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PRUNE GROWING IN CALIFORNIA

By A. H. HENDRICKSON

Prunes are grown in nearly every part of California. 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 Formerly prunes were grown in many districts without irrigation, but this practice is being rapidly superseded by a cultural system that includes at least one or two waterings during the growing season. The necessity of water during this season was clearly shown in the dry years of 1919 and 1920. 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 is 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. Early fall rains interfere with the picking and drying operations. Evaporators are now coming into use where fall rains may be expected. In some sections the growers are using evaporators to cure the entire crop.

* In cooperation with Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture.

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 caliper one-half to five-eighths of an inch just above the union is the ideal deciduous fruit tree to plant.¹ 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 root stocks: the myrobalan, the almond, and the peach. As a result of an inquiry made by the Division of Pomology in 1919 among the nurserymen of the state, the popularity of these stocks was found to be as follows, indicated by the percentage of trees propagated on each: 63.3 per cent were grown on myrobalan; 10.4 per cent on almond; 21.2 per cent on peach. In addition, 5.1 per cent were propagated on apricot.

The myrobalan stock is preferred for deep, moist 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. Either peach or almond is more susceptible than myrobalan to injury from extremes of soil moisture.

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 root stocks.

¹ Monthly Bull. State Com. Hort., Vol. 7, No. 4, April, 1918.

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 the end in money and labor.

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 following table gives the approximate number of trees per acre for the square and hexagonal systems:

TABLE OF PLANTING DISTANCES

Distance Apart	Number of Trees per Acre	
	Square	Hexagonal
20 × 20	108	124
22 × 22	90	104
24 × 24	76	87
25 × 25	70	80
26 × 26	64	74
28 × 28	56	64
30 × 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 every other tree.

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 disc 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 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, *Medicago*

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 aphids.

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 no 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-sulphur 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, almonds and apricot trees may be grafted over profitably up to 15 or 20 years of age, provided 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 Fig. 1. The cleft is held open by the wedge on the chisel (Fig. 2). The scions are then cut wedge-shape as shown in Fig. 3. The cut surface of the scion should be about 1¼ to 1½ inches long for the usual sized scion and should be a true flat surface. The

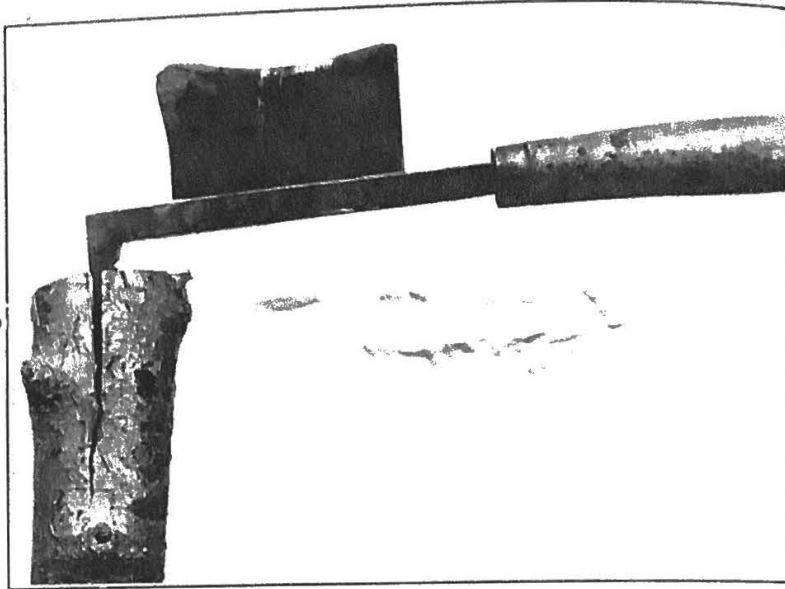


Fig. 2—Wedge inserted to hold the cleft open until the scions are cut and placed in position.

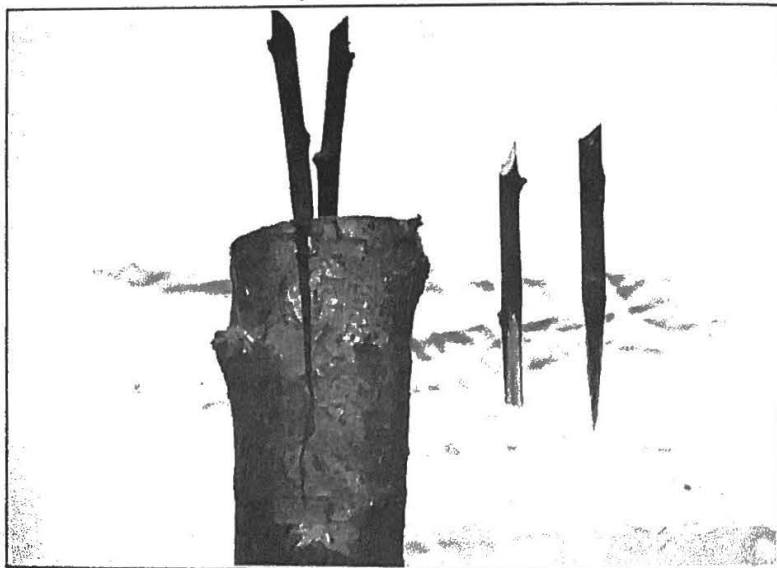


Fig. 3—Scions in place and ready for waxing. Scions (on right) cut and ready for insertion.

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 and scion are then completely covered with grafting wax (Fig. 4). Instead of splitting large branches (those 3 to 3½ 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.

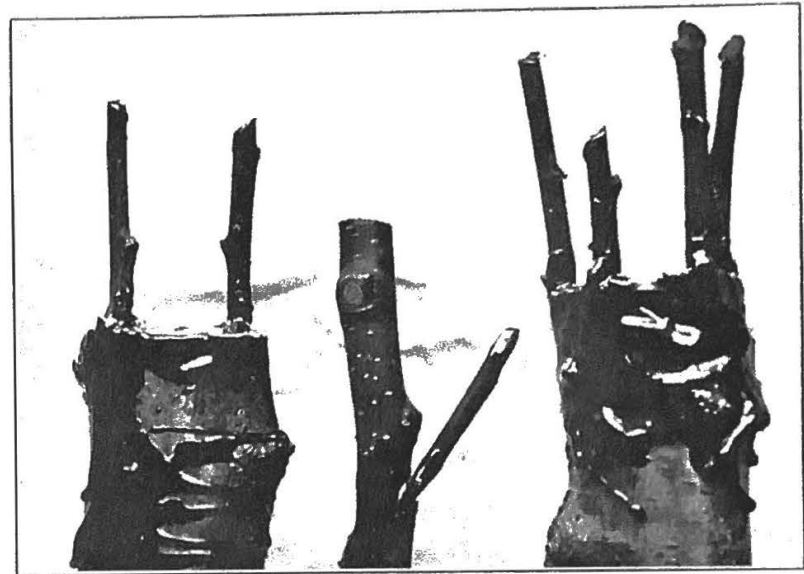


Fig. 4—Different forms of grafts after waxing.

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.

Not all prunes make strong unions with all stocks. French prunes have a strong affinity for almond and peach but often do not grow well on apricot. The Sugar prune, on the other hand, is reported as uniting with apricot as well as with almond and peach. Robe de Sergeant does not unite satisfactorily with almond on nursery trees.

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

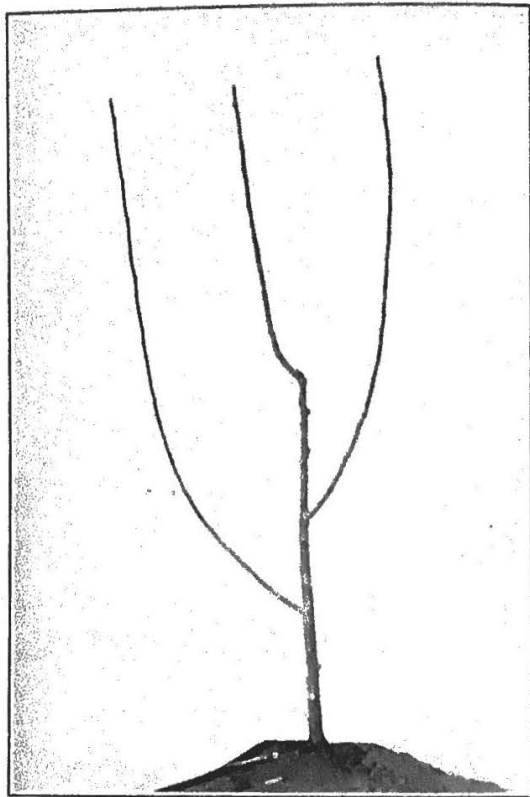


Fig. 5—Branches should be spaced up and down on the trunk to avoid weak crotches.

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 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

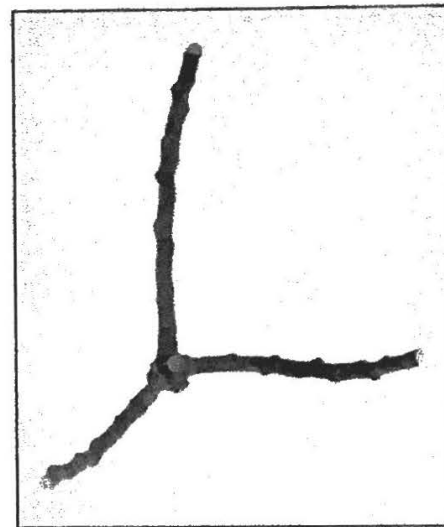


Fig. 6—The young tree should have the branches evenly spaced around the trunk. This photograph, taken from directly above the tree, shows an ideal arrangement.

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 pruning the young tree described in the preceding paragraph 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.

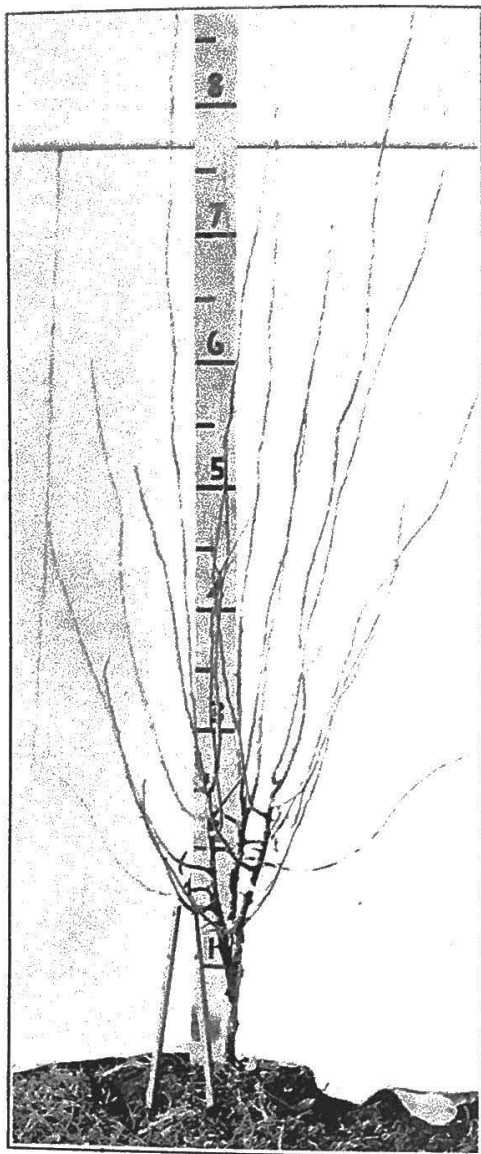


Fig. 7—Two-year-old French prune tree which was cut back the first winter.
(See Fig. 8.)

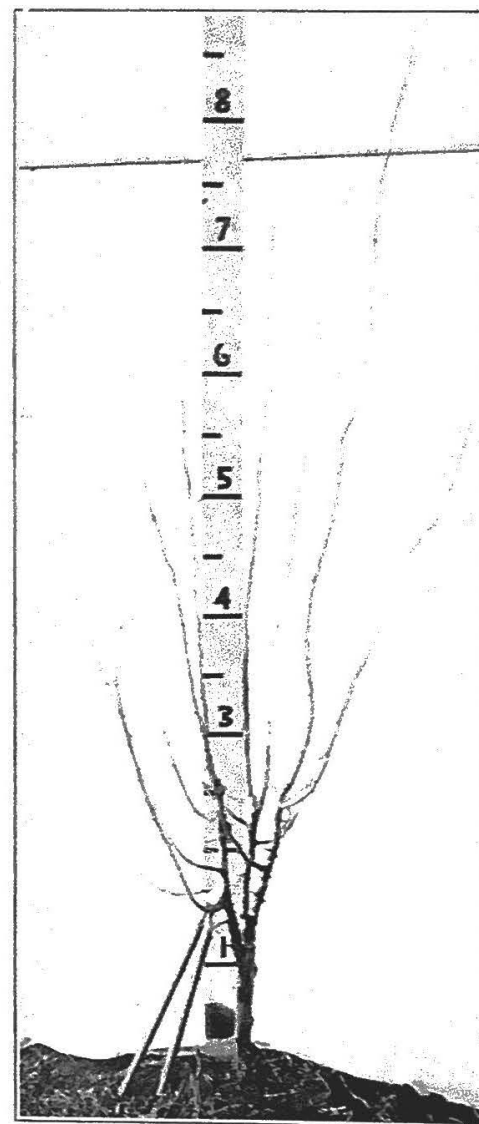


Fig. 8—The same tree as in Fig. 7, after pruning by thinning out branches where too thick. This method of pruning is best with French prunes.

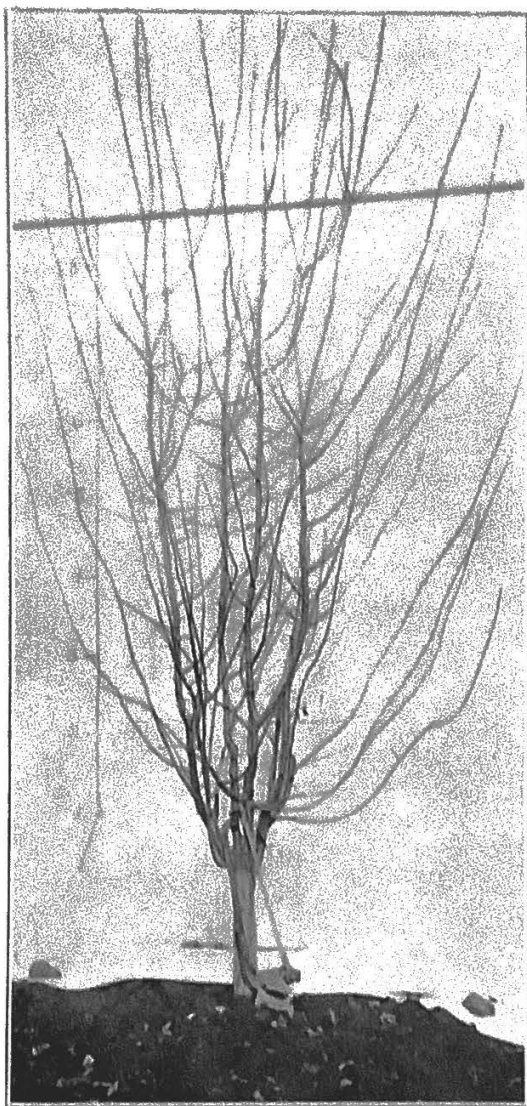


Fig. 9.—Three-year-old French prune tree which had been thinned the previous winter. Note the fruit spurs already formed on the main branches. (See Fig. 10.)

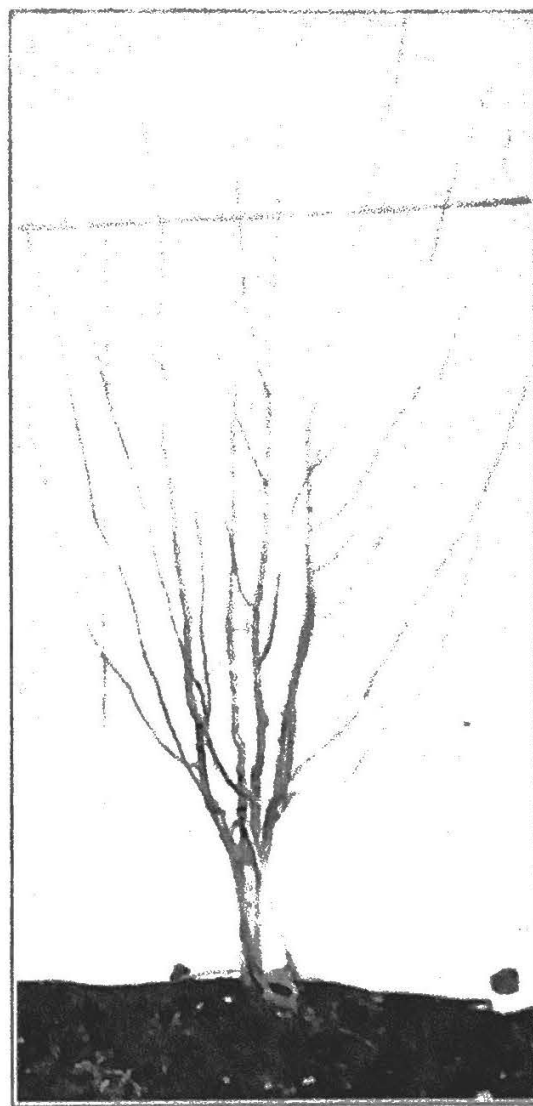


Fig. 10.—This three-year-old French prune tree (see Fig. 9) was thinned to permit of full development of remaining branches.

The pruning given the first winter season determines the form of the young tree. 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. The best form is built from three scaffold branches (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. These branches should be evenly spaced around the trunk so that no two come out from the same side of the trunk. In 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 approximately 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).

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 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.

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, lack of irrigation water, or severe infection of crown gall, they may often 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

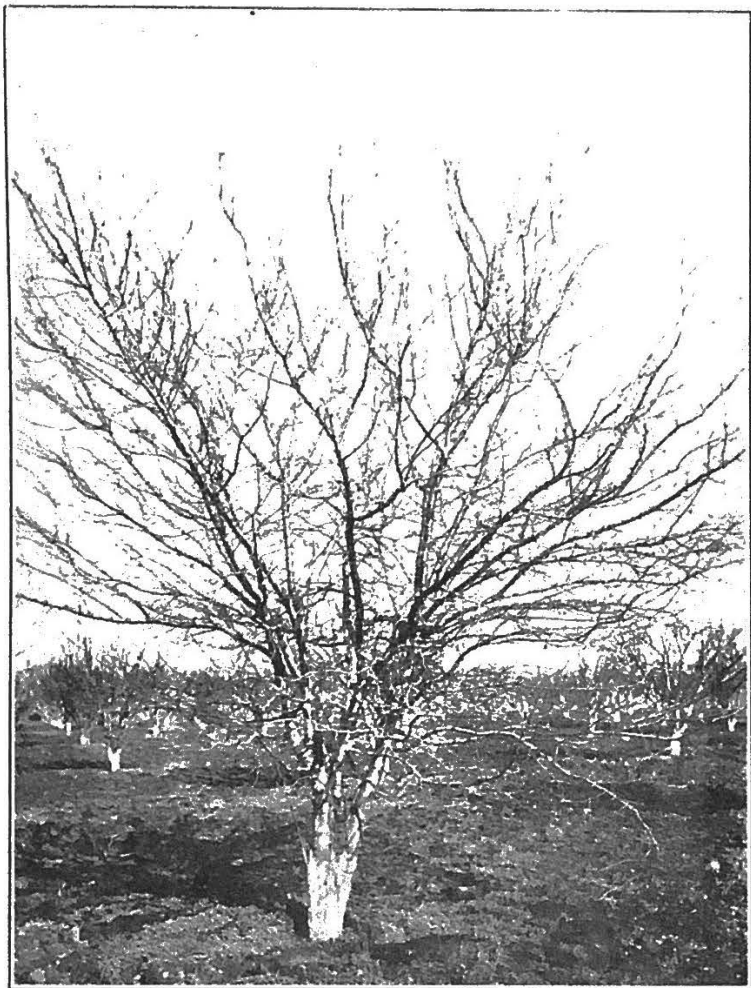


Fig. 11—Twelve-year-old French prune tree which has not been pruned for six years. The top is too dense and the spurs in the interior are losing their vigor.

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 upon 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



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.

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 orchard 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 once or twice during the growing season. 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 greatly influenced by the rainfall of the preceding winter. If the rainfall has been light, two irrigations are usually given, and in some cases three. On the other hand, after a season of heavy rainfall one irrigation is often considered sufficient. Many foothill orchards are grown with no water other than that received from rainfall during the winter. This practice, however, is usually the result of necessity rather than of choice. From observations of many successful orchards, it would seem that in the central coast counties and interior valley sections a program calling for three irrigations is best. The first irrigation should be given late in May or early in June; the second in July, just before propping the trees; and the third immediately after the crop is harvested, preferably early in October while the leaves are still green and active. In the northern coast counties, where the rains continue until late in the season, the first irrigation may be unnecessary. Likewise, in sections having early fall rains, the October irrigation may be omitted. In the sections now producing the bulk of the prune crop it is usually not safe to wait for the autumn rains. Water should be applied while the foliage is still on the trees.

Lack of sufficient moisture in the soil during the growing season is not shown in the appearance of the prune tree until the drought conditions have become very severe. Some other fruit trees indicate dry soil conditions readily. Apricot trees show it by a wilting of the leaves during midday, and almond trees indicate the same trouble by shedding a part of their foliage. The only safe plan to follow is to make an examination of the moisture condition of the soil itself. This may be done with the aid of a soil auger. Ordinarily if the top four to six feet of soil is fairly moist, the tree will not suffer.

An insufficiency of moisture is sometimes shown in young trees by formation of terminal buds and stoppage of length growth before mid-season. Young French prune trees at the University Farm during the season of 1920 stopped growth early in June. Investigation showed the soil to be very dry. New growth started immediately after the trees were irrigated. Cessation of length growth, however, is not always a certain indication of lack of water in the case of mature trees. Bearing trees, in addition to adding new growth, are also maturing a

crop of fruit. They ordinarily cease length growth earlier than younger trees. Lack of moisture throughout the season may also be shown by the small size of the prunes. This last indication is of service only in avoiding the same difficulty the following season.

Most growers who irrigate agree as to the value of an early summer irrigation. Late summer irrigation, just before setting the props under the trees, is not so universally favored, because it is believed to cause cracking of the prunes. Experiments being carried on by the College of Agriculture indicate that cracking of prunes is not due to irrigation. During the season of 1920 an exceptionally heavy crop of prunes in the Boag & Earle orchard near Mountain View, Santa Clara County, was irrigated late in July. The prunes produced, in the opinion of several growers, were larger than would otherwise have been the case, and there was no trouble from cracking. These results indicate that late irrigation does not cause cracking if the prunes are kept growing constantly. The best results are obtained if an ample supply of water can be maintained in the soil throughout the season. This condition can be approximated by the two irrigations during the summer. In a few sections where orchards are situated on land kept moist by seepage during the growing season watering during the summer is probably unnecessary.

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 fence staples, which are drawn snugly down against the bark. 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 October is shown by the increased bloom the following spring.

Irrigation water is usually applied to prune orchards by the basin or check method. Under certain conditions the furrow system may be preferable. An average irrigation is probably approximately 3 or 4 acre inches. A common mistake in irrigating is to regulate the amount of water put on the land by an approximate 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.² These experiments are amply substantiated by local observations in practically every orchard section.

DISEASES

Brown Rot.—Brown rot, until recently, has not been generally found on prune trees, except in some of the mountain or coastal sections. During the season of 1920 a considerable amount of this disease was noticed, both on the blossoms early in the season and later on the fruit itself. This fungus has long been known as a disease of stone fruits, and at various times has been serious in parts of California. Outbreaks have occurred from time to time, principally on cherries and apricots.

During the spring of 1920 the Deciduous Fruit Station at Mountain View, Santa Clara County, successfully controlled brown rot on apricots. The same disease attacks the prune, hence similar measures of control should be used. Lime-sulphur (1 gallon to 9 gallons of water) or Bordeaux (4 pounds copper sulphate, 5 pounds stone lime, 50 gallons water) were equally successful when used against this disease. The spray should be applied in early spring when the first few buds are showing white. No injury will result if the first blossoms are actually open.

If the rot on the fruit itself continues as serious as during the season of 1920, it may become necessary to spray for this form also. Experiments are now in progress for controlling both the spring and summer forms on prunes, but no recommendations can be made at this time.

² See Calif. Agr. Exper. Sta. Bulls. 291 and 310.

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 chisled off and the wounds painted with Bordeaux paste. It is somewhat doubtful if this practice is worth its cost. 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 fungus 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 black or purple strands may often be seen. These are the hyphal threads by which

the fungus spreads. These hyphal threads or mycorrhiza are able to push through the soil for a considerable distance, possibly several feet. When they come in contact with the roots of another tree that tree becomes infected. 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 crown of the infected trees.

Isolation of the infected area is the only method of fighting this disease that has as yet been devised. 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. 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 3 feet will be sufficient if the trench is dug at least 12 feet from a row of trees, although in some soils it may have to be 4 or 5 feet deep. Roots entering the trench should be cut off and burned.

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 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 convenience in irrigation and cultivation.

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

The grower is then confronted with the problem of what to do with the oak fungus areas. All the common root stocks 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 root stock 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 California black walnut, the pear on French root, and the fig are resistant. Any one of these three which is suited to the district may be planted without danger.

Rust.—Rust is of but minor importance on prunes. It appears as a reddish brown mass on the under side 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 sulphate, 5 pounds stone lime, 50 gallons water).

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 a new powder known as "Nicodust," 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-sulphur or oil emulsion must be used. Borers, however, cannot be controlled by either of the above, and must be dug out with a knife or stiff wire.

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 effectually 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-Louse or Aphid.—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 spray³ should be used when the insects first appear: soap, 4 pounds; Black Leaf 40, 1 pint; water, 100 gallons. This must be applied thoroughly, wetting the under side 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. As yet no entirely satisfactory method of controlling this pest in California has been devised other than the old laborious digging out with a knife or wire. If the orchard is badly infested, the borers should be dug out in the fall and the trees inspected in the spring for any missed in the previous operation. Care should be exercised in digging out these pests. In cutting to find the tunnels, the careless workman, if not cautioned, may seriously injure, if not completely girdle, the tree. The hole in the soil made in this work is sometimes left until spring to save the expense of reopening. This practice is a questionable one, especially in sections where the roots are thus exposed to freezing temperatures.

A coat of whitewash applied to the crown of the tree seems to act as a deterrent to the moth, and is of some value. Asphaltum, grade C or D, applied hot to the crown and upper portions of the roots, has materially lessened the injury from this insect in some sections.

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.

Cankerworms.—These insects are also known as measuring worms. They are quite 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. As 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

³ Proved to be successful by D. L. Currier, Assistant Horticultural Commissioner of Santa Clara County.

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. If the orchard has been troubled with this pest 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 may be 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 two-spotted 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 two-spotted or summer mite. A crude oil emulsion, as recommended below for Italian pear scale, effectively controls this pest in most districts. Lime-sulphur, 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 two-spotted 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 sulphur 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 sulphur 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 sulphur has not always been successful, because the fumes liberated by the sulphur do not remain concentrated enough to kill the insects.

Where dusting cannot be employed, lime-sulphur, sulphur paste, or some form of "wettable" sulphur will have to be used as a spray. Lime-sulphur 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.

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 the crude oil emulsion. 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-sulphur 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-sulphur 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.

Heretofore the thrips have been combated with a liquid spray, usually a 1½ per cent oil emulsion, to which is added 1 pint of Black Leaf 40 to every 200 gallons of spray. Results with this spray have been fairly satisfactory. Recently, however, a new material, "Nicodust," has been used which gives promise of being the most effective yet devised. The 5 per cent strength is recommended for thrips. It should be dusted on to the trees with either a hand or a power duster when the first black thrips appear in the spring. Ordinarily from one-third to one-half a pound of Nicodust 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 Nicodust 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 quite 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 warmer 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.

CURING

Most prunes grown in California are sun-dried. In recent years, however, an increasing proportion are dried in evaporators. Evaporation, while more costly, assures the grower that he can dry all his crop without regard to weather conditions. The recent increase in popularity of evaporation in this state undoubtedly was greatly stimulated by the disastrous season of 1918, when a large proportion of the crop was spoiled by mold and fermentation following the heavy rains early in September.

Whether sun-dried or evaporated, 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. In some of the interior valley sections it is necessary to shake the fruit from the trees when it is ripe. Four or five pickings during the season are usually sufficient. The pickers are not allowed to shake the trees until the last picking.

After picking, the prunes are first taken to the dipper, where they are immersed in a hot solution of lye. 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. Likewise, the Robe de Sergeant has a very thin skin and must be dipped but a very short time in a dip of moderate strength to prevent entire removal of the skin.

After dipping, the prunes should be rinsed in clean water. Not many dry yards are equipped to do this, however. The prunes, in some cases, are then often shaken down over a needle board which aids in perforating the skin. The use of the needle board is especially desirable in certain interior sections where the skin is tough. They are then separated into two sizes and placed on the trays. From this point they are taken either to the dry yard or to the evaporator.

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 three by eight 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 full trays 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.

Evaporation (frequently termed dehydration) of prunes is rapidly being adopted in many sections. Many types of evaporators are used. They fall into two general classes, the natural draft and the forced draft driers. In the natural draft, or stack drier, the trays are placed one above the other on cleats. The heat is applied from beneath and is distributed as uniformly as possible over the trays by means of baffles. The heating system may be either a steam radiator or a furnace. In the former, a series of coils are placed beneath the bottom trays and the steam is generated by a suitable boiler. When hot air is used, the fuel, whether wood or oil, is burned in a furnace. This furnace is often an old boiler shell. The hot air is conducted by means of large iron pipes back and forth throughout the length of the heating chamber in order to secure a large radiating surface.

The tunnel driers now being used are principally of the forced draft type. The air is heated either by steam coils or hot air pipes and is circulated over the fruit by means of a blower or a suction fan, which may be at either end of the tunnel or in the middle, according to the arrangement of the heating system. Some evaporators are equipped with return flues which provide for returning and reheating part of the air so that the greatest economy may be secured.⁴ For a small

⁴ For full technical description see Calif. Agr. Exper. Sta. Bull. No. 322, The Evaporation of Grapes, by W. V. Cruess, A. W. Christie, and F. Flossfeder.

orchard, a stack or tunnel drier, as described in Circular 213 of the California Experiment Station, would probably be satisfactory.

The trays used in evaporators are usually about 3 by 3 feet, varying somewhat according to the particular make of evaporator. They are made with a solid, slat, or wire cloth bottom. A 3 by 3 tray holds approximately 25 pounds of green prunes.

The length of time for drying prunes in an evaporator varies from 12 to 72 hours, according to the size of the prunes, the temperature maintained and the type and efficiency of the evaporator. With proper adjustment of temperature and air humidity, prunes may be dried very rapidly. Too high a temperature near the end of the drying period causes case hardening and a scorched flavor. The temperatures used vary from 140° to 200° F., but for the best results should probably not exceed 175° F. Evaporators are usually so designed that the fresh fruit is started at the cooler end of the evaporator. According to W. V. Cruess, it is doubtful if this is the best arrangement.

Sun-drying and evaporating both have advantages and disadvantages. Sun-drying is usually cheaper and probably requires less skill. Large prunes require several days longer to dry than do the small ones.

Evaporation does away with the necessity for a dry yard. The trays may be used many times during the season instead of only twice, as is the case in sun-drying; therefore a smaller number are required. The fruit is not covered with dust, as is the case in many dry yards. The strongest argument in favor of the evaporator, however, is the positive assurance of curing the entire crop, regardless of inclement weather. On the other hand, an evaporator involves a heavier initial expenditure, and the beginner may often make serious mistakes in evaporating his crop before he is familiar with the process.

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 an evaporator in case the fruit is not sun-dried. For a crop of 100 green tons, approximately 1000 to 1400 or 1500 trays are 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. Before the recent increases in cost, these trays could be purchased at about 50 cents each. During the past few seasons the cost has advanced to \$1.15, to \$1.35, and in some cases, to \$1.50 each. For the same crop approximately 250 lug boxes at 35 cents each are needed. The dipping equipment and the platform cost from \$300 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 $2\frac{1}{4}$ 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.

The cost of all orchard operations during the past two or three seasons showed a great advance over those of the preceding years. A large part of this increase was due to increased cost of labor. Costs of such operations as cultivating, pruning, spraying, picking, and drying are directly proportional to the prevailing wage of labor. The cost of cultivation, including plowing, was probably at least \$20 per acre. In many cases it was more and in a few cases less. Pruning costs vary somewhat with the condition of the trees. Ordinarily prune trees are not pruned heavily, but sometimes considerable cutting is necessary. The average cost of pruning and burning brush was probably not less than \$15 per acre. Spraying cost approximately \$15 per acre per application. Digging for borers cost at least \$3 to \$5 per acre.

The widest ranges in cost of any of the orchard operations was found in irrigation. In general, irrigation by gravity water was less expensive than irrigation from wells. The cost probably varied from a nominal charge under some of the gravity systems to \$35 or \$40 or more per acre where water was pumped against high heads.

Picking cost from \$7 to \$12 per green ton. For average crops of two to three tons of green fruit, this meant a cost of from \$14 to \$36 per acre. Ordinarily the higher rate prevailed in orchards having the poorest crop, as picking is done on a piecework basis. The drying costs were approximately \$12 per ton, or from \$24 to \$36 per acre for a two or three ton crop.

To the foregoing costs must be added: taxes, insurance, upkeep of tillage implements, depreciation of machinery and buildings, cost of horse feed, and interest on the investment.

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