunes must be handled carefully, as the skin is more tender than that of the French variety. Some growers prefer to put the Imperials out to dry for a few days before dipping to avoid injury to the skin. "Over-dipping" prunes for dehydration should be avoided, since it is likely to cause the fruit to "bleed" and stick to the trays. Imperials and other thin-skinned varieties, when dehydrated instead of sun-dried, are usually dipped in hot water without lye.

After dipping, the prunes should be rinsed in clean water, though not many dry-yards are equipped to do this. They are usually then separated into two sizes and placed on the trays. From this point they are taken either to the dry-yard or to the dehydrater.

⁶ For more detailed description of dehydrating see: Christie, A. W. The dehydration of prunes. California Agr. Exp. Sta. Bul. 404:1-32. (Revision by P. F. Nichols, 1929.)

The length of time for sun-drying varies from about ten days to two weeks. In general, prunes dry more quickly in the warm interior regions than in the coast valleys. More time is necessary late in the season or in years when the weather is cloudy or foggy. The large prunes require more time than the small. Sugar and Imperial prunes must be turned often on the trays to insure even drying and to prevent molding. Turning is accomplished either with short wooden scoops or with long-handled wooden rakes. No exact methods are in use for determining when a prune has dried sufficiently. Some growers use one guide and some another. When the prune has become firm in texture and the pit cannot be separated from the flesh by rolling between the thumb and first two fingers, it is usually considered cured. Another method of determining when the drying is complete is by squeezing a handful. If the prunes retain their shape and do not mash together, they are dried sufficiently. The trays are then stacked for a few days, after which the prunes are placed in lug boxes and taken to the storage bins. When scraping the trays, all prunes insufficiently dried—known as "chocolates"—are sorted out. The prunes are then placed in storage bins and allowed to "sweat" for about three weeks, after which they are ready for delivery to the packing house.

For sun-drying, the trays commonly used are 3 by 8 feet. During an average season, each tray is used usually twice in the coast valleys and possibly three or four times in the interior sections. A well filled tray holds about 60 to 70 pounds of green fruit. Approximately 1000 to 1500 trays and 250 to 350 lug boxes are necessary for each 100 tons of green fruit. Approximately one acre of dry-yard is considered a sufficient proportion to 20 acres of orchard.

In the smaller dry yards, at least five men are necessary for economical dipping, spreading, and placing the trays in the dry-yard. One man dips the prunes, two men spread them as they come off the shaker, and two more place the full trays on the cars and replace them on the receiving platform with empty ones. After loading several cars, four of the men take the trays to the yard and distribute them. The fifth man attends to the fire under the dipping kettle and moves up the full lugs to a convenient place. In larger plants, with fruit enough to run continuously, more men are required, depending upon the size of the yard and the track facilities. A light railway with several cars and one or more lines of track, while expensive to install, is convenient for rapid and economical handling of the crop.

Dehydration of prunes is rapidly being adopted in many sections. Several types of dehydraters are used, almost all being of the air-blast

tunnel type which has proved to be the most efficient. The air is usually heated by hot air pipes and is circulated over the fruit by means of blowers or suction fans, which may be at either end of the tunnel, distributed along the side, or placed in the middle depending upon the particular type. Dehydraters are equipped with return flues which provide for returning and reheating part of the air so that the greatest economy may be secured.

The trays used in dehydraters are usually about 3 × 3 feet, varying somewhat according to the particular make of dehydrater. They are generally made with a slat bottom, although some trays with solid or wire cloth bottoms have also been used. A 3 × 3 tray holds approximately 25 pounds of fresh prunes. Some dehydraters are so designed that the ordinary 3 × 8 solid bottom trays used in sun-drying may be used after slight modification.

The length of time for drying prunes in a dehydrater varies from 20 to 36 hours, according to the size of the prunes, the temperatures used, and the type and efficiency of the dehydrater. With proper adjustment of temperatures and air humidities, prunes of average size are ordinarily dried in about 24 hours. Large prunes may require more than 24 hours, and small ones, somewhat less. The fruit is usually started in the cooler end of the dehydrater at a temperature between 120° and 140° F and finished at the warmer end at a temperature not to exceed 165° F with a relative humidity of 25 per cent.

After drying, either in a dehydrater or in the sun, prunes are usually placed in bins for a period of from two to three weeks in order that the fruit may undergo a process known as "sweating" which tends to equalize any differences in moisture content in the different fruits.

The quality of dehydrated prunes is now recognized as equal to or better than that of the sun-dried product. The advantage of a shortened drying season, together with assurance of securing all of the crop without damage from rain, is an important factor favoring the use of dehydraters for drying prunes. No dry-yard is necessary with a dehydrater, hence this area may be planted with additional trees. Modern dehydraters are so efficient that the costs of dehydration are no higher than those of sun-drying under favorable sun-drying conditions, and are distinctly lower, when the latter are unfavorable. Although the total investment required for a dehydrater is not much greater than that for sun-drying equipment of equal capacity, the former must be installed at one time, while the latter may be accumulated through purchase of material through a period of several

years. For example, if a grower is developing a young prune orchard and decides to dehydrate the fruit, he must install a dehydrater complete, or at least one unit complete for the first small crop. If, on the other hand, he decides to dry in the sun, he may be able to handle his crop the first year with rather limited equipment, to which additions may be made from year to year. For these reasons it may be easier for the grower with limited capital to finance sun-drying equipment rather than a dehydrater. It is probable, therefore, that many small growers will continue to sun-dry, particularly if they are located in districts where there are no custom dehydraters.

COSTS OF PRODUCTION

The amount and kind of equipment on the average prune orchard is extremely variable. The larger orchards are usually well equipped with all necessary tools and power. Many small growers, however, do not feel that they can afford all the machinery necessary for running their places. Some prefer to hire all team work. Ordinarily all orchards are equipped with the common soil-working implements, such as plows, harrows, cultivators, and small tools. A power sprayer although important, is not found in every orchard. This fact very often works to the serious disadvantage of the grower, who must depend upon loans from a neighbor or upon contract spraying. In either case it is often impossible to make the application when it would do the most good. In the same way, many growers in sections where water is pumped for irrigation do not own their own pumping plant. If the lift against which the water must be pumped is very high, the acreage cost of well and pumping equipment may be so large in small orchards that it is prohibitive. The only alternative is to buy water from a neighbor who has a pump. The buyer is often subjected to inconvenience, such as irrigating at night, due to having to take his turn among several. Where the water for irrigation is obtained from underground sources, the cost of irrigation may be a large portion of the total cost of operation.

In addition to the ordinary orchard machinery, the prune grower needs special equipment for drying. The equipment includes trays, lug boxes, dipping appliances and platform, and a dehydrater in case the fruit is not sun-dried. For a crop of 100 green tons 1000 to 1500 trays, costing approximately 90 cents each, are usually needed. In the interior valleys less may be needed, but in the central coast region, especially in certain years, the larger numbers will be necessary. For

the same crop approximately 250 lug boxes at 20 cents each are needed. The dipping equipment and the platform cost from \$400 to \$500, depending on kind and size.

Prospective returns on the prune orchard cannot be estimated with any degree of certainty. Prunes are grown under so many different climatic conditions and soil types in California that any statement concerning production must be of a very general nature. Uncontrollable factors like those directly or indirectly influenced by the weather, make any prediction involving exact figures hazardous. Furthermore, no two growers manage their orchards alike.

It is probably safe to say that a sustaining crop of prunes is not ordinarily produced until the trees are six or seven years old. For three or four years the orchard may be intercropped to provide a maintenance revenue. During the fifth and sixth years the trees usually produce enough fruit to pay expenses and possibly yield a small profit. Yields of mature orchards show extreme variation. A fair crop for central coast regions may be estimated at four or five tons of green fruit per acre. On fertile soils, with ample irrigation facilities, the yields are often greater. In the foothill regions the average may not be more than two tons per acre. Interior valley orchards on deep, fertile soils, particularly on the so-called river bottoms, yield heavily, sometimes as high as twenty tons green fruit per acre. The drying ratio varies, for different regions, from 2¼ to 1 to 3 to 1. Statistics show that the average production of the state over a period of years is about one to one and a quarter tons of dried prunes per acre.

Cost account records are available for a number of prune orchards in different prune growing sections. While the different operations show wide variations in costs, the average figures show the expenses which it may reasonably be assumed the prune grower must meet. Some of the items involving the principal costs are given below. The cost of pruning bearing prune orchards in five counties varied from \$4.14 to \$9.65 per acre. In a few cases, the cost was below these figures, and in a few cases where considerable pruning was evidently necessary or the trees were exceptionally large, the cost was several dollars higher than the maximum given above. Brush disposal in these orchards cost from \$1.25 to \$3.37 per acre. Cultivation added a considerable item to the total, the average costs varying from \$9.20 to \$13.01 per acre. Irrigation cost between \$3.31 and \$12.71 per acre. In some individual cases, however, the costs were much higher than these averages, probably because of pumping water from deep wells.

Spraying cost from \$2.14 to \$7.04 per acre for labor and materials. The cost of picking varied from \$9.06 to \$12.93 per ton, and the average cost of drying was between \$11.42 and \$19.57 per ton. Pruning heavily loaded trees cost between \$0.96 and \$2.11 per acre. To these operating costs many items may be added covering expenses in planting cover crops, hoeing, smoothing, sacking and hauling fruit, treatment of borers, etc. In addition there must be considered taxes, insurance, depreciation of machinery and buildings, and interest on the investment.

AGRICULTURAL EXTENSION SERVICE CIRCULARS

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| <p>No.</p> <ol style="list-style-type: none"> 1. Series on California Crops and Prices: Peaches. 2. Home Preparation of Jelly and Marmalade. 3. Feeding Beef Cattle in California. 4. Irrigation by Overhead Sprinkling. 5. Series on California Crops and Prices: Lettuce. 6. Care and Management of the Milk Goat. 7. Suggestions on Grapefruit Culture in Imperial Valley. 8. Diseases and Parasites of Poultry in California. 9. Rabbit Raising. 10. The Home Preparation of Fruit Candy. 11. Cauliflower Production. 12. The Manufacture of Monterey Cheese. 13. Selection and Care of Electrical Equipment Used in Dairy Manufacturing. 14. Pork Production in California. 15. Pork Production in California. 16. Irrigation of Orchards by Contour Furrows. | <p>No.</p> <ol style="list-style-type: none"> 17. Liver Fluke and Stomach Worm of Sheep. 19. Artificial Incubation of Eggs. 20. Pear Blight Control in California. 21. Bovine Tuberculosis. 22. Thinning Sugar Beets. 23. Strawberry Culture in California. 24. Enterprise Efficiency Studies on California Farms. 25. Bush Fruit Culture in California. 26. The Home Vegetable Garden. 29. Control of Pocket Gophers and Moles in California. 30. Elements of Grape Growing in California. 31. Powdery Mildew of the Grape and Its Control in California. 32. What to Do About Bovine Tuberculosis. 33. Rearing Dairy Heifers free from Tuberculosis and Abortion Diseases. 34. Plum Growing in California. 35. Alfalfa Production. |
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