BULLETIN NO. 111 20,000 SEPTEMBER, 1911

DIVISION OF HORTICULTURE

Oregon Agricultural College
Experiment Station
Corvallis, Oregon

ORCHARD MANAGEMENT

BY C. I. LEWIS

The Bulletins of this Station are sent free to all residents of Oregon who request them.

Oregon Agricultural College Press
Corvallis, Oregon
1911

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Oregon as a Fruit State

Oregon is a very large state containing many varied conditions. The elevation extends from sea level to the limit of plant growth, and the rainfall ranges from 130 down to 2 inches. One can find in this state climatic conditions that will suit every taste. There are regions where frosts are hardly ever known; others are subject to fairly cold winters. There are great ranges in summer temperature. Some of the valleys are able to produce almost tropical growth.

The Cascade range of mountains divides the state into two great sections, each of which has many special divisions.

As one enters the state from the east he finds on the eastern boundary that some development has taken place at Ontario and vicinity. This region, while but slightly developed, has conditions somewhat similar to those of the Payette Valley of Idaho, which is quite highly developed. At Baker quite a large acreage has been devoted to orchards but only a very small percentage is in bearing. The Grande Ronde Valley is one of the largest fertile valleys of Eastern Oregon situated along the railroad. The rainfall here is about 17 inches. The soils, for the greater part, are rich alluvial bottoms; the hill lands, generally, are worthless for fruit growing.

At LaGrande there is an extensive area given over to apples. Imbler, the famous sandy ridge formerly thought worthless, has developed into a fine fruit district, while at Cove apples and cherries are grown extensively. Irrigation, as applied to fruit growing, is practiced only to a limited extent in this region, but in the future will become much more extensive.

At Freewater-Milton, in the Walla Walla Valley, we find quite an extensive fruit industry; prunes, apples, pears, peaches, and small fruits all receive considerable attention. The rainfall in this district is about 20 inches. Considerable irrigation is practiced, especially in the early summer. It is a rich, fertile valley and is especially adapted for early fruits. The so-called stony soils of that district are very early.

Proceeding westward we reach the Umatilla Irrigation Project. This is a government project recently placed under irrigation and is being sold in 40-acre units. A mere start has been made at the present time. The soil, sandy in character, has indications that it will be splendid for truck crops and

early fruits. The Umatilla Experiment Farm, a branch of the Oregon Experiment Station, is situated at Hermiston and is devoted largely to fruit growing.

As far as fruit growing is concerned, Central Oregon at the present time is very slightly developed. There are a number of locations that are producing first class fruit and give great promise of becoming commercial centers of fruit growing. Many regions, however, are too frosty, have insufficient drainage, and in places the soils are too thin to ever allow successful commercial orcharding.

In the Eagle and Pine valleys in the vicinity of Baker, considerable area is being devoted to fruit growing and the outlook is promising. In the famous John Day Valley extensive orchards have been planted and are in heavy bearing. Indications are that considerable area of that valley will be devoted to fruit growing. At times frosts will do some injury and one should select locations with that end in view.

In such sections as Harney County, fruit growing is developed to a rather limited extent. The valley lands in many cases are too poorly drained for fruit growing, and many of the hill lands are too bleak and exposed for this industry. However, one finds on some of the foothills and in regions subject to canyon and valley breezes, orchard areas that are producing unusually good crops.

In Rosland, LaPine, and Odell districts very little attempt has been made along the lines of fruit growing, and only few vegetables, such as cabbage and beets, are grown. In all probability most of that area will be too frosty for the growing of tender fruits and vegetables.

In the vicinity of PowellButtes near Prineville, a considerable area adapted to fruit growing is to be found, and at the cove near Madras in the vicinity of the mouth of the Metoleus river, a considerable area is to be found which is promising as a fruit district.

In the Fremont and Fort Rock districts up to the present time but little or nothing has been attempted along the line of fruit growing. In all probability some of our hardiest varieties of fruit will succeed, but probably for home orchard planting only. Orcharding should not be undertaken commercially in this district from present indications.

In the Silver and Christmas Lake districts the soils for the

greater part are unadapted for most fruits and vegetables. In general the soil is very shallow. Hardy vegetables are doing fairly well, but only where the soil is fertilized or irrigated. In some of the more sheltered districts and foot hills good fruit can probably be grown in limited quantities, but probably never on an extensive commercial scale.

At Summer Lake we find one of the most inviting fruit districts to be found in all Central Oregon, on the western shore of the lake. This region seems admirably adapted to the growing of fruits of every description. Even such tender fruits as apricots succeed, while such vegetables as tomatoes grow to a high degree of perfection The soil is very good, ranging from a sand through the loams to muck as one nears the lake. Undoubtedly the lake has an influence in that region. Fruits of all kinds seem to yield excellent crops and the product is of splendid quality. Such apples as Spitzenberg and Winter Banana have taken a very high color and the entire region seems to be admirably adapted to the growing of fruits and vegetables on a commercial scale. There is considerable activity in this region, a considerable area being planted to young orchards.

Chewauchan valley is now largely given up to stock raising, but there are a few home orchards that seem to be producing fair crops, but not what would be called commercial yields. It is possible that fruit may succeed on the foot hills, but the valley proper is too flat and frosty for commercial fruit production.

At Goose Lake there are few home orchards to be found on the north and west shores, but these are hardly worthy of mention, as the trees are rather spindly and at times the yield is even insufficient for home use. In all probability fruit growing on this side of the lake will never be a paying proposition commercially. On the east side of the lake, however, one finds splendid home orchards. Some irrigation is being practiced, but orchards are being grown both with and without irrigation; in all probability the unirrigated orchards are to a large extent sub-irrigated. The fruit possibilities of this side of the lake seem to be much the same as those found at Summer Lake. Apples take on splendid color; the trees produce heavily and make splendid, vigorous growth. Small fruits do especially well, and the climatic conditions are such as to allow

the growing of the tender fruits, and even such vegetables as tomatoes, cucumbers, etc. Much of this side of the lake could be developed into a splendid fruit growing district and should be given more attention. Most of the activity is confined to Pine Creek and New Pine Creek.

It is to be feared that the vicinity of Hampton Butte will be too frosty for successful fruit production on a commercial scale, and one should plant in that region only the hardiest fruits.

At Warner Lake little should be done with fruit, although at Adell there are regions supposed to be adapted to fruit growing and limited areas are being devoted to this industry.

In the vicinity of The Dalles, on the Columbia, extensive fruit areas are found. Peaches, prunes, cherries and grapes are all being grown for shipment. To the south on some of the table lands and in some of the valleys, especially in the vicinity of Dufur, considerable areas are being planted to apples.

Twenty-two miles west of The Dalles we find the famous Hood River Valley. This district has earned world-wide reputation for its apples. Yellow Newtown and Spitzenberg are the principal varieties. It has about 10,000 acres in orchards; has seven or eight different types of soil, all of which grow fruit successfully when supplied with humus and when deep and drained thoroughly both as to air and soil. The region which is directly above the town of Hood River is known as the lower valley, while in the vicinity of Mount Hood is the upper valley. In the upper valley we find rich fertile soil, but as yet few bearing orchards in that district. With the proper handling the prospects are very encouraging for orcharding. The elevation of Hood River Valley ranges from 600 to 2500 feet. The rainfall is about 35 inches. The main apples are Yellow Newtown, Spitzenberg, Ortley and Jonathan.

Between Hood River and The Dalles is a small valley known as the Mosier district. This district has much the same conditions as are found in the Hood River Valley. Formerly a great many prunes were grown in this district, but it is becoming chiefly an apple district, producing such varieties as Newtown Spitzenberg, Ortley, etc.

The next district of interest is the Willamette Valley, which extends from Portland on the north to Cottage Grove on the south; 150 miles long and 60 miles in width. The rainfall

varies from 30 to 60 inches. It is a valley of great variations and wide adaptability. The river bottom lands are splendidly adapted for peaches and truck crops. Cherries have also done well on these bottom lands, and orchards of apples and pears in a number of cases are making successful growths. Young walnut trees planted on many of these lands have made splendid development. Whether they will prove to be apple and pear lands on an extensive scale will need further demonstration, the one point being that excessive frosts might damage such crops where the orchard locations were at the base of benches quite a distance from the river. Directly above the river soils which are generally sandy and silt soils, we find especially in the upper part of the valley quite extensive areas of so-called white land. Fruit has never been grown on these lands to any great extent, and probably never will be grown until drainage has been undertaken; although with drainage the pear can, in all probability, be successfully grown in preference to other fruits. Apples likewise would be very promising. Small fruits do especially well on such lands. Between these white lands and the foothill lands will be found the gently rolling clay loams, splendidly adapted for apples and pears. In the lower part of the valley in such counties as Washington, Yamhill, etc., are found such areas as we might term table lands, tending from an elevation of 500 to 1500 feet, or in some cases to the very base of snow-capped peaks. Where these are deep and contain strong clay loams they are splendidly adapted for the growing of apples and pears. Some of the lighter loams seem adapted for the growing of cherries and prunes. Wherever of great depth walnuts should also thrive. The foothill lands which one finds extending from the table lands south to the white lands of the valley are, as a whole, more adapted for prunes and cherries than for any other crops. They are apt to be thin and poor to the west and south exposure, but deep and of greater value to the north and east; it is true not only in this valley but also in the valleys found to the south; there seems to be a general tendency for these hill lands to become poorer as they extend southward. The Willamette Valley is the center of the famous Italian prune industry and the cherry industry of the state. The principal walnut interests of the state are also found in this valley, while the apple and pear industries are also increasing rapidly.

The Umpqua Valley, found immediately south of the Willamette Valley, has 25 inches rainfall, and its rich, gentle, rolling bottom lands are splendidly adapted for apple and pear culture. It is the earliest valley we have in the state, producing the first cherries and strawberries for our markets. More attention should be paid to the production of our early fruits. Many of the hill lands, which are light in character, grow small fruits to splendid advantage. Some irrigation is practiced in the Umpqua, although the greater part of the valley is not irrigated. Prunes receive some attention, although apples lead. One can find deep soils adapted to all classes of fruits.

Continuing southward we come to the vast Rogue River Valley, extending from the vicinity of Merlin to Ashland, containing many thousands of acres planted to fruit, the present acreage being estimated all the way from 40,000 to 60,000 acres. Rainfall is all the way from 19 to 25 inches. This region has a world-wide reputation for its pears. Apples are also being grown very extensively. There is a tremendous range of soils, elevations, etc. The hill lands are more adapted for peaches and cherries than for other crops. Some of the rich red hill lands with sunny exposures and elevated beyond fogs or frosts, are well adapted to the growing of such Enropean varieties of grapes as Muscat, Tokay and Malaga, which are produced in unsurpassed quality. There is an opportunity for a large development of the grape industry. With the extension of irrigation many of the uplands along the hillsides will be come famous for apple and pear growing. The bottom lands show a wonderful range of soils, from the heaviest adobe to good free soils, sand, silt loams, etc. Fruit is being grown on each. The bottom lands at times are subject to frosts. It will take some years yet to determine just what conditions are best adapted to the best varieties of fruits. It is thought by many that such pears as Bartlett, Bosc, Comice grow better on some of the lighter loams, while the Winter Nelis thrives best on the strong rich loams. The Yellow Newtowns are found growing on the heaviest adobe, as well as on the lighter soils on the hillsides, there being very often one month's difference in the maturity of the fruit under such conditions.

OVERPRODUCTION.

Overproduction of fruit is a dread which seems to hang over the heads of many people interested in fruit growing. Over-production has rarely occurred in America fruit growing; at times we have had poor distribution, and in 1896, owing to a heavy crop and poor distribution, one might say an overproduction was realized, but we have had nothing of the kind since then, and both apple and pear production has been downward, the shrinkage being from 76 million barrels in 1896 to 25 million barrels in 1910. With the proper organization, with good distribution, with fruit growers controlling their fruit and handling it when placed on the market for consumption, with storage in transit rates, there is a field for fruit production for all classes. One must also remember that the average yield is low and that there are thousands of trees that will never become profitable, owing to being planted in improper locations as regards soils, frosts, etc., to poor management, to unwise choice of varieties, and one must remember that there is a large acreage each year that is practically going out of bearing.

CHOOSING AN ORCHARD.

The average man in choosing an orchard is apt to think that soil analysis is the panacea of all troubles, and that analysis will show what can be grown to advantage on his soil.

In choosing an orchard there are many points to be considered which will vary more or less in degree of importance according to the locality. These points are, air and soil drainage, exposure, elevation, depth of soil, general character of the soil. In the various northwest fruit growing sections one must have the natural conditions which are conducive for fruit growing before one is concerned about the soil. Foolish comparisons are often made between irrigated and non-irrigated districts. Each district probably has its advantages, as well as its disadvantages. East of the Cascades in regions where it is impossible to irrigate, the soil must be of good depth if one is to grow fruit successfully. The silt loams and volcanic ash soils are much more retentive of the moisture than the sandy types. One needs in such cases to pay close attention to immunity from frosts. In the irrigated districts of Eastern Oregon extreme depth of soil may not be as necessary, al-

though it is very desirable. Good drainage on the other hand becomes very essential; we must try to avoid seepage water and the accumulation of alkali; the orchards along the high line ditches are apt to suffer less from such dangers. In some of these districts one finds all types of fruits being grown in the same orchard. With abundance of water one can at times overcome the drawbacks, such as the lack of the desired kind of soil. Often the sandy soils with plenty of moisture will produce many types of fruit such as apples, pears, peaches, prunes, cherries, grapes and small fruits all in the same orchard under similar conditions. I have never yet seen, however, an orchard under irrigated conditions, planted to many types of fruit, producing them all to a high degree of perfection. Peaches and apples, for axample, need entirely different treatment, different amounts of water and different times of application. What might be ideal for peaches may be poor for apples, and vice versa. One of the special points to observe in irrigated districts is good drainage, seepage water often becoming a menace. Many of the valleys are also subject to frosts, and one should study such conditions carefully.

In Western and Southern Oregon, where irrigation is not practiced, one should strive for good depth of soil. A good way to determine this is to get a carpenter's auger of half inch diameter and screw into this a section of small gas pipe. With this instrument borings four or five feet or much deeper can be made. While I have seen such fruit as apples grown on shallow soil underlaid by disintegrated rock, nevertheless I should avoid soils that are underlaid with hard-pan, soapstone, loose gravel or cement gravel at a depth of four or five feet from the surface. Be sure of good soil and splendid air drainage. Exposure becomes important with some classes of fruit; the Spitzenberg, for example, does better on the warm, rich, but not too heavy soil and in a sunny exposure. On some of the rolling lands and bottom lands one needs to be careful about seepage waters, which retard the tree's growth unless proper drainage is given.

In the irrigated sections of Southern and Western Oregon, good depth is desirable and splendid drainage becomes very essential. One should choose locations that are provided with good air circulation. Where such fruits as grapes are to be grown, they should be placed on a sunny exposure where they

can get the maximum amount of sunshine and warmth in the fall of the year and where they are not subjected to fogs and frosts when the fruit is ripening.

Exposure, elevation, good air drainage, all play an important part in a successful orchard.

PROFITS IN ORCHARDING.

At times the profits in orcharding throughout the Northwest are somewhat hard to believe. There are many authentic records of profits exceeding $1,000 per acre. The average profits, however, are not nearly as great, and many people will be disappointed in their orchard investment because they are expecting unusual and unreasonable returns. In establishing profits, one should compile figures extending over a series of years; they should be based on average good orchard conditions and we should take for granted that the person interested has average ability. Under average conditions one can expect at present an income of about $200 net per acre. The income will depend, of course, upon the personal element, and the acreage, methods of management, etc.

Many people are choosing too small an acreage. While the ten acre tract is an inviting investment to the man who cannot live on his land for a number of years, nevertheless, the income from such tracts will in the majority of cases be disappointing. Under average conditions the ten acre tract is not large enough to insure the desired income and support the family in many cases, at least not to the degree that many of the investors would desire. The ten acre tract, as a rule, should be purchased with the aim in view of producing an income, rather than absolute support as is often expected. Some tracts, especially those of wide adaptability, of splendid soils, and with irrigation waters, may be able to come up to expectations. However, these are not average conditions. Unfortunately many tracts are not in proper and good locations, and there is a tendency at times not to give them the best commercial care. Prospective buyers are often quoted bonanza figures which are based on some unusual yields and not average conditions. There are many companies that are doing all in their power to grow first class orchards. The best advice to give a purchaser is to come and see the lands before buying. Often very fair returns are realized where one diversifies on

ten acre tracts. In such cases a few hogs can be kept; a few chickens, two or three acres in fruit, and some acreage in strawberries. The average ten acre tract, however, is too expensive to manage, and it is not a sufficient acreage to insure a good income for a family during the series of years. The cheapest unit to establish an orchard is about 40 acres, as one man and a pair of horses can do the work on an acreage of this size up to the time the trees come into bearing. Also 40 acres can be managed by planting 10 to 20 or 30 acres at the start and have enough land for chickens, hogs, and other side lines to be handled to give the family a living until the orchard comes into bearing. After the orchard comes into bearing it is doubtful if one can undertake any specialties other than the orchard. Taken on th supposition of 40 acre units, one can probably care for an orchard for the first four or five years for about $100 to $150 per acre. This includes the price of the planting and setting of the trees, cultivation, pruning, etc.; the total cost would depend on the initial price of the land, whether or not clearing will be necessary, or the acreage to be developed. Exclusive of price of land and including interest on investment and all running expenses, it will cost from $150 to $350 an acre to bring an orchard up to four years of age.

CLEARING THE LAND.

Clearing of timber lands and stump lands is, at the best, quite expensive. The cost will vary all the way from $25 to $150 per acre, according to the density of the growth and the size of the stumps, and the opportunity to dispose of lumber or wood. Many methods are used in clearing land; such as blasting, burning, the use of char pit, and the air pressure methods, and piling with donkey engines and afterward burning. These all have their special advantages, and the chances are that in clearing a large area one would use all these systems to a more or less extent. Special information concerning the char pit method of burning stumps can be had by addressing the Portland Commercial Club, Portland, Oregon. The Puyallup Station at Puyallup, Washington, issued an interesting bulletin on burning stumps by using an engine to give forced draught. In a general way, fir stump land where the growth has been heavy is apt to be good fruit land if it has proper

air drainage. Oak stumpage or timber may be on good land, although in many cases oak trees will thrive on land that would not be considered first class fruit land. It is not safe to choose land for fruit simply because it grows large oak trees. It has been customary to advise one not to plant young trees on oak stump land until several crops have been grown, owing to the presence of mushroom fungus, but this has not been as thoroughly worked out as might be desired, and many men are planting orchards even before all the stumps are removed, as the small oak stumps will decay so that they can be plowed out in a few years. Some men prefer never to plant on newly cleared land, claiming trees make a poor growth and that it is a better practice to plant crops for a few years before setting trees. This undoubtedly depends on the amount of plant food available, and the thorough preparation before planting. On fir land the organic matter may not decay so as to be available for trees for some time. However, it has been my observation that where the ground has been thoroughly worked down before planting and the setting of trees is not delayed until too late in the spring, the young trees planted grow very nicely.

On some of the silt loams, peaches are being grown successfully before the land is thoroughly cleared. With sage brush lands it is often better not to clear the land entirely until one has supplied it with enough humus to prevent blowing. The best method to prescribe is to clear a strip and pile the brush along in rows in right angles to the prevailing winds. The brush should not be removed until the soil is well filled with humus and the ground has become settled and established so there is no danger from shifting soils during the windy periods. It is a fatal mistake to clear large areas of light soils covered with sage brush where there are strong prevailing winds, as the soil under such circumstances will blow badly.

PREPARATION OF THE LAND.

In most cases it will pay to give thorough preparation to the land before planting. In the heavy clay soils this may mean sub-soiling also. Where land has been devoted to grain growing for a number of years, it is often desirable to subsoil in strips where trees are planted. In newly cleared lands the soils are well supplied with humus although perhaps not

well decayed, and good preparation in this case while often seeming not as essential as in old wheat lands, is, in most cases, necessary, as these lands are often very uneven and loose. It is believed that in newly irrigated sections on soils devoid of humus, it is better to grow crops a few years before attempting to grow fruit trees. We are conducting experiments along this line at the present time.

BUYING THE TREES.

This is a question which needs very careful attention. Orders should be placed early for nursery stock, owing to the fact that for the last few years the supply has not been equal to the demand. One should in all cases insist on procuring what is known as one year old trees. It is true that in various irrigated sections they are able to grow a large tree from a piece root in one year, but there is a tendency to force the tree unwisely. It will probably make little difference whether the tree is grown with or without irrigation provided the trees have not suffered from lack of proper handling and from excessive irrigation. We have been encouraging nursery men to grow extra tall trees. We should encourage them to grow trees of larger caliber and good heavy base; the medium tree of large caliber is better than the high spindling tree. It is extremely desirable to have trees well supplied with buds scattered over the entire length; this assists materially in forming a good head with branches well spaced.

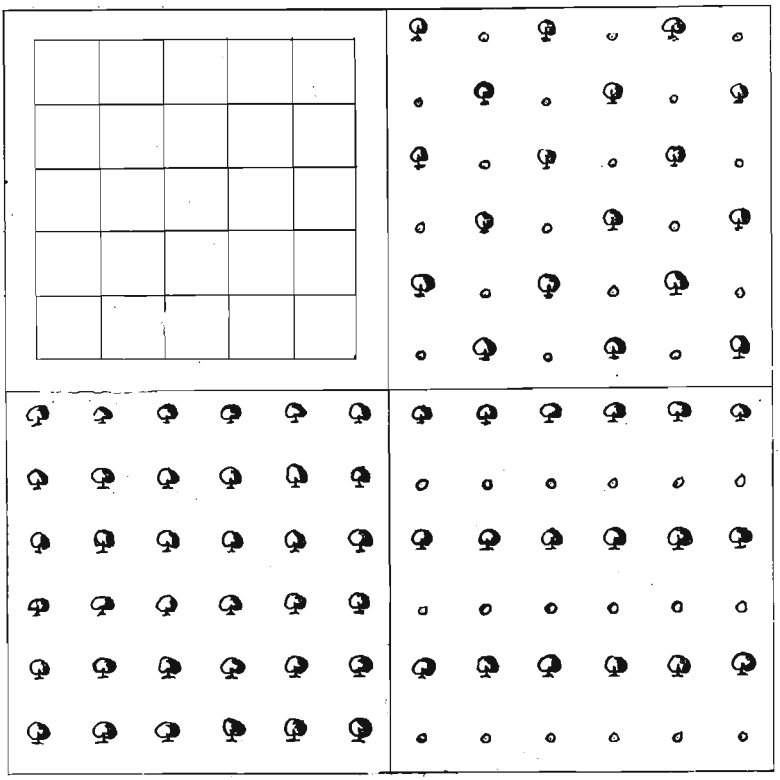
As soon as trees are received from the nurseries, remove them from the boxes and, the ground having been previously plowed out, heel them in as soon as possible. Delay may be disastrous to the tree.

It is desirable with such trees as peaches, prunes and cherries to have them heeled-in with tops facing the south, as the buds will remain dormant longer than if pointed to the north. Cover the root firmly and well. If the roots are allowed to freeze in any way they will probably die. Never handle young trees when they are frozen. Never heel-in in bundles and let remain for an extended period, as they will often die from scald, drying out, or even freezing if the earth is too loose around the roots. The bundles should be cut and the trees heeled-in singly. Occasionally when trees arrive in a shriveled or dried condition they can be revived by burying the entire

trees in damp sod for a few days; this will often cause the bark to become plump again.

TIME TO PLANT.

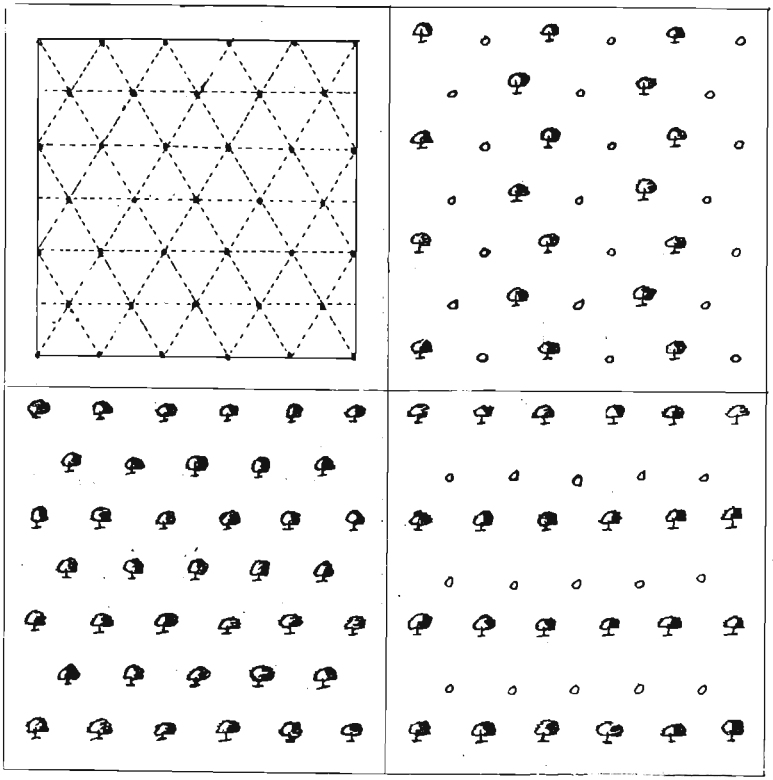
In all the regions of the state subject to extreme low temperature in winter, such as zero or lower, and more especially



No. 1. Rectangular System of Planting.
Fig. 1.—Field Lined.
Fig. 2.—Field Set.
Fig. 3.—Proper Thinning.
Fig. 4.—Improper Thinning.

where the ground is exposed to such extremes and dry freezing is experienced, spring planting is preferable, but in all other sections of the state, fall planting is much to be preferred. In Western and Southern Oregon it is desirable to plant trees by the first or middle of March. Trees planted in late fall or

early winter become established and make a quicker and better growth than those planted in the spring. I have noticed a smaller percentage of the trees die, and in many section even less winter killing, with the fall planting of trees. In the latter case it may have been due to improper care of trees before planting.

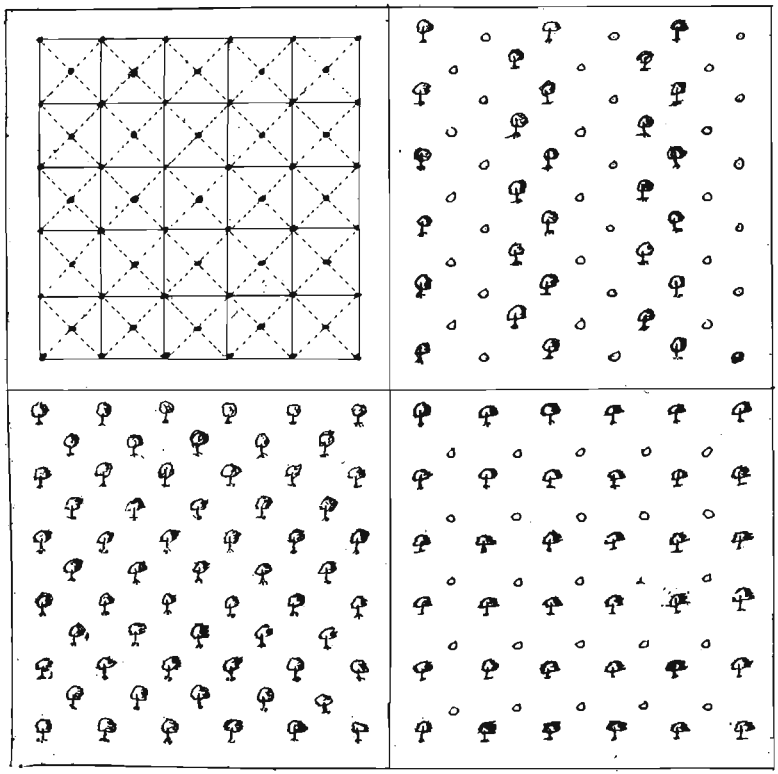


No. 2. Hexagonal System of Planting.
Fig. 1.—Field Staked.
Fig. 2.—Field Set.
Fig. 3.—Improper Thinning.
Fig. 4.—Partly Thinned.

PLANTING THE ORCHARD.

There are a number of systems that may be used in planting an orchard; each has its defects and its strong points. The most common system is the rectangular. According to this system the trees are planted in rectangles or squares. The

main advantage of this system is that it allows one to cultivate both ways to the best advantage, especially when the trees become large. It does not, however, give equal distribution of the trees over the ground. In planting orchards by this system with the intention of thinning out later on, one can easily make mistakes. The common mistake is to plant trees



No. 3. Qunicunx System of Planting.
Fig. 1.—Field Staked.
Fig. 2.—Field Set.
Fig. 3.—Improper Thinning.
Fig. 4.—Proper Thinning.

20 feet apart each way and then to think that by taking out every other tree the distance will be increased to 40 feet. On the contrary, they will be left in squares running diagonally acress the field 28 feet apart. It would be necessary to take out three-fourths of the trees to throw them 40 feet apart.

The second system is the quincunx. This is not used to any great extent at the present time, but has many advantages and is desirable where fillers are to be used. It means planting in fives. One can make permanent plantings in the rectangle or square and then place another tree in the center of each rectangle or square. When the trees crowd the center one can be easily removed. In this way you can plant 75 per cent more trees to the acre than you can by the rectangle.

The hexagonal system is based on the circle, but can be planted with an equilaterial triangle. The trees are really planted in groups of seven, six trees in a circle with one in the center. It has the advantage that all trees are equally distant and each receives an equal distribution of air and light. However, by this system cultivation is rendered more difficult than by the rectangular system, especially when the trees begin to crowd a little. While fillers can be used, the system does not work as nicely from a horticulturalist's point of view as does the quincunx, which horticulturally is the most ideal to me where close planting or fillers are desired. The hexagonal gives 15 per cent more trees to the acre than does the rectangular.

NUMBER OF TREES PER ACRE.

Distance Apart.	Rectangular.	Quincunx.	Hexagonal.
16 x 16	170	303	196
18 x 18	134	239	154
20 x 20	108	192	124
22 x 22	90	148	104
24 x 24	76	132	87
25 x 25	70	125	80
26 x 26	64	114	74
28 x 28	56	100	64
30 x 30	48	85	55
32 x 32	43	76	49
33 x 33	40	71	46
36 x 36	34	60	39
40 x 40	27	48	32
45 x 45	22	39	25

DISTANCE TO PLANT.

The distance to plant trees varies according to the type of fruit, variety, soil, elevation, etc. On strong soils of low elevation, greater distances are needed than on the higher elevations and the lighter soils. In some of the uplands of Eastern Oregon and on some of the hill lands of Western Oregon, 25 to 28 feet will be sufficient for apples, while on the stronger soils 30 to 35 feet is more desirable; pears, 20 to 25 feet; peaches, 12 to 20. Many growers are giving more room. Trees grow larger as a rule in Western and Southern Oregon than they do in Eastern Oregon. Prunes formerly had 16 feet, but the older orchards need 25 feet to do best. Mature sweet cherries should have 35 to 40 feet, while the young orchards of sour cherries need about 20 feet. Walnuts require all the way from 40 to 60 feet. One often finds that certain varieties of fruits do not need the maximum distance. Among our apples some of the less sturdy growers are the Yellow Newtown, Ortley, Rome Beauty, Ben Davis, Duchess, Yellow Bellflower, Wagener.

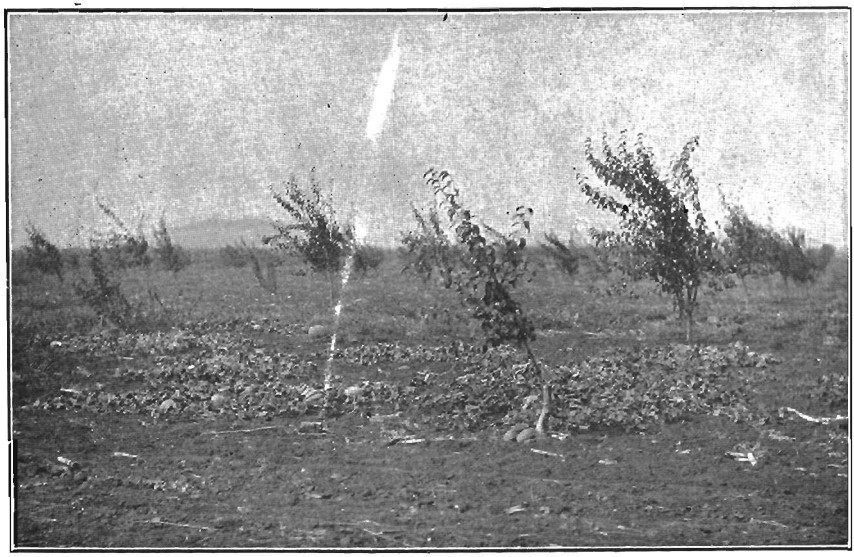
PLANTING.

The size of the hole dug for planting trees will depend on the conditions. In the volcanic soils large holes are not as necessary as with heavy soils. On clay loams and all heavy soils, more attention must be given to this subject. It is better not to dig holes as wide as is practiced by some people, nor should they be dug a long time before you plant the trees. Often the question is asked, "Does it pay to blast holes for planting?" Generally I would say no, as such soils are apt to be poor for fruit. There might be exceptions to this, however, where it is desirable to loosen up clay and more especially where one wishes to break up a shallow hard pan. Generally cut off one-half to one-third of the root system and on planting remove all broken and injured roots. Avoid letting the roots become too dry and never expose them to freezing. The Stringfellow system of pruning and planting is, on the whole, not very satisfactory with us.

Many growers do not set trees firm enough and thousands die because of this loose setting; they must be set firmly in all cases, and should be planted from two to three inches

deeper than they were in the nursery row. In planting young trees a planting board can be used to advantage. It is a common board with a notch cut at the center and holes bored at the ends. After the orchard is staked and before the holes are dug, the board is placed so that the notch comes next to the stake and short stakes are driven through the holes in the end of the board. The board is then lifted and when the trees are planted the board is replaced, and the tree set so that it comes in the notch in the board. If this is practiced the trees will keep the exact alignment of the stakes.

When there are strong prevailing winds, lean the trees at

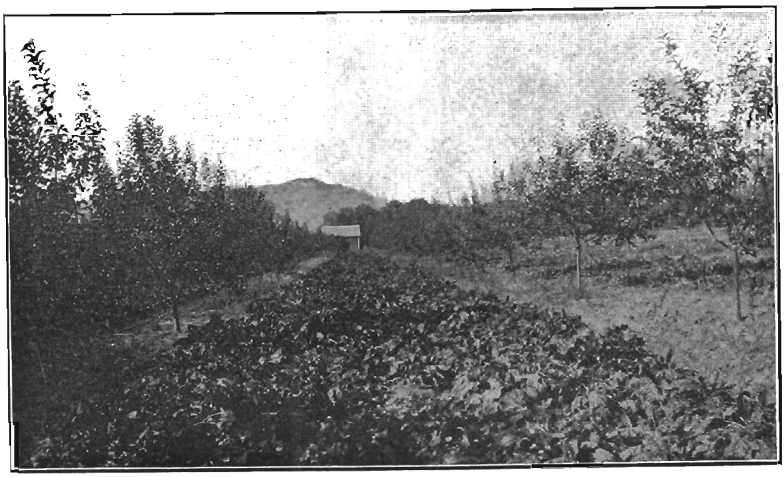


No. 4—Windbreak greatly needed. Only by the most judicious pruning can these trees be balanced, and then only with great difficulty. Staking would have helped many of these trees.

the time of planting slightly to the windward. Especially should this be observed in Eastern Oregon. Where the wind is so strong as to make proper training of the trees difficult, it will be found advisable to stake them. The trunk and main branches should be tied to the stake in such a way as to avoid cutting or other injury to the trees. Use broad bands for tying material and protect the branches where tied with such material as leather or heavy canvas. Windbreaks may be grown to good advantage.

INTERCROPPING AND FILLERS.

These are two questions in which every orchardist is interested. It is of course desirable to obtain as much profit from the land as possible, and to have it produce an income as soon as practical. In fact, many orchardists must have some income while the orchard is coming into bearing. There are several ways in which this may be accomplished. One way is to plant crops between the trees. When this is done one should avoid grains, as they take a large amount of plant food that the trees need later. Potatoes are used, but these are hard on the potash of the soil. Most other truck crops are good, such as melons, squash, beans, beets, peas, etc. Undoubtedly

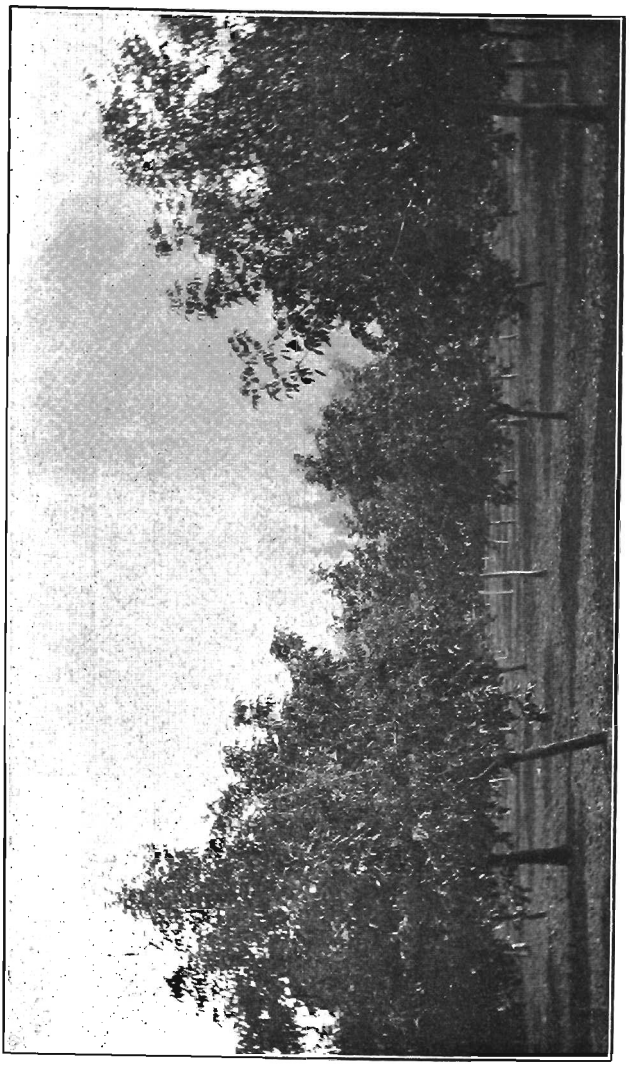


No. 5.—Permissible in a young orchard but the crop is somewhat too heavy. Never grow grains, but garden truck may be grown if necessary.

many of the virgin soils in the Northwest would not be injured by intercropping, for chances are that clean tillage causes oxidation of much of the plant food which is later leached out by winter rains and irrigation. There is a possibility in such cases where crops are grown between the trees that much of this plant food would be retained or utilized by the crop. On the other hand, a number of our soils should not be intercropped unless one is willing later to add plant food in some form.

When intercropping is practicable, leave ample distance be-

tween the crop and the young trees so that the latter do not suffer for want of plant food and moisture. The average man should practice intercropping carefully, as he is apt to overdo



No. 6.—Arrangement of walnuts and prunes. Every other row is set to walnuts. Every third or fourth row would be better, thus allowing 50 feet between trees.

it and grow the crop at the sacrifice of proper tree development. Small fruits like strawberries are often grown. If they are planted close to the trees, and especially in those cases

where irrigation is practical, the moisture and shallow cultivation encourage the young trees to become shallow, rather than deep rooted. Such crops as clover and vetch are often grown and while preferable to many other crops, if they are always harvested and never plowed under they exhaust rather than build up the soil, especially in potash.

By filler system we mean planting of some trees that will be removed when the main orchard comes into heavy bearing. We try to get off a number of crops in order to bring in a large income during the first few years of bearing and then later we plan to cut out from one-half to two-thirds when they begin to crowd.

Personally, I believe the best way to handle fillers is to plant the same type of fruit, as peaches with peaches, apples with apples. Dwarf pears are becoming popular as fillers and can often be used in apple and walnut orchards. The trouble is the average man is not provided with sufficient nerve to cut out trees when they begin to crowd, and as a result he allows the crowding of trees to continue until the orchard is often ruined.

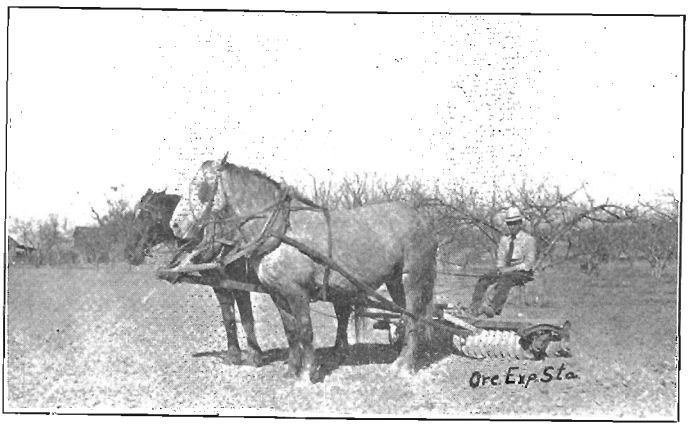
TILLAGE.

Throughout the Pacific Northwest a common practice for orchardists has been what is known as the clean culture system. By this practice we mean generally a thorough preparation of the ground in spring, followed by frequent cultivations during the summer time. Orchardists in general feel that experience has taught them that there is no way superior to thorough tillage of the ground to maintain trees in good thrift and heavy bearing. Some of the reasons for tillage in an orchard are: to maintain a sufficient supply of moisture and to make available the plant food there is in the soil, so that trees can obtain this food; by pulverizing the soil a much greater feeding area is presented for the rootlets of the trees; by pulverizing this soil deeply in the spring of the year we also get additional root holding area for the plants. Tillage also has considerable to do with the moisture content of the orchard soils. By the spring plowing and harrowing of the ground we are apt to have less extremes of temperature, the ground is apt to become warmer, and is placed in such condition that the roots can begin their activity and top growth begin early. For this reason at times one should not practice too early tillage with

fruits that are apt to be caught by frosts. The stone fruits especially should not be given too early tillage.

Tillage in the spring of the year increases the water holding capacity of the soil. It places the soil in such condition that it can catch the spring rains and hold them for tree growth. Later on in the summer the frequent shallow cultivations will check the rapid evaporation of moisture from the soil.

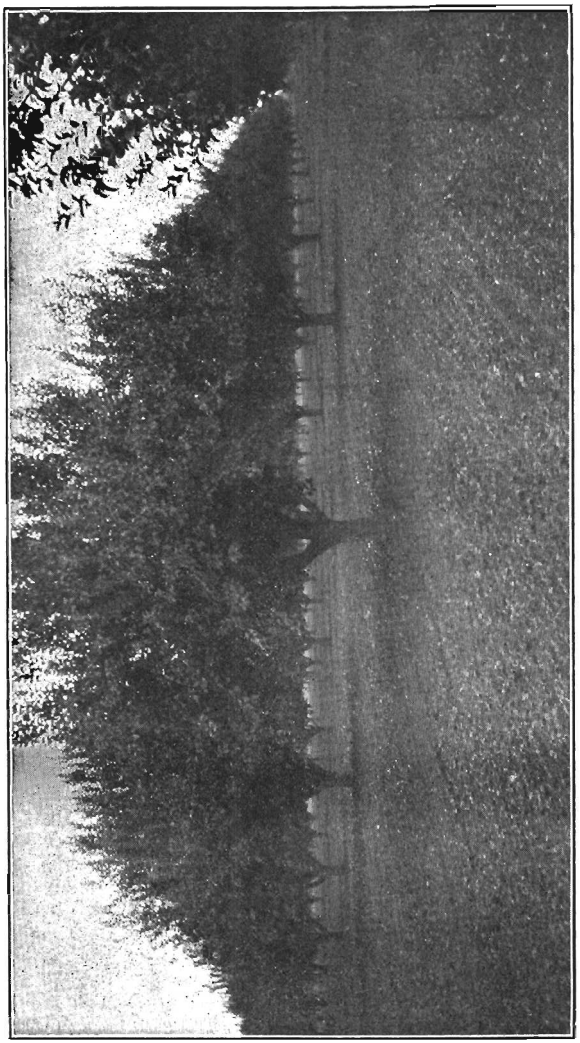
Tillage promotes nitrification; it places that available element in such condition that the trees can use it. It aids in hastening decomposition of all humus and organic matter there is in the soil and tends to set plant foods of all kinds free so that it will dissolve and in that form or solution can enter the roots of the trees.



No. 7.—Corrugated roller. One of best tools to use on clay loams.

We must study this important subject from the point of view of soil, season, age of tree, general climatic conditions, etc. The tools that are used also differ according to conditions. Plow, corrugated roller, float, disc harrow,, Kimball weeders, and many other tools all have their places. Our particular object in the spring preparation is to form a reservoir for moisture, and make plant food available so as to maintain a large root-feeding area in order that we may develop strong trees, with vigorous wood and abundance of good sized fruit. With most of our clay soils annual spring plowing will be necessary; with the heavier soils harrowing should follow close on the plowing, as the heavy soils tend to become packed and cloddy.

They will need discing and pulverizing, and should be put into as good condition as possible. The sticky soils upon which many of the orchards are planted are exceptionally hard to



No. 8.—An orchard correctly planted and in a good state of cultivation. These trees show beautiful symmetry and good care.

handle. If they are plowed in the fall the soil runs together during the winter and they need replowing in the spring. These soils will have to be watched closely to catch them at

just the right time. If an attempt is made to plow while they are too wet, they are so sticky as to be almost impossible to handle; if you attempt to plow them when they are a little dry, they plow up in large lumps and it is almost impossible to do anything with them. Occasionally these soils have been simply disced and thoroughly harrowed in place of plowing.

The free soils and the sandy and silt loams work up very nicely. On the lighter of these soils, and especially with light rainfall, the problem is not so much in the spring to loosen these soils as it is to compact them. They are often rolled and floated, a drag is used, and when this is done, light shallow harrowing should always follow. Our main object in the spring is then to get the ground into as good conditions for growth as possible. After the rains have ceased great care must be taken to maintain as much of the moisture as possible under the soil conditions. This will mean frequent cultivations during the growing season. One of the best tools to use in such cases is the Kimball weeder; this stirs the soil freely, will pulverize the top soil, and prevents drying or packing. It forms a dust mulch which aids in retaining the moisture in the soil.

The number of times one will cultivate during the summer will vary with the soil, type of fruit, season, and the age of the trees. With young trees it is well to practice deep, thorough preparation in the spring so as to encourage the roots to strike deeply. It is not only a problem of holding the moisture but one of forming deep rooted trees. As soon as sufficient growth has been obtained the summer cultivation should cease; this, in some regions, may be as early as July, while in some locations it will be about the first of August, but rarely later than the middle of August. The aim should be to throw the young trees into dormancy so that they will not be injured by premature fall frosts or suffer needlessly from cold winter weather.

Bearing apple trees, on the other hand, will need cultivation in most cases up to the time the fruit is picked, since the trees draw very heavily upon the soil as the fruit is maturing. The time for ceasing cultivation with bearing trees will be determined by the general condition of the tree and fruit. Cultivation influences the color and size and often the form of the fruit, the amount of juice, and has a marked influence on the percentage of drop of the fruit.

As a general rule pears do not need as late cultivation as

apples, with the exception of the winter varieties. The general belief is that cherries should not be cultivated, but this belief is unjustified; while cultivation of cherries should not be undertaken so early as to cause the sap to rise prematurely, nevertheless, they should be given good intensive cultivation at least up to mid-summer. Thousands of cherry trees are dying from neglect. The aim should be to place the trees in good condition for the winter. There is never the danger of winter killing from over-cultivation in the case of heavily bearing trees as there is with young trees. The summer cultivation of fruit trees need not be deep. There is nothing to gain by cultivating over three inches in depth, but this cultivation should be very thorough in order to prevent baking, cracking, or drying, and should be intensive enough to keep down the weeds at the time the trees need moisture. In the fall of the year the growth of weeds in young orchards would probably be an aid rather than an injury to the trees.

Now while cultivation sets plant food free and retains the moisture and gives good results as far as tree growth and production are concerned, nevertheless, it may be, and is being, overdone in most of our fruit districts. Excessive cultivation may ruin an orchard, and has proved the Waterloo of many of those of the Pacific Northwest. It may ruin the physical character of the soil, making it too compact or lumpy on the one hand, or too loose and subject to blowing on the other hand. It destroys the fiber in the soils, burning out the organic matter, and through its oxidizing effect gradually reduces the available plant food.

Instead of being an aid to many of our mature orchards we find that in spite of all we are doing the trees are ceasing to make satisfactory growth, and in many cases the fruit is too small. The ground becomes harder and harder every year to manage. The remedy will be to add fiber to the soil and supply it with additional food in one way or another. Various remedies have been recommended to overcome these conditions; such as cover crops, shade crops, mulching, diversified farming, that is combining the raising of hogs, poultry, etc., with fruit growing, and the purchasing of manures and commercial fertilizers. The consideration of this subject throws us into the great field of orchard fertility. The amount of plant food removed from the soil by fruits is much greater than the average man conceives. One reason that orchards do not run down as speedily as some farm lands is due to the

fact that trees are deeper rooted and work over a larger area, so to speak.

AMOUNT OF PLANT FOOD NECESSARY FOR GROWING FRUIT TREES.

Plant Food Removed From the Soil by One Acre in Orchard.

	Nitrogen.	Phos. Acid.	Potash.	Lime.	Magnesium.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Apple	51.5	14	55	57	23
Peach	74.5	18	72	114	35
Pear	29.5	7	33	38	11
Plum	29.5	8.5	38	41	13

*This table was copied from "Popular Fruit Growing" by Greene.

The following table was based on the assumption that an average crop was 15 bu. of grain per acre.

Amounts of Plant Food Removed From an Acre in Twenty Years' Continuous Cropping to Wheat.

	Nitrogen.	Phos. Acid.	Potash.	Value.
	Lbs.	Lbs.	Lbs.	
Grain	424.80	160.20	109.80	$79.86
Straw	234.78	50.40	214.20	48.37

In contrast with this table Professor Roberts of the Cornell Experiment Station has prepared a table which gives the amount of plant food an acre of bearing apple orchard would remove in twenty years, the trees being from 13 to 33 years of age. This table does not give the amount of food stored in the wood of the tree.

Amounts of Plant-food Removed From an Acre of Apple Orchard in Twenty Years.

	Nitrogen.	Phos. Acid.	Potash.	Value.
	Lbs.	Lbs.	Lbs.	
Apples	498.60	38.25	728.55	$110.26
Leaves	456.75	126.00	441.00	97.17

These tables were copied from Cornell Bulletin No. 103, by Roberts.

The following table shows the amount of nitrogen, phosphoric acid and potash found in a good crop of fruit grown on one acre:

**PLANT FOOD OF MANURIAL VALUE REMOVED FROM THE LAND BY VARIOUS FRUIT CROPS.*

	Pounds.	Nitrogen Lbs.	Phos. Acid Lbs.	Potash Lbs.
Apples	11,250	4.5	2.25	11.25
Pears	10,000	4	1	12
Plums	7,200	7	3.6	14.4
Peaches	4,950	4	2	9
Quinces	7,200	8	3.6	17.2
Raspberries	4,800	5.6	4.3	12
Blackberries	4,800	9.6	2.4	11
Strawberries	4,000	5.2	2	9.2
Currants	4,000	12	4.8	12
Gooseberries	4,000	6	2.8	.8
Grapes	6,000	9	4.2	18

*This table was copied from "Popular Fruit Growing" by Greene.

**TABLE SHOWING THE CHEMICAL COMPOSITION OF 75 BARRELS OF APPLES.*

Water	Dry Matter.	Nitrogen.	Phos. Acid.	Potash.
9563 lbs. or 85%	1687 lbs. or 15%	4.51 lbs. or .04%	2.25 lbs. or .02%	11.25 lbs. or .1%

*This table was copied from "Popular Fruit Growing" by Greene.

One can readily see from the tables that fruits exhaust the soil more than ordinary farm or grain crops. The probable reason why orchard lands do not seem to run down as rapidly as wheat lands is, as stated, due to the fact that the roots generall feed over a greater area.

VALUE OF VARIOUS FOOD ELEMENTS.

Nitrogen is the so-called vital element; without a fair amount of this in the soil it is impossible to get a satisfactory growth. It is the substance which produces the vigorous green color of our trees, and gives us splendid leaf and wood growth. If used to excess it may produce too much wood growth at the expense of fruit, and the fruit may lack in color. Most of our mature orchards would probably be benefited by additions of some nitrogen in some form or other. Potash forms about 50 per cent of the ash of trees; it is found in the

buds, leaves, etc. This substance gives firmness and aids in matering and ripening the wood. It is the base of numerous fruit acids. By some people it is thought to produce the color, but this contention has never been proven. Phosphorous is one of the essential elements in the tree and fruit; it is thought to be of aid in ripening the fruit and of considerable importance in seed formation. We must keep up the supply of all three of these foods if we are to derive the best results. Lime is thought to be of value in producing hard, firm wood and in aiding trees to mature and go into the dormant state.

COVER CROPS.

By cover crops we mean a crop which is planted in the late summer or early fall and grows while the trees are dormant. In many parts of the northwest they will make very satisfactory growth during the winter. The growing of cover crops is one of the very first steps to be taken in maintaining in good vigor and heavy bearing our mature orchards, and they may be of great assistance in young orchards which have been planted on land which has been cropped for a great many years and is more or less run down. All the cover crops are of value in, first, that they add fiber. This fiber allows us to keep the ground in better physical condition and prevents the ground from becoming lumpy and hard to till; it makes light soils heavier, and heavy soils lighter; to a large extent it prevents puddling, and on hillsides may prevent washing and extensive seepage. It aids us to till our lands earlier in the spring than would otherwise be possible. Many of these plants have the ability to take nitrogen from the atmosphere, making it available for plant growth.

In growing cover crops we must make a study of the crop to be used, the climatic and soil conditions, season, etc. As far as crops are concerned we can make several classifications. First, nitrogen gatherers. These have the power of taking nitrogen from the air and when they decay in the soil to set free this nitrogen to be used for plant growth. This nitrogen is found on the roots of these plants contained in the little nodules on such crops as clovers, beans, peas, vetch, etc. These plants then are of especial value, since they add this vital element—nitrogen—and at the same time furnish an abundance of fiber.

The second class make potash available. Upon their decay

they set free a large amount of potash which the trees can use. These crops include cow horn turnips and rape.

The third class of crops are principally valuable because they supply humus to the soil and thus give an abundance of fiber; they include such crops as rye, oats and weeds of various kinds.

If we are to make a success of growing cover crops we must put them in the ground at the right season and in the right way. The best time is to plant the seed the latter part of August and not later than early September. It is much better to thoroughly drill them in than to sow them broadcast and harrow in. Last season at this Station in one of the dryest summers we have experienced, we germinated cover crop seed in six days and when the first fall rains came these crops took hold vigorously. Many people make the mistake of planting seed too late, planting in the latter part of September and early October. Under such conditions the plants do not get sufficiently large before the fall frosts come, and, as a rule, make unsatisfactory growth if subjected to heavy frosts and rains.

The next main point is the proper time to plow under. As a general rule I would advise one to plow the cover crop under at the time one would naturally plow the orchard if it had no cover crop. In many cases where the cover crops are allowed to grow late in the spring, such growth may be at the expense of the trees, as the former at this time are pumping out increased amounts of moisture from the ground, and should you have a dry spring this loss of moisture might be felt by the trees. Again, it is never wise to leave cover crops that contain materials such as rye and barley to grow very high or become tough, for when such material is plowed under it will decay very slowly and under some conditions it would be almost impossible to hold moisture between this layer of undecayed material and the surface. As a result the ground might dry out exceedingly and instead of the trees receiving benefit from the cover crop they would experience a checking influence for that season at least. In many of our hill lands where cover crops have not been grown, the growth the first few years is very discouraging. Nevertheless, I would plow the ground at the proper time in the spring, and experience has shown generally that the cover crops grow well after a few years' trial, becoming better each succeeding year. The proper time for

planting the seed and the proper time of plowing under the cover crop is one that the growers generally do not observe carefully enough. In many cases one can disc under the cover crop, and probably this method would have to be used in many of our orchards. Where the cover crop is becoming very rank in growth one can assist in working it under by using a coulter when plowing, or often by chain drags.

AMOUNT OF PLANT FOOD IN A CROP OF VETCH.

Value of vetch, ready to bloom, roots and tops:

	Original Substance. Per cent.	Dry Substance. Per cent.
Nitrogen	.65	3.1
Phosphoric acid	.146	.7
Potash	.475	2.28
Water	79.15	

*This table was taken from "Principles of Fruit Growing" by Bailey.

The amount of seed to sow per acre will vary considerably with various conditions. The more heavy and shaded the orchard the more seed will be necessary. On land to be planted with young orchards that is in great need of cover crops, such as land that has been in wheat for a long time, one will have to plant heavier cover crops than would otherwise be required. One bushel of rye to the acre and a bushel of vetch drilled at right angles to the rye has given very satisfactory results. The following amounts of seed are those we generally recommend to try per acre:

Rye	10 lbs. to 1¼ bu.
Vicia sativa	40 lbs. to 60 lbs.
Vicia villosa	40 lbs. to 50 lbs.
Oats	20 lbs. to 50 lbs.
Canada peas	100 lbs.
Rape	10 lbs.
Cow horn turnips	2 lbs.
Cow peas	100 lbs.
Soy beans	10 lbs.
Crimson clover	20 lbs.

As far as Western and Southern Oregon are concerned, Vicia Sativa is the most satisfactory crop of the nitrogen gatherers to grow. In a few unusual years when the winter

is a little more severe than common the Vicia villosa makes better growth, but the Vicia sativa is more to be desired under ordinary conditions. We have found it a good practice to drill vetch and rye together, as the rye seems to serve as a nurse crop and holds up the vetch. In some cases oats can be substituted for rye; rape and cow horn turnips do fairly well in this district.

We are conducting experiments at the present time to determine which crop is stronger. In Hood River both sativa and villosa have done well; however, in some districts even there sativa is preferable to villosa. In some sections, especially in those that experience a great deal of cold weather, the villosa is the best crop that we have tried.

The chances are, that in those orchards in which vetch or similar crops make rank growth, it would be unwise to use such a crop every year; probably three years out of five would be sufficient. Clean culture could be practiced every two years, though crops like rape and cow horn turnips might be used. In most cases where the trees are making as much of a growth as one should desire but the ground is hard to manage, either baking or becoming lumpy on the one hand or too light and easily blown by the wind on the other, the growing of such crops as rye, barley and oats, to be plowed under later, would probably aid materially in the ease with which such soils could be handled.

The general principle to be observed in growing the cover crops is simply to maintain the trees in good vigor and health and at the same time to get good crops. While in the majority of our orchards there would be little danger for a number of years at least of growing too many crops of vetch, nevertheless, I would not advise the continual use of such crops in orchards that already have vigorous foliage and are making a large wood growth. In many of our orchards trees will need slight checking at times in order to bring them into proper fruitfulness. This is especially true of trees from 9 to 12 years of age that have been put on very rich soils and which are either being irrigated or are receiving considerable subirrigation waters.

Each grower must study his individual orchard carefully and feed the trees according to their individual needs. One will often find that the variety and age of the trees will deter-

mine the treatment the orchard should receive. Our growers need to study the individual varieties more and even the individual trees. It is well to have definite plans made of the orchard, either working according to age or variety, keeping the trees accurately outlined or designated in such a way that one can note the degree to which such trees are fruitful and making a satisfactory growth. In many cases the individual trees should be given more attention than they are now receiving. A system of plotting the orchard and keeping records need not be laborious, and if properly done should tend to materially increase the income from the orchard. Our orchardists must learn to study their individual trees in the same way that the dairyman studies the individuals of the herd. Especially is this true as related to such subjects as feeding the trees, pruning, thinning, etc., and the treatment for various pests.

SHADE CROPS.

The term shade crop is used to designate those crops that are grown in the orchard during the growing season, the aim being to supply food and give the same benefits to a large degree that we are receiving from the use of cover crops. The shade crop is adapted to irrigated districts only, as far as mature trees are concerned at any rate, and should only be attempted where one has sufficient irrigating water to grow both the trees and crop successfully. The shade crop is being used quite extensively in parts of the inland empire as the Payette Valley, and the Walla Walla Valley. There are a great many crops being tried; the best ones to use, however, have not been thoroughly determined. The clovers, where they will grow successfully, offer one of the best crops to grow. They are handled in a number of ways. In most cases the crop is grown for two years, being mowed two or three times each year, and is then plowed into the ground and clean culture practiced for the first year or two. The other method is to cut the crop, allowing one crop of clover to go to seed, and then discing the crop under each year, the crop reseeding itself. In some cases alfalfa is being used, but it is a questionable practice. It is yet to be determined whether or not it is a desirable practice to grow alfalfa or any other crop in an orchard for a number of years without discing or plowing deeply; such a practice might cause roots to come too near the surface, and when

plowing was undertaken, if it became necessary, it might be disastrous to the trees. Shade crops are very desirable in those districts where the soil becomes excessively warm and where there is a great deal of reflective light and heat. They shade the ground, tend to make it cooler, and furnish a large amount of plant food. Whether it is desirable to plant young trees with shade crops is yet a question, and needs to be experimented with more. We do know, however that young trees will grow well where there is a strip cultivated each year on each side of the tree and a shade crop grown between the trees; later the crop may be allowed to grow over the entire ground.

COMMERCIAL FERTILIZERS.

Another method of maintaining orchard fertility would be by means of manures or commercial fertilizers. Probably well-rotted manure is one of the best materials to apply to orchards; however, this is scarce and at times too expensive. Under average conditions one could not afford to pay over one dollar a load for average manures. In very light soils one should avoid applying a very large amount of very strawy manures, as the straw decays slowly and may do more harm than good, causing the soils to dry out rapidly. The time may be close at hand when it will pay in some of our orchards to use commercial fertilizers. While many growers would hate to admit that such a time is here or will come in the near future, all sentiment will disappear when it is demonstrated that an application of fertilizers will pay big interest.

In all cases I would advise one to take up the application of fertilizers in a conservative way. Each orchard can become an experiment station and demonstrate the needs of these plant foods. In purchasing fertilizers two points should constantly be kept in mind; one is the actual amount of plant food the fertilizer contains and how much one is to pay per pound for such food, and the other point, the availability of this plant food. Some fertilizers cost more per pound of actual plant food at $20 a ton than others that sell at $50 a ton. Bulletin 79 of this Station has dealt with this subject very nicely.

In applying commercial fertilizers to the orchard, I would choose a few trees; apply some quickly available nitrogenous food, such as nitrate of soda, or dried blood, applying nitrates at the rate of 50 to 100 pounds per acre. Choose a few more

trees and apply acid phosphates at the rate of 300 pounds per acre, or super phosphate at the rate of 100 pounds per acre. Muriate or sulphate of potash may be applied at the rate of 100 to 200 pounds per acre. Then make combinations of some of these and make a complete application. If the trees respond to such applications it would probably pay in many cases to use such fertilizers. Later on in applying fertilizers one may wish to mix some of the more slowly available ones with the quickly available fertilizers; this should be applied in the spring and be plowed under or harrowed into the ground.

ORCHARD MULCHING.

The mulching of orchards with straw, grass, and similar substances, has been tried in several parts of the country with more or less success. This Experiment Station is conducting a series of experiments along this line. We are not ready to publish as yet, but I will still advise growers to practice cultivation with either the cover crop or shade crop wherever possible.

Combining fruit growing with some industry as poultry husbandry, dairy husbandry, hog raising, etc., would probably keep up the fertility of the land, and while this would be practicable with young orchards before they come into bearing, in the majority of commercial bearing orchards it would not be practicable, since it divides one's time too much and there are few men who can make a success of several specialized lines. Generally they will neglect some of these lines in order to perfect the other. Again, with land worth from $1,000 to $2,500 per acre, one could not devote much ground for general farming purposes. There is undoubtedly a field for combined fruit growing with diversified farming on a small scale, and many people are making a very good living from such combinations.

IRRIGATION.

Irrigation in its relation to fruit growing is a subject which the department of horticulture is investigating, and bulletins will be published from time to time on this subject. Irrigation properly handled will, in many cases, assist in producing very desirable crops and tree growth. Theoretically, irrigation should bring about the same results as proper rainfall. Unfortunately, however, the average man abuses the practice

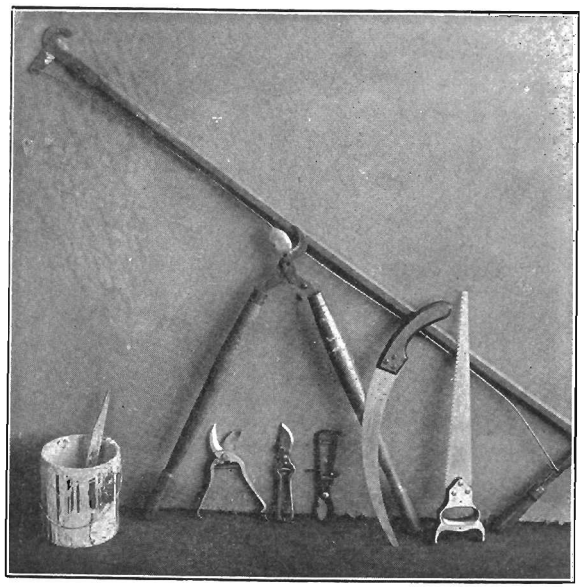
and over irrigates in order to produce a large crop, and often detracts from the fine quality of the fruit by such practice. He is apt to produce fruit of poor quality and inferior for shipping and keeping. In districts with less than 20 inches of rainfall irrigation can become a great help and in many cases is a necessity, especially with such fruits as the apple. In regions with a slightly greater rainfall than this it is of help in keeping the trees in good healthy condition and in tending to produce annual crops. In irrigation, the problem is to see how little water to use instead of how much. Irrigation must go hand in hand with cultivation. Under most conditions about two irrigations during the growing season are ample where the ground is thoroughly moistened and followed by intensive cultivation. Generally irrigation can be given in the latter part of August of sufficient amount to produce a good crop of fruit and prevent heavy dropping. One should avoid using large amounts of water near the time of harvesting, as this has a tendency to keep the trees in active growth and may have a bad effect on the fruit, especially with such crops as peaches. It is poor policy to irrigate peaches within three weeks of picking time. Heavy irrigation with young orchards may increase winter killing. Extensive late irrigations with bearing trees may retard color and even interfere with final developments of high color. Where irrigation is practiced one needs to look after the drainage very carefully, as a great deal of seepage water results and many fine orchards have been ruined by such water.

PRUNING.

Pruning is one of the oldest of orchard practices and is a very essential one. While it has been thought by some to devitalize some plants, proof of this is unfounded. On the contrary, it generally tends to increase vigor, which is one of the principal aims of pruning. Our objects in pruning may be stated in the following way: to increase vigor of the plants, to make them fruitful, to aid in such orchard work as thinning, spraying and harvesting, to regulate the amount of light and heat which may strike the plants, thus reducing injury from sunburn, etc.; to train plants to some desired form, and, unfortunately, in some cases to get a supply of fire wood. In studying pruning we must become acquainted, however, with

the general principles and must make a special study of buds, much more study than the average grower gives to this vital topic. Concerning some of the general principles, I may state that in many cases heavy top pruning has a tendency to produce heavy wood growth and rejuvenates the trees. Heavy pruning may develop strong growth of water sprouts which indicates a lack of equilibrium or balance between the roots and the top, and often causes one part to live at the expense of another.

The habits of trees vary greatly; not only does the tree vary



No. 9.—A group of satisfactory pruning tools. Every one necessary. Do not overlook the paint or wax can.

in habit of growth from youth to old age, but there are many variations in shoot growths. Many have a tendency to grow from uppermost buds. These uppermost buds tend to produce strong terminal growth, which when headed in produces laterals. Fruit bearing tends to become a habit with trees and can be greatly modified or changed with pruning. Summer pruning if done at the proper time and moderately may tend to produce fruit buds, while winter pruning tends to make wood growth.

The relation of leaf and fruit buds and their differentiation is a large topic in itself and if being investigated by this Station at the present time. It will pay every grower to pay more attention to the bearing buds of his trees. With apples and pears, for example, he will find that some varieties will be annual bearers, while some will bear only once every two or three years. Some produce fruit on the end of last year's

No. 10.—This kind of pruning is never permissible, always cut close to the trunk and make a smooth wound.

terminal growth; others bear on axillary buds on last year's growth; some produce from one year old spurs, while some will not produce until the spurs are several years of age. On trees in foliage one will generally find the new wood bears leaves singly, while the old wood bears in clusters. The new growth generally arises from terminal or strong lateral buds.

The terminals may produce fruit, but this generally develops from the laterals.

If one studies buds carefully he will find there are several kinds. Some produce fruit only, others produce both fruit and foliage, others develop into a fruit spur, while others remain dormant and never start unless the tree in injured. The terminal bud is apt to be the strongest, the first lateral next, and so on down the shoot. When spurs bear fruit one year they are apt to develop shoot buds the next year, hence the

No. 11.—Never start the main limbs in this manner. They should issue in a whorl from eight to fourteen inches apart to prevent a bad crotch.

habit of bearing once in two years. Fruit spurs are often forced into shoots by heavy pruning, especially at times of light cropping. However, when a branch becomes a fruit spur, so to speak, it is apt to maintain this habit unless the tree is excessively pruned.

With apples and pears we have mixed fruit buds; that is leaves and flowers on the same bud; while in some fruits like the apricot, cherry and peach, for example, certain buds con-

tain only leaves and others only flowers. With many of our stone fruits the fruit buds are found laterally in the axils of the leaves. The peach always bears on one year old wood; the buds appear singly with a branch bud, or in pairs with a branch bud between them. The position of the buds will depend largely on the vigor of the tree. The stronger the wood the nearer the tips the buds are formed. With cherries we rarely find many buds on the strong growing new wood, the greater part of the fruit being borne on fruit spurs. These spurs are generally new growth and often bear axillary buds and terminal branch buds.

No. 12.—4 year old Jonathan unpruned and pruned

PRUNING THE APPLE.

The majority of our growers favor the low tree; that is with head formed from 18 to 25 inches from the ground. In many cases one is apt to lose less trees from sunburn where headed low and properly handled, than otherwise. There are several types of trees being grown, and much heated and often worthless discussion is held concerning the respective merits of the open or vase tree versus the pyramid or leader type. A third type is a combination of the two, where the leader is allowed to grow for a few years and then held in check. We should be more interested in the general principles of pruning than in the growing of an exact type. Good, strong, heavily

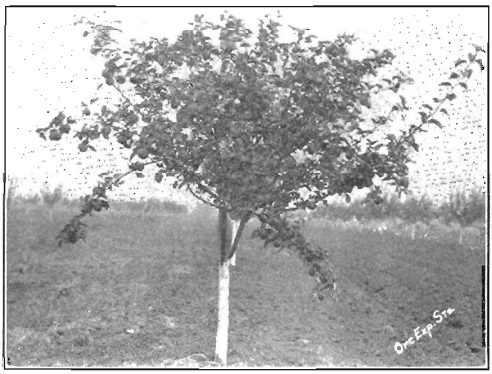
bearing trees can be produced by all systems, while, on the other hand, very weak, worthless trees can be produced by each. The so-called open or vase tree was introduced from California, where they were obliged to head the trees low and shear the tops to protect from the sun. Here in Oregon we do not shear the tops of the trees but still try to encourage the open trees. Many people have made a mistake in thinking that a short trunk means a low head. This has little to do with the head of the tree unless one practices proper pruning the first five years of the tree's life and always gives the tree plenty of room for lateral development.

No. 13.—4 year old Spitzenberg unpruned and pruned.

Concerning the open versus the center tree both will be used according to the type of tree we are growing. Undoubtedly all varieties that tend to grow large and rangey should be grown as open trees, while many varieties like the Yellow Newtown, for example, which often makes a weak, scraggly growth, can be made stronger and larger and be made to produce more by growing a leader for a number of years at least. Those who are using the open tree need to modify it considerably in the majority of cases. They are allowing most of the main branches to issue from the same point, with a resulting weak tree which breaks badly and is often short lived.

PRUNING THE OPEN TREE.

Head from 18 to 25 inches; some prefer to head at 25 inches to get a better distribution of branches. This can be done and still keep the head as low as the average tree that is headed as low as 18 inches. The tree should be studied very closely during the first growing season; some buds will need to be rubbed off, others pinched back, the aim being to grow a well balanced tree, with as much space as possible between the branches. The branches will never grow any farther apart than the distance at which they are started, and in fact never get higher from the ground. If one leaves trees alone during the entire growing season the chances are he will find all the



No. 14.—4 year old Baldwin showing effect of summer pruning, tree heavily loaded with fruit. Companion trees of same variety and unpruned the previous summer have no fruit. This tree has been slightly overpruned.

branches growing near the cut and a weak tree will be the result.

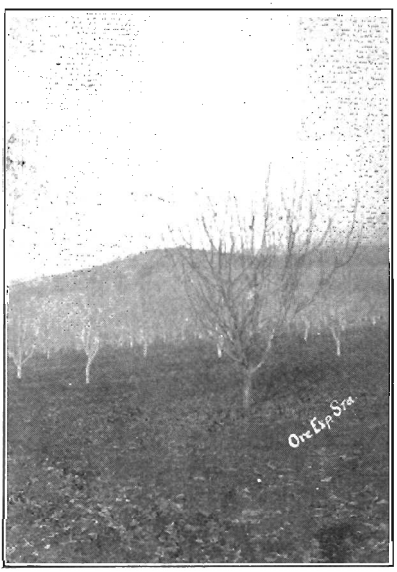
At the end of the first year leave from three to five branches and head these back under average conditions to stubs 10 to 12 inches in length. Remove all laterals other than these. I would not advise heading closer than this, as it would tend to throw future laterals too close together. At the end of the second year you will find that each of these branches will have produced from one to a dozen or more laterals. I would advise choosing two of the best located and removing the rest, heading back these to stubs 10 to 15 inches in length, and either removing the remaining laterals or cut back some of

these to two or three buds. These will later form fruit spurs. I may state, however, that where blight is prevalent it is poor practice to form fruit spurs too low down on the main branches. From this time we will have to modify pruning somewhat, as every time we head in a terminal branch we force out more main laterals. It would be very easy to grow a brush heap every year and be obliged as a consequence to practice very severe pruning annually. I have observed, especially with Yellow Newtowns, that heading in strongly, as is often practiced, is too severe, and as a result the trees are often kept from heavy bearing until 10 or 12 years of age. Where terminal growth tends to become too strong it will need heading

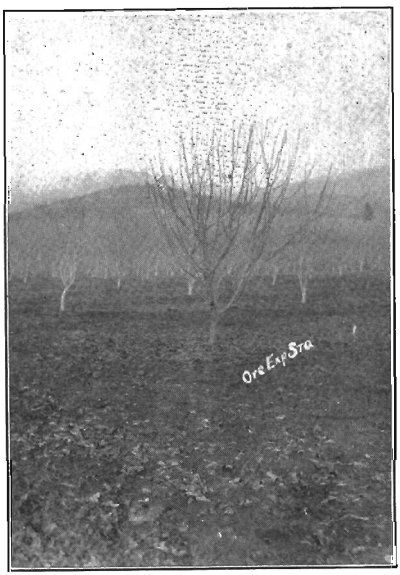
No. 15.—Summer pruning the apple. Showing excessive pruning. Summer pruning should be generally light in character.

back to produce a sufficient number of strong laterals; this is true of such varieties as Northern Spy, Ortley, and King of Tompkins County. One can do this to good advantage by pruning at two seasons of the year. Remove the excessive laterals and practice moderate heading back in the winter, and follow this by moderate heading back from the first to the middle of July. As the apple tends to come into bearing, one should practice light annual pruning, and avoid if possibly such vigorous pruning as to produce water sprout growth. With young trees the pruning should always be delayed until growth is about to start in the spring, as by this method there is apt

to be much less die-back. Avoid handling trees when they are frozen. Where trees have been neglected for a number of years it is better to get them into shape gradually, taking several years, rather than to prune excessively, as excessive pruning tends to force fruit spurs into wood growth and it may be four or five years before you can bring the tree back into proper bearing. Where heading back is necessary on large trees one often gets less water sprout and shoot growths where the heading back is just above a strong



No. 17.—6 year old Newtown before pruning.



No. 17.—6 year old Newtown after pruning.

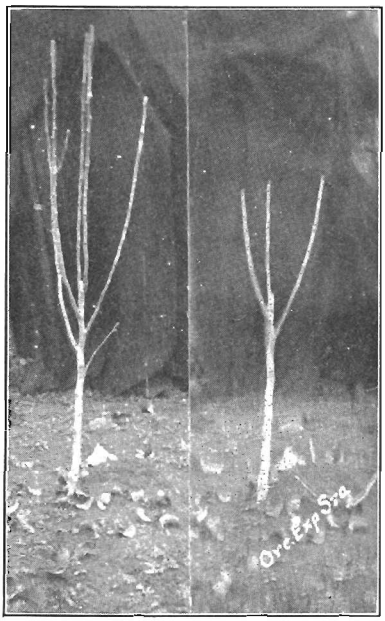
lateral. When water sprouts start to grow vigorously they should be removed immediately. In thinning out laterals always choose the stronger. All decayed branches should be removed. In cutting off branches remove these as near the body as possible. Make an undercut some distance from the tree at first, so when the branch crashes to the ground it will not rip the tree. All large wounds should be painted or waxed. Trees that tend to bear every year will stand more pruning than those that bear once in two years, and the latter class will stand more pruning in the bearing year than otherwise.

PRUNING CENTER TREE.

There will be little difference in pruning the open and center tree the first two or three years, but from that time on the center is allowed to have a slight lead over the remaining branches. Some of the strongest trees that I have seen in Oregon have been produced by maintaining this leader for a number of years and not allowing them to develop further.

PRUNING THE PEAR.

The same general principles that apply to the apple are suited to the pear. The pear will stand very low heading,



No. 18.—D'Anjou one year after planting, before and after pruning. As a rule all branches should not be cut at same height from ground.

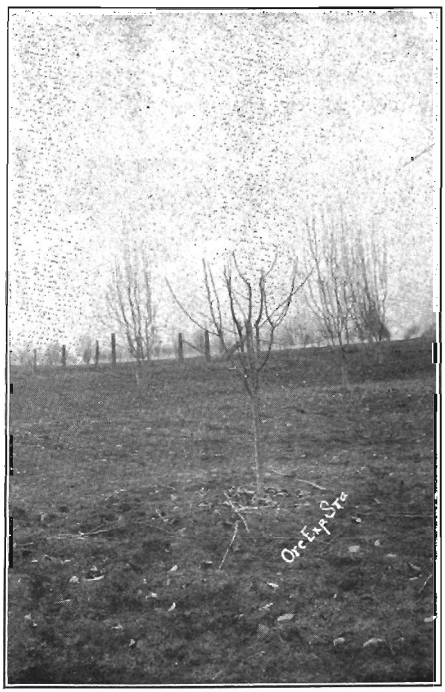
generally lower than the apple. I would, however, advise growers as a rule to try and allow more distance between branches than they now practice. This will mean slightly higher heading. Most growers prefer an open tree to the center tree, as it is less liable to loss from blight. I will state

that a tree that is grown with well spaced branches may be subject to less disease loss from blight than those where the branches all center at one point. The pear will often stand more wood than the apple, and it spreads more proportionately when heavily laden with fruit. Color is not as greatly desired as with most apples, and spurs are encouraged and allowed to grow more closely together. The first three years the pruning should be very similar to that of the apple, making an intelligent choice of laterals. With such varieties as the Bosc

No. 19.—3 year old Bartlett before pruning.

and Winter Nelis considerable care is necessary to get a well balanced tree. Amateurs often become discouraged with these varieties the first few years, but they will give less trouble as they become older. Staking will aid very materially in maintaining a well balanced tree. The Anjou will stand more severe pruning than most varieties, since this variety has a tendency to produce a very large number of blooms, but at times sets very little fruit. This is not caused by poor pol-

lination, but frequently by lack of vitality. Heading in often overcomes this difficulty. After the pear comes into bearing one should avoid pruning in such a way as to produce extra sappy growth, as such growth is easily injured by blight. Prune annually and head back occasionally to strengthen the laterals. Avoid allowing trees to grow a number of years without pruning, for in the meantime they get too rangey and when headed back uniformly severe, the result of such heading back is to produce a large amount of rank soft growth



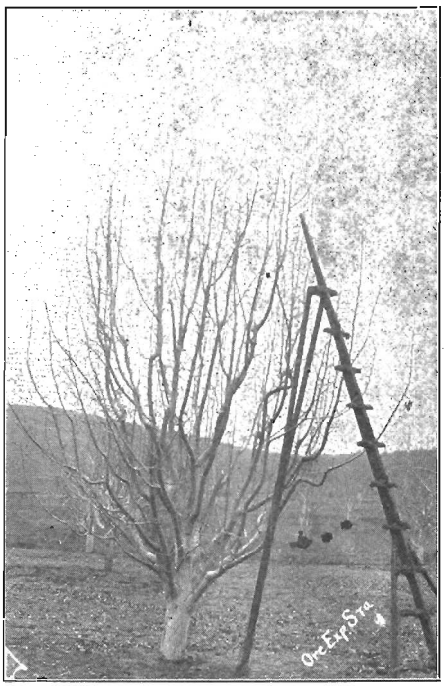
No. 20.—3 year old Bartlett after pruning.

that by the time it comes into heavy bearing has carried the tree as high as formerly and you have gained nothing from such practice.

SUMMER PRUNING OF THE APPLE AND PEAR.

Summer pruning is a subject in which our growers are becoming more and more interested. It is a topic of which we, as yet, know comparatively little. This Experiment Station

has done some work along this line, and we are at present conducting experiments that will be of interest to the growers. In a general way in Western Oregon we believe that the best time for summer pruning will be from the first to the middle of July; if summer pruning is done too early it will probably defeat its aim and will produce additional shoot growth rather than tending to check the trees and cause the formation of fruit buds. If done too late it forces out soft growth which kills



No. 21.—15 year old Comice pear tree well pruned. A convenient ladder for this work is shown at right.

badly. One must remember that it is very easy to overdo summer pruning, and there is a tendency at the present time to prune too vigorously. Severe summer pruning has much the same effect as severe spring pruning. Where practiced moderately good results may be obtained. I would advise all growers to use summer pruning more, checking any excessive terminal growth so that one need not prune so severely the following spring. Where this checking is done in such a way

as to remove only a small amount of wood in each case or merely pinch back the buds, the tendency will be to force out a few laterals and also to form a few fruit buds lower down the shoot. Among pears it is very common to find the trees producing numbers of large fruit buds at the terminals, and if the trees are pruned in the spring it is done at the sacrifice of a large percentage of the crop. One should endeavor to grow an abundance of fruit spurs the entire length of the branch. Probably material heading in in the spring, followed by a light checking such as is produced by moderate heading back about the first of July, will go a long way to produce these fruit buds lower on the branches than they commonly occur.

This is a subject which our growers should look into more closely and should be willing to experiment with much more than they are doing at present.

PRUNING THE CHERRY.

The general belief is that cherries should not be pruned. It is hard to understand upon what such a theory is based. The lack of proper pruning of the young cherry trees will simply mean that the bulk of the fruit must be picked from ladders at least 20 feet in length, and it is hard to realize any profit under such conditions. The cherry naturally grows with little encouragement to the goblet or wine glass shape. Growth is very vigorous the first few years and the tree if often 15 feet in height before the main fruit spurs are formed. The fruit is clustered in heavy spurs near the base of the vigorous growth and one often discovers wood bearing areas that should be developed into heavier fruit bearing. Care should be taken that the branches do not form at one point; decay sets in and excessive gumming is often found in such places. Try to get the branches well distributed and cut severely the first few years. One will often need to practice at least two prunings, one in spring and one in summer, the first few years in order to produce a spreading tree. By using a little care one can make a more spreading tree than we commonly see, and one that will be both more fruitful and more easily handled. In cutting off large branches care should be exercised in protecting the wounds. Cut the branches as near the main branch or body as possible. Where trees have badly declined they can often be successfully rejuvenated by heading back quite severely,

cutting below the dead and weak growth. I have seen trees pruned so severely that 15 to 20 feet were removed from the top, and these trees when given good care came into good bearing in a few years. Many large neglected orchards can be rejuvenated in this way.

PRUNING THE PEACH.

Buy one year old peach trees. Head them low; the lower the

No. 22.—Peach tree one year after planting unpruned.

better. In the majority of cases I would not advise one to prune off all the laterals at the time the trees are set, as often I have seen much die-back and have at times experienced difficulty in getting well balanced trees. We prefer to leave some laterals, cutting them back to two or three buds. Great care should be observed in heading peach trees; do not do this until

just before the growth starts. At the end of the first year's growth it will be advisable to allow only from four to five of the main branches to grow; but in the majority of cases these should be cut back to about one foot in length. Choose a right angle triangle, with the apex of the angle on the base of your tree, for your ideal. This pruning may seem severe, but it

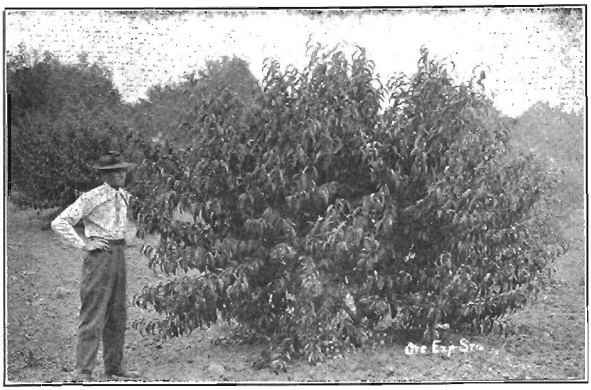
No. 23.—Same tree pruned.

will give strong thick heavy branches and a good foundation for heavy bearing.

At the end of the second year you will have need to practice a great deal of thinning out, as the heading back the first year will force out many lateral buds. The aim from now on is to develop strong shoots. Strong terminal shoots will need heading back. This will mean that most of your fruit will be cut

off. In fact one should not expect his trees to bear heavily until at least four or five years of age. At the end of this second year's growth the tree should not be more than four feet in height but will have a broad spread, since we are encouraging this broad spread each year.

By the end of the third year's growth the young trees should be nicely formed, and less severe pruning will be needed. They will need considerable heading back each year, but more bud wood is allowed to remain than formerly. You must not forget that the fruit of the peach is always borne on one year old wood, and each year it is necessary to get strong wood if one is to get large peaches. This will mean that each year you will cut away from one-third to three-fourths of the one year



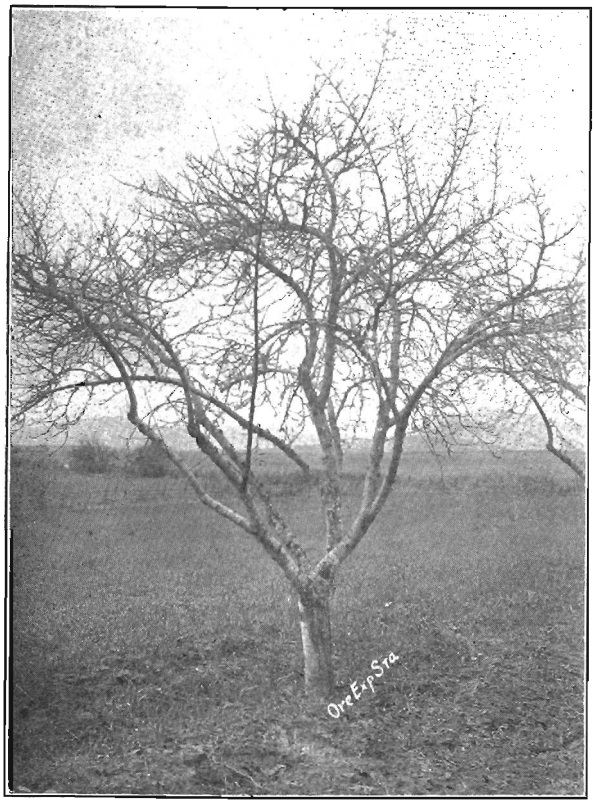
No. 24.—Peach tree 13 months after planting, shows good heading and proper spreading.

old wood, in order to allow the trees to have plenty of air and light and room for development, and keep them from killing out all the lower bearing branches. As the tree comes into heavy bearing it is good practice to head back at the end of the dormant season but often it is best not to head in laterals or do much pruning until the tree has bloomed, or until one can determine the amount of fruit that is set, and then prune accordingly. With peach trees that have been neglected but still have smooth bark, plump buds, or lower shoots, the old tops can be severely cut back and in a few years a new top can be developed. Summer pruning can be practiced to advantage. I would not practice shearing as is done so often, as it means the development of weak lateral growth, which

becomes so dense that it kills out all bearing growth below, but moderate cutting back during the summer will have a tendency to encourage the formation of fruit buds and force out new laterals.

PRUNING THE PRUNE.

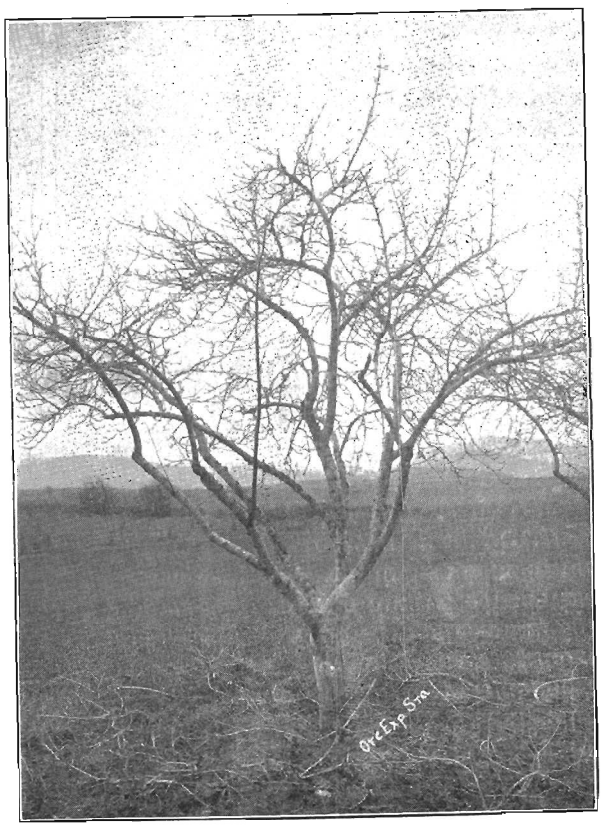
Here in Oregon the prune is generally grown for drying



No. 25.—Prune tree before pruning.

purposes rather than to be picked by hand. The Italian prune does not tend to become as high as most fruit trees. It is very desirable to have a heavy mulch at the base of the tree, since the fruit is allowed to drop before it is gathered for drying purposes and the trees are pruned accordingly. Head all the way from 20 to 30 inches. One of the main points to re-

member about the prune is that we must have a fair amount of strong wood each year if we are to have large fruit, and large fruit is much more desirable than the smaller size. This means that we must practice annual pruning, for if you tend to skip a year you will fail to produce strong on year old wood, which will mean that sooner or later you will have small



No. 26.—Same tree after pruning.

prunes. Thinning and pruning are combined as a rule in one practice. Give the branches plenty of air and light in which to develop.

PRUNING THE GRAPE.

Under grape pruning considerable confusion is often found, as authorities frequently do not discriminate between pruning

and training. Pruning has to do with cutting back the vines to produce fruitfulness, etc., while training is applied to some method of tying or growing the vines. The renewal system is the one most commonly practiced with the American grapes. Under this system we only allow the bearing wood to remain a single year; after bearing once the canes are cut out and new bearing wood is grown. Remember not to allow too much bearing wood to grow at one season. While a vigorous vine might be able to carry four canes 10 to 12 feet in length, some others can carry only about two. In removing any of the canes it is better to remove the weak ones and allow the vine only to retain such fruit as it can grow to a high degree of

No. 27.—Grape unpruned.

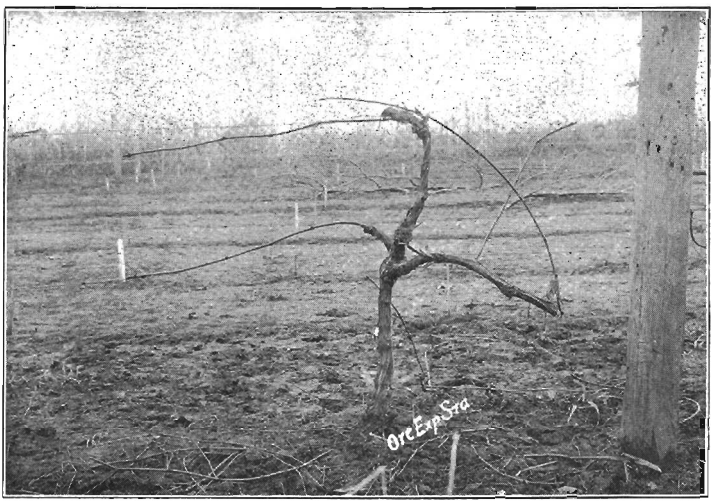
perfection. In purchasing grape vines, one needs to be sure that he has good plants and will give them good ground preparation and food the first few years. If the vine becomes weak at the start it may never rally, and will never be a good producer.

The vine is generally cut back to two or three buds at the time of planting. These shoots are allowed to grow the first year and at the end of that time the stronger is chosen and in pruning it is desirable to cut it back to two buds. The weak shoot is removed, the aim being to get a sturdy vine with a strong, heavy feeding root system. The main stub of all

American varieties is tied to wires. Some allow a stub to grow only to the bottom wire, but most growers train the main stub to the top wire four or five feet high.

No fruiting should be allowed before the third year, and only light cropping at that time. In pruning the grape the fourth year remove all but two or three of the stronger canes and each year in the future the practice will be to remove most of the bearing wood.

There are many methods of training, such as the low horizontal arm where only low wires are used, and high horizontal arm, where several wires are employed; the arms are trained to wires four or five feet from the ground, as well



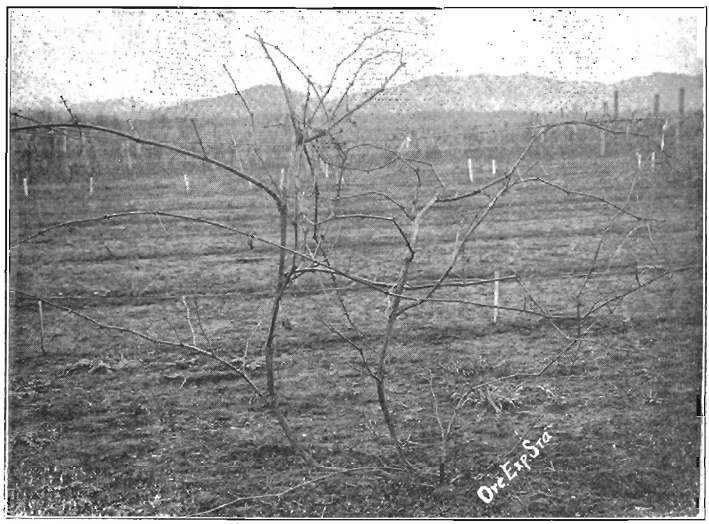
No. 28.—Same grape pruned to 4 arms.

as on lower wires. Some men have fruiting canes on one wire and train new shoots and canes on the other wires. This means considerable work and may not pay unless one can secure high prices for the product.

There are many methods of training other than those mentioned, such as fan, Kniffin, etc. The Kniffin is the droop system. A single stem or trunk is carried to the top wire and then about two canes are taken out from side spurs of each wire, two wires being used. Some growers cut these back severely, while others allow quite long arms on each wire. Generally the top canes are allowed to grow out somewhat longer

than the lower canes, and the bearing shoots are generally allowed to hang at will. With the horizontal arm systems the canes are usually tied to wires with raffia, yarn or similar material. The Kniffin system is specially adapted to strong growing vines. There are a great many modifications of the system.

The Vinifera, or California grapes as they are commonly called, are as a rule not grown on trellis, but on stumps. The aim is, for the first few years, to grow a strong self-supporting stump. In some cases it will be necessary to stake the stump for the first two or three years. There are a number of methods

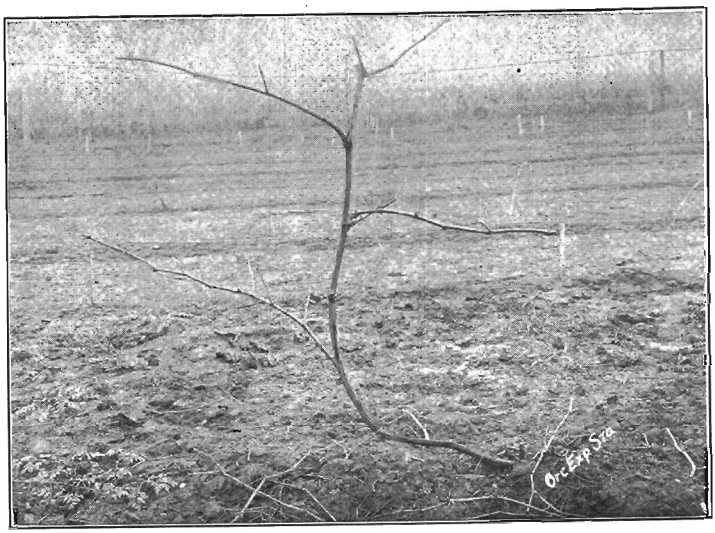


No. 29.—A younger vine than previous cut, unpruned.

used, and grape growers must become expert pruners and study their varieties very carefully, adopting the system of pruning best adapted to varieties at hand. They will do this as they obtain more and more experience.

There are several methods of pruning, known as short pruning, long pruning, and the combinations of these. One will have to modify these various systems in accordance to the variety requirement, the aim being simply to maintain only sufficient wood to bear the amount of fruit possible without exhaustion. The pruning in most cases consists in the cutting away of last year's wood to a large extent, although occasionally it is necessary to cut off some of the older wood.

In short, we first pick out the desirable canes that we wish to remain, paying attention to their vigor and strength and the amount they can consistently carry to advantage; all other canes are entirely removed. These remaining canes are cut back to spurs containing two or three buds. This system is only adapted to those varieties that bear fruit heavily at the base of the canes. With those that do not have this habit the system known as the half long system is commonly used. From four to eight or nine eyes are left according to the variety. Generally more fruit is borne than by the short pruning system, for more shoots as a rule are allowed to remain and there is a general tendency of a great many varieties to be more fruitful



No. 30.—Same vine pruned.

from the upper buds than from the lower. This tendency to bear better on the ends of the canes, if followed too closely, will often lead to disaster, as the vine will get too rangey and at times will cease to be highly productive. To remedy this we cut back a few of the canes to just two or three buds so that new strong canes can be grown near the stump, which will eventually take the place of the longer canes, which, in due time, will be removed.

One will constantly need to watch the vines so as to keep up the vigor of the wood, to encourage canes to spread, and yet keep the bearing wood as a rule fairly close to the main

stump. Occasionally the long system of pruning is used where long canes are tied to a stake or trellis. One will adapt the vine to the system to which it is most suited, according to its growth, and will go always on the principle to develop each year a sufficient amount of strong wood for that crop. The very short pruning is very rarely practiced in Oregon; the half length is more commonly used.

REJUVINATION OF ORCHARDS.

The question is often asked, "Can we rejuvenate many of the old orchards of our state?" Possibly in some cases this can be done profitably, but in the majority of cases I doubt if we ever could make good commercial orchards from them. The only case in which it is worth while would be where the trunk and main part of the bodies of the trees are fairly sound and still reasonably low headed. It might be possible by some methods of grafting if the body or main branches are sound to still make fair trees, but it is very hard to keep them low-headed up to the time they come into bearing. The majority of the apple orchards had better be ripped out. Peaches can often be rejuvenated, especially where the bark is still smooth and the bodies are sound, they would develop a new top. I have seen splendid results from the rejuvenation of cherry orchards that seemed almost hopeless. The prune in many cases seems hard to rejuvenate. In most cases where the bark is still smooth and sprouts can be forced out, rejuvenation is possible. Where one plows up old orchards that have not been in cultivation for a number of years, the result is that a large area of the feeding roots is destroyed. In order to balance up these old ones we should vigorously prune the tops, otherwise the trees will suffer not only in regard to their growth, but in the class of fruit produced. I have known of apple orchards that for a period of five years after plowing up have not produced commercial crops, the fruit produced being of an unsalable nature, often being damaged by peculiar spots which are typical of trees treated in this way, and due probably to an insufficient supply of moisture and food.

THINNING.

There is no other line of orchard work that will pay as large dividends as thinning. It is practically impossible with most types of fruit to grow highly desirable specimens without ju-

dicious care in this respect. Experiments have been conducted in various parts of the country which prove this conclusively. Some of the purpose of thinning are to get a better class of fruit and obtain desirable size, produce better color, make fruit often freer from blemish, produce annual crops, and at times even aid in controlling certain pests. Thinning may commence with the pruning. Apples, pears and peaches are thinned by pruning and also by hand thinning later. The amount of thinning will vary with the variety, with the vigor of the tree, etc. Most growers seem to prefer to delay thinning until the so-called June drop. Thinning is generally done by hand, although some men prefer to use shears. Care should be used to leave the best specimens of fruit, removing all the malformed, diseased specimens. Many growers have found it to advantage to thin more than once and thus throw the vitality of the tree into the production of the best class of fruit and have less culls to handle at picking time. We are experimenting at this Station at the present time on various lines of thinning. It may be that with many varieties of pears and with the yellow, and possibly some of the red varieties of apples, it may be found to advantage to thin all fruit from some spurs, and to leave two specimens on other spurs. We have found, in some cases at least, that such treatment has a tendency toward annual bearing and the spurs that rest are very apt to produce fruit the succeeding year. No definite rule can be given as to the amount of thinning for each type of fruit. The point is to allow a tree to set only as much fruit as it can mature to a high degree of perfection. The distances that one will allow between individual specimens on a branch must vary with variety, age of trees, general vigor, etc. Apples that naturally run very large like the King of Tompkins County are not thinned as much as some varieties that tend to grow small, like the Winesap. Some varieties have a tendency to set four or five specimens in a cluster. The Yellow Newtown is very apt to do this, while varieties like the Arkansas Black and the Comice pear will often very naturally thin themselves down to one in a cluster. As regards thinning varieties, do not always follow the same rule in the various localities. With some the center specimen of the cluster is apt to be the best, while in others the outside specimens are generally much preferred. Peaches, where the tree sets heavily, will need very severe thinning, often three-fourths of the crop must be picked off. Cherries and prunes are gener-

ally thinned by pruning. Many varieties of plums, however, will need hard thinning.

DWARF FRUITS.

Considerable interest is being manifested in dwarf fruits throughout the Northwest. For a home orchard, especially in cities and towns, and in many cases on the farm, they offer a very inviting field. They are much easier to take care of, especially as regards spraying, cultivation, etc., but require a little more skill in pruning. As a commercial proposition dwarf fruits offer an inviting field to be used as fillers in many of our orchards. Probably the dwarf pear is the most promising of the various dwarf fruits. For the pear the Angers and Portuguese quince are generally used. It is then preferable to double work these; first to either Duchess or Koonce, the latter seems to be increasing in popularity; and then in turn to whatever varieties are desired, such as the Comice, Bartlett, d'Anjou, etc.

Some of the points in favor of the dwarf are that it comes into bearing early, can be closely planted and used to good advantage as fillers in commercial plantings, and is thought in many cases to produce a superior type of fruit. They are easier for nearly all orchard operations, though requiring more skill in pruning. It must be remembered that the dwarf is produced in two ways: first, by using a stock which tends to retard growth, and second, by judicious pruning. With nearly all dwarf fruits some pruning must be practiced, and all rank growth is checked so as to produce stronger body growth as much as possible. The dwarf apple is still more in an experimental stage than the pear. When placed on Paradise stock they make very small trees, and are of value more as an ornamental or for an amateur than for a commercial tree. Some people believe that the dwarf apple on Doucin stock will be used quite extensively, and they are increasing in popularity. Further than this the dwarf fruits are being used rather sparingly as yet. The Experiment Station has been, and is working at the present time on dwarf fruits for Oregon, and later will be able to give more detailed information.

VARIETIES.

The subject of variety adaptation in the Pacific Northwest is still in its infancy. Since the greater part of the acreage in orchards is still not in a bearing state, it will be some time before final conclusions can be adopted concerning the best varieties to grow under the various conditions to be found in each locality. There is a tendency in the state to plant in some cases too few varieties, or rather try to adapt a few varieties to all conditions. For the principal varieties of apples, the Spitzenberg, one of the most popular varieties, is one only adapted to deep rich soils with warm sunny exposure. This variety is subject to all the troubles a tree is heir to; it needs constant nursing and careful handling, and is only profitable when grown to a high degree of perfection, as the second and third grades of this variety are often a drug on the market. The Jonathan apple is an apple of quite wide adaptability, but to be at its best should develop a high degree of color; it needs careful handling at the time of picking, as it develops core rot and breaks down rapidly if allowed to hang on the tree too long. The Northern Spy in most sections of the Northwest is of rather poor quality, but some sections of the Willamette Valley have been especially successful in growing this variety. It should not be placed on too rich or too heavy soil. We should discourage rank growth by the use of summer pruning and by avoiding giving the tree too much stimulation caused by too intensive cultivation or irrigation. When highly colored and not overgrown it is a very desirable apple. The Gravenstein is a very popular apple, becoming a Fall apple in most sections like the Hood River, Willamette and Rogue River Valleys, but having long keeping qualities in some of the coast counties and some of the uplands of Eastern Oregon. By careful picking its keeping season can be prolonged. King of Tompkins County has a great tendency to overgrow and water at the core, but when grown to a high degree of perfection it will find a ready market as a fall apple. The Wagener is especially valuable as a filler; it comes into bearing early and is productive. The Gano is an improvement in some ways over the Ben Davis, as it has a better color and is thought by many to be of superior quality; while a low grade apple, it has been profitable. The Rome

Beauty is rapidly becoming one of the leading baking apples, and is steadily increasing in popularity throughout the state. It is profitable in most sections where it has been tried. The York Imperial is grown to considerable extent in the Grande Ronde Valley; it has not been tried to any great extent in other sections. The Winesap, while grown to perfection in parts of Washington, is grown sparingly in most Oregon districts. It has a tendency to grow too small. The Mackintosh Red is grown but sparingly in this state as a high class Christmas apple; it would be adapted to high elevations and localities or severe weather conditions. The Russian apples are usually adapted to more or less hardship, and often succeed on the high elevations and bleak exposures where others fail. The Delicious has been grown very little as yet in Oregon and is in an experimental stage. It is probably better adapted to higher altitudes, as in low altitudes the apple is often poorly colored and too soft. The King David is practically a new apple in Oregon. Only a few trees have as yet come into bearing, and it is too early to state just how promising this variety will be and to what conditions it will be especially adapted. It is a productive apple of pleasing quality and is worthy of trial, but like other little known varieties, to a limited extent only.

Of the light colored apples the Yellow Newtown is the leader; it has wide adaptability and is now being grown to a high degree of perfection in the Hood River, Willamette, Umpqua and Rogue River Valleys. The Ortley is a popular apple in the Hood River district; it is planted considerably with Yellow Newtowns as filler and pollenizer. It is a high quality cooking and eating apple. Grimes Golden is increasing in popularity, especially in the Willamette Valley. It is a high class apple; at times it grows rather small and occasionally has a tendency to drop badly, but it is one of our most promising varieties. Winter Banana has as yet little commercial rating. We believe it is more adapted to the high elevations, as the upper Hood River Valley, than to other sections of the state. White Winter Pearmain is grown splendidly in parts of Oregon; it is an apple of excellent vitality. It is a splendid pollenizer with practically everything we have tried, and in certain sections it is worthy of trying more than at present. The Rhode Island Greening, where grown to a

good degree of perfection, is of good quality and should receive more encouragement. It is successfully grown in parts of Eastern Oregon, and is increasing in popularity in some sections of the Willamette Valley.

As to pears, it is the general belief that varieties like the Bartlett, Comice and Bosc are grown to a greater degree of perfection on lighter soils than on the heavier. Whether they will keep as well when grown on such soils is a question to investigate, and where it is reported that they have not kept as well when grown in such conditions, it may have been due to the fact that the crop was compared in this way: regions that had nothing but light soils against regions which had both light and heavy soils.

The Comice is being planted more than is justified; while it is high priced when grown to a high degree of perfection, it is a shy bearer, coming into bearing late, and is not as much of a money maker as many other varieties. The Winter Nelis should only be planted on the richest of soils. Pear districts should try varieties of pears at present that are not commonly grown in Oregon, such as Glou Morceau, Patrick Barry, Beurre Hardy, etc.

VARIETIES OF FRUITS FOR VARIOUS LOCALITIES.

For the lower altitudes of Wasco, Morrow, Crook, Gilliam, Sherman and Umatilla counties, the selection can be made from the following varieties:

Apples: Yellow Transparent, Gravenstein, Jonathan, Winesap, Rome Beauty, Wagener, and Ben Davis. The latter for spring use.

Pears: Practically any commercial variety, including Bartlett, Clapps Favorite, Seckle, Anjou, Winter Nelis.

Cherries: Sweet—Lambert, Royal Anne, and Bing. Sour —Early Richmond, English Morello, and Olivet.

Prunes and Plums: Use any of the standard varieties, such as Italian, Hungarian, and Peach Plum.

Peaches: Alexander, Early and Late Crawford, Lemon Cling, and many other commercial varieties.

Grapes: European varieties are generally covered and protected in the winter. Such are Black Hamburg, Muscat, Rose of Peru, and Tokay. American varieties are: Worden, Concord, Niagara and Delaware.

Strawberries: Clark's Seedling is the best. Practically almost any of the early, medium and late varieties would give a good family supply.

Raspberries: Cuthbert, Gregg, Marlboro and Cumberland.

Blackberries: Lawton, Eldorado, and Kittatiny.

Currants: Fay, Cherry and White Grape.

Gooseberries: Red Jacket, Champion, and Industry.

For the lower elevations of Union, Baker, and Wallowa counties the following varieties are found to do best:

Apples: Yellow Transparent, Gravenstein, King, Jonathan, Rome Beauty, York Imperial, Gano, Ben Davis, and Hyde-King.

Pears: Bartlett, Clapps Favorite, and d'Anjou.

Cherries: Sweet—Lambert and Bing. Sour—Early Richmond, and Olivet.

Prunes and Plums: Italian and Hungarian.

Peaches: Any of the early varieties, such as Early Crawford, Hales Early, Alexander, etc.

Grapes: Worden, Concord, Niagara and Breighton.

Strawberries: Clark's Seedling, Sharpless, and Magoon.

Currants: Fay, White Grape.

Gooseberries: Red Jacket, Industry and Champion.

The higher elevations of Eastern Oregon counties suffer more or less from the severity of the winter and drouth in summer:

Apples: The Russian varieties will be hardiest. These varieties in low altitudes are summer and fall varieties, but often in the high altitudes they are long keepers. Red Astrachan, Gravenstein, Duchess of Oldenburg, Wolf River, Wagener, and Mackintosh Red are the best and most satisfactory varieties to plant. Occasionally nearly any of the standard varieties grow sufficiently well for family use. Varieties of some promise in such sections are also Rome Beauty, White Winter Pearmain, Delicious, and Gano.

Pears: White Doyenne, Seckle, Clapps Favorite.

Peaches: As a rule they should not be grown. Occasionally such varieties as Alexander and Amsden June do very well. The Gibbs Apricot is often successful.

Cherries: Sweet—Lambert and Bing. Sour—Early Richmond and Olivet.

Raspberries: Cuthbert and Turners Red.

Blackberries: Any of the standard varieties such as Kittatiny, Lawton, and Eldorado.

Gooseberries: Red Jacket and Champion.

Strawberries: Clark's Seedling, Warfield, and Bederwood.

In the districts of Central Oregon like Goose Lake and Summer Lake probably any of the commercial varieties can be planted successfully. Last year a great many leading varieties of apples were found growing to a high degree of perfection, splendid in color and form, and with indications of long keeping. Such varieties as Spitzenberg, Winter Banana, and Winesap were very promising. With the conditions that prevail in those regions it is probable that there is a long list of varieties that could be grown commercially.

VARIETIES FOR HOOD RIVER VALLEY.

The leading varieties of apples in the Hood River Valley are the Yellow Newtown, Spitzenberg, Ortley, Jonathan, Red Cheek, Arkansas Black.

For Pears: D'Anjou is the leading variety and seems to grow well. Other varieties worth trying would be Bartlett, Patrick Barry, Howell, and Glou Morceau.

The varieties at Mosier are similar to those at Hood River. Very few other fruits are grown in these districts except for home use.

For Raspberries: Cuthbert; and for Strawberries, Clark's Seedling.

In the Upper Hood River Valley variety adaptation is still in an experimental stage. The Winter Banana seems to do well, and it may be that the Delicious will be good for that district, also Gano, Jonathan, etc.

In the vicinity of The Dalles we find a district especially adapted for peaches, prunes, cherries and grapes. The district above The Dalles is being cultivated to apples, varieties of which are given in another list.

For peaches the principal ones are Early Crawford, Late Crawford, Salway, Elberta, Muir, Orange and Lemon Cling, although many other varieties would do well.

Cherries: The Lambert, Bing and Royal Anne do well.

Grapes: Such varieties as Tokay and Muscat grow successfully and color beautifully.

VARIETIES FOR WILLAMETTE VALLEY.

This is one of the hardest valleys concerning which to give advice as to the variety of fruit to plant, due to the large area of the valley and the many varied conditions that are found, and owing also to the fact that, with apples especially, the industry is still in its infancy.

Apples: Yellow Newtown, Jonathan, Grimes Golden, Rome Beauty, Gano, Rhode Island Greening, Gravenstein, Ortley, Wagener, Spitzenberg, Vanderpool Red, Northern Spy.

Pears: Bartlett, d'Anjou, Comice, Patrick Barry, and Clairgeau. Worthy of trial are Glou Morceau, Beurre Hardy, Bosc, and Howell.

Peaches: Early Alexander, Amsden June, Waterloo, Triumph, Early Columbia, Hale's Early, Mamie Ross, Lovell, Champion, Early Crawford, Early Charlotte, Tuscan Cling, Golden Cling, Muir, Late Crawford, Elberta, Globe, Fitzgerald, Salway. These varieties are named in their fruiting order. Some of the most promising of the list are the Amsden June, Early Crawford, Early Charlotte, Mamie Ross, Muir, Elberta, Globe, and Salway.

Prunes: Italian. Plums: The Peach Plum and the Satsuma. The Maynard is a good home plum.

Cherries: Sweet—Royal Anne, Bing, and Lambert. Sour—Olivet, Montmorency, and Early Richmond; and May Duke and Late Duke for Dukes, which are especially fine for local cherries.

Walnuts: Franquette, Mayette, and Meylan.

Grapes: Worden, Concord, Niagara, Delaware and Breighton.

Apricots and almonds are rarely grown, but such almonds as Grosse Tender and Languedoc should be tried.

Red Raspberries: Cuthbert, Marlboro, Superlative, Antwerp.

Black Raspberries: Cumberland and Gregg.

Blackberries: Evergreen, Snyder, Mammoth.

Gooseberries: The Oregon, Downing, Industry, Smith.

Currants: Perfection, Fay, Victoria, White Grape.

Strawberries: Gold Dollar, Sixteen to One, Magoon, Clark's Seedling, Autumn Bell, Marshall.

VARIETIES FOR THE UMPQUA VALLEY.

The principal apples grown are the Yellow Newtown, Spitzenberg, and Jonathan. Pears have been planted sparingly as yet; the Bartlett, d'Anjou and Comice are in the lead. As this district is very early, more of the early types of cherries, pears, apples and peaches should be grown than is now practiced. These would find a local trade throughout the Northwest.

Leading cherries are Royal Anne, Lambert, Montmorency, Early Richmond, Early Purple Guigne. The Olivet should be tried.

Of small fruits I would advise for strawberries, Gold Dollar, Everbearing, etc., while the Clark's Seedling, Magoon, Sixteen to One, etc., will thrive.

Red Raspberries: Cuthbert, Marlboro, Superlative, Antwerp.

Black Raspberries: Cumberland and Gregg.

Blackberries: Evergreen, Snyder, Mammoth.

Gooseberries: The Oregon, Downing, Industry, Smith.

Currants: Perfection, Fay, Victoria, White Grape.

Grapes: Worden, Concord, Delaware, Breighton. Possibly in some sections a few of the European grapes like the Muscat and Tokay will thrive.

VARIETIES FOR THE ROGUE RIVER VALLEY.

Apples: Yellow Newtown, Spitzenberg, Jonathan, Winesap.

Pears: Bartlett, Comice, d'Anjou, Howell, Winter Nelis, Bosc are commonly grown. Such varieties as Glou Morceau, Patrick Barry, Beurre Hardy are worthy of trial.

Cherries: Lambert, Royal Anne, Olivet, Montmorency, Early Richmond, May Duke and Late Duke.

Grapes: Muscat, Tokay, Thompson Seedless, Worden, Concord, Delaware.

Peaches: Practically all the commercial varieties of peaches thrive in this district.

Prunes: Few prunes are grown except for local consumption, such varieties being Italian, Petite.

Apricots: Royal and Tilton are leading varieties.

Almonds: Soft Shell, I. X. L., Languedoc, Drake's Seedling; while the Texas Prolific is recommended as worthy of trial.

VARIETIES FOR COAST COUNTIES.

All varieties of small fruits seem to grow to a high degree of perfection in these coast counties. Most of the pomacious fruits are still in the experimental stage. Locations should be chosen that are not exposed to the strong ocean winds. The Gravenstein is thought to be one of the finest apples for these sections. Only a few of our commercial varieties are growing to a fair degree of perfection.

Peaches, cherries and grapes as a rule will probably only be grown for home consumption.

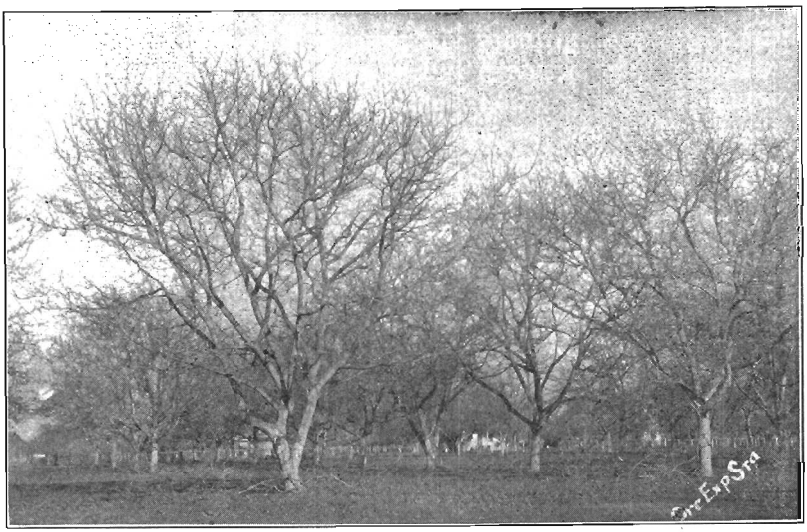
No. 31.—A splendid type of walnut tree, low headed and spreading.

WALNUT.

The English walnut is found growing very extensively through Western and Southern Oregon; specimen trees and small plantings are found from Portland to Ashland. In nearly every city of Western Oregon one will find bearing trees, more especially is this true in the Willamette Valley. These plantings vary from a few trees to 20 or 30 acres of young orchards; and even much greater acreage is found. These are also found growing over parts of Eastern Oregon as far as Baker. Probably the large commercial area of

walnuts in this state will eventually be found west of the Cascade Mountains. At the present time the largest development of this industry is in sections of the Willamette Valley.

In choosing the location for an orchard one should seek as deep rich loams as possible. The walnut is a heavy feeder and makes a very large tree; for that reason we should avoid shallow soils. At the present time we find the walnut growing successfully under many varied conditions, from silt loams along the river to the red hill lands. It is thought by some that many of the red hill lands are too light in character and that the nuts will not fill out well in such locations. It is



No. 32.—Results of close planting, these trees were headed well but have lost one-half bearing surface because of crowding.

probably a question of adequate food and moisture, and where the hill lands can fulfill these requirements there is no reason why the walnut should not succeed. One must in all cases avoid shallow soils. It is advisable to have splendid soil drainage, and while air drainage is not as necessary as with some fruits, since the walnut starts into growth very late in the spring, still it is advantageous in that it might ward off injurious frosts, especially in the fall. Give the trees plenty of room to develop. They will probably need to be planted from 40 to 50 feet apart.

Much difference of opinion is found among our growers concerning the value of grafted versus seedling trees. The writer firmly believes that if we are to put the walnut industry on a firm footing we will need to plant either grafted trees or first class seedlings with the idea of top working a large percentage of these later on. The best class of seedlings are obtained by taking the seeds from an orchard of one variety, or from isolated trees that are producing desirable nuts. Where the varieties cross the variations at times become extreme. While one does not get as noticeable variations in walnuts as with apples and peaches, nevertheless, the variation does occur, not only as regards the type of nut, but as to the bearing habits of the tree, such as too early fruiting, too late fruiting, and the amount of nuts borne. The California growers realize after twenty-five years of experience that they must work on the grafted tree basis and must abandon the seedling. There is some question as to what is the best stock to use for grafted trees. Some prefer California Black, which has been making splendid growth in our Experiment Station plantings, some like the American Black, while some prefer the English root or its hybrids with the preceding. It is reasonable to expect that we will find that various soils and locations will be adapted more to one than to another. It will take a few years to demonstrate this point. I would not advise one to plant nuts where the trees are to grow, as it is too expensive to care for them in this way, and a very few people will give them proper care.

Nuts can be germinated either in boxes, or the method we use at this Station successfully. According to this system lay down some boards on the south side of a building, cover these with an inch or so of moist sand, place a layer of nuts upon this and cover with moist or damp burlap, sand, etc. This can be done in February, and in a few weeks nuts will germinate. For the nursery the bed should be rich, thoroughly prepared, plowed and reharrowed until the lumps are removed, and the ground should be in such a condition as would form a good seed bed for small seeds. The young seedlings must then be planted in this soil in rows three to five feet apart and the plants set six to eight inches apart in the row. Care will be needed the first few weeks not to injure the young seedlings, as the roots are tender like asparagus and if not handled

carefully and soil lumps are allowed to form and are thrown against the seedlings, many of the plants will be destroyed. With good cultivation a large percentage of these seedlings will be ready for grafting the following spring. Necessarily grafting is a rather precarious operation, as often not over 10 per cent will live, while 50 per cent is an unusually good figure to reach. Top working is much more successful. Trees that are not to be grafted in the nursery row can be set out as yearlings. In grafting walnuts one must be exceptionally careful to make smooth clean cuts for absolute union, and have the graft hermetically sealed. The illustrations in this bulletin show the methods used on both top worked and grafted trees. Top working is done with a modification of

No. 33.—Walnuts need lots of room for proper development. The tree on left is well headed, the tree on right is a little too high.

the cleft graft, greater precaution being used to have very close union and to protect the wound from decay. Grafting is done in the spring just as the sap starts to flow. It is very essential that the cions should be dormant.

Formerly very little pruning was done with the walnuts in this state; most of the authorities have advocated growing trees to a pole, so to speak, for the first two or three years. I believe that the California method is preferable, however. The trees are headed from three to four feet and from three to five branches are allowed to form, as is often practiced with apples. The branches, however, must be kept tied up for the first two seasons and they should be headed back and

caused to spread, in much the same way as is advocated for apples by this bulletin. Such practice gives us a low head, but one that does not droop as much as our present system; gives better spread, and better bearing surface. The leaders will need some pruning from time to time to get ample light and check excessive terminal growth. All wounds should be waxed or protected carefully.

The French varieties are preferable, such as the Mayette and Franquette; the Meylan is being grown some and is increasing in popularity. The orchard should be given as intensive cultivation as for apples, and will need cover crops from time to time. The nuts are harvested by shaking the trees or beating with bamboo poles. The nuts should be picked up immediately; the husks removed and spread in the sun to dry. They can be put on racks similar to those used for prune drying, and the nuts will be dried more rapidly if placed on wooden horses than if placed on the ground.

It will be necessary to grade the nuts when the crop is large; this can be done with mechanical graders. The nuts are put up in cartons or placed in sacks and sold in this way. No bleaching or sulphuring is being used in this state. There is quite a demand for nuts at the present time ranging from 12 to 20 cents a pound, and we cannot begin to supply the demand; it is doubtful if we ever can be able to within the next twenty years, and perhaps never, since we are importing more and more nuts every year. Fair profits can be expected from nut growing. Trees will begin to bear all the way from four to seven years of age. The yield of nuts varies extremely, but probably from $100 to $200 per acre can be realized from this industry. While the profits may not be as great as from some other lines of fruit growing, nevertheless, it has its advantages in that a man can take hold and handle a much larger acreage than he could of most fruits; the expense of handling per acre is also less.

ALMONDS.

The almond is very exacting in its requirements, especially in regard to frost. While the tree is hardy, it blooms so early in most localities as to be nipped by spring frosts. However, there are a few localities in our state adapted to this nut. There are some regions along the Columbia, some of the valleys of Eastern Oregon, and portions of Jackson and Josephine

counties. At Merlin, Oregon, considerable quantities of these nuts are now grown. It is claimed by some that such varieties of almonds as the Languedoc and Grosse Tender can be grown successfully in the Willamette Valley and other sections where almonds are not now grown. The soil requirements are much the same as for the peach, except that the almond is a much deeper rooted tree. While it will stand considerable hardship, nevertheless, it responds greatly to good care and cultivation. The care is similar to that of the peach, except that in the pruning we thin out rather the excessive growth than so much heading in as is practiced with the latter. The almond is generally propagated by budding on seedling almond roots. Occasionally the peach is used. Some of the most promising varieties are the I. X. L., Ne Plus Ultra, and Texas Prolific.

FILBERTS.

While a great deal of interest is manifested in regard to filbert growing, few plantings have been made upon which we can make careful observations. Undoubtedly there is a considerable area of land adapted to this nut, as one finds wild species growing prolifically through Western Oregon. It is a question yet as to the best soils to use. Some believe that the clay loams will produce large trees but will not be heavy bearers, and therefore not as profitable for planting as other classes of soils. We find the nut growing naturally on the deep moist loams. Most authorities believe they should be encouraged to grow as a tree rather than as a bush. They should be given good cultivation and care. The best varieties are the French and Spanish varieties, such as Barcelona and DuChilly.

PRUNES.

Fifteen or twenty years ago the prune industry was overdone in this state. This was due to the fact that prunes were often planted under conditions that were not congenial. We did not understand handling the product properly, often the prunes were dried too much, and again the product was rough and very unattractive in appearance; a great deal of the product was insufficiently dried so that it became mouldy and decayed, and we tried to force this then unknown product upon the world's markets.

The present outlook for the prune is very encouraging, and more people should become interested in this industry. It offers one of the most attractive investments in this state at the present time. It can probably be said that when one considers the cost of land, cost of production, etc., the prune offers one of the most attractive investments to be found in Oregon. One of the prominent prune men this year remarked that we could have sold twice as many prunes had we had them, without lowering the price. The present indications are that the prune will pay larger dividends in the future than they are even paying today.

The world's markets are thoroughly familiar with the Oregon prune, and are demanding more and more of the fruit. They are easy to handle and can be put up in an attractive way.

The principal prune grown in Oregon is the Italian, though some Petite, Hungarian, Silver, etc., are grown. At The Dalles and parts of Eastern Oregon like Cove, prunes are raised largely for shipping green. In the Willamette and Umpqua valleys the prunes are raised principally for evaporating purposes, although much of the product is being shipped green. Undoubtedly years of light prune crops in the East will find trainloads being shipped green from the valleys of Western Oregon. Salem is perhaps the center of the prune district, although one finds large areas in the vicinity of Newberg, Sheridan, Dallas, and other cities.

The prune likes a well drained loam, and does especially well on our rolling foothills when deep and provided with good air and soil drainage. While they can be planted 15 to 16 feet apart at the time the orchard is set, by the time the trees come into heavy bearing they will need greater distance—probably 25 feet would not be too great a distance at which to plant. The ground should be given especially good preparation in the spring, followed by frequent summer cultivation. Where extra good care is given up to the middle of July many of the growers cease cultivation from that time on, claiming that by this method they get a standard prune and one with tender skin. This can be done only where good care has been given to the orchards during the spring months.

Prunes are allowed to drop upon the ground and are picked up in boxes. Generally five cents a box is paid for such work. They are then usually dipped in boiling water, rinsed in cold

water and graded. The fruit is then placed on trays and put in a dryer, where evaporation takes place. There are many types of dryers. Average heat is started at from 80 to 120 degrees and gradually increased to 180 degrees. It will generally take about 36 hours to dry prunes well. After drying, the fruit is taken to the packing house, where it is well graded and very thoroughly cleansed and sterilized by steam; it is then packed according to size in boxes for the market.

At the present time commercial prune orchards are paying on an average $100 per acre net. Many of them are doing a great deal better than this, $200 and often $300 being realized. When one considers that there is much less work in handling prunes than an equal area of apples, and that the world's markets are demanding more and more of our delicious product, the industry certainly has a very bright future.

CHERRIES.

In no part of the United States are cherries grown to so high a degree of perfection as in the state of Oregon. Their size and deliciousness have given them a world wide reputation. In Eastern Oregon in such regions as The Dalles, Cove, etc., cherries are grown largely for shipping purposes; while in Western Oregon and in the Willamette Valley especially they are grown for both shipping and canning. Thousands of acres of fine cherry lands are lying idle. The leading commercial varieties are Royal Anne, Lambert, and Bing; the Royal Anne being the standard canning cherry and the Lambert and Bing the shipping varieties.

Cherries should never be placed on soil that is heavy or water logged, or, in short, should never suffer from wet feet. They do well on the lighter loams and demand good drainage. Many of the rolling hill lands, such as one finds in Western Oregon, are admirably adapted to this fruit. They also flourish on some of the well drained sand and silt loams along the rivers. They are large growing trees, and will need at least 35 feet when reaching their mature size. They should be given very good spring cultivation, although in many localities it would be very desirable not to give spring preparation so early as to cause the sap to rise before the permanent spring weather. The ground should be thoroughly prepared and frequent cultivations follow until mid-summer. Cherries grow especially well in lawns and it may be that at some time the most successful cherry culture will be practiced where cherries are

placed in the sod or some growing crop, and irrigation water provided.

There seems to be a notion prevalent that cherries should not be cultivated or pruned. This is an erroneous opinion and is not based upon facts. While it is true that gummosis kills off quite a large number of cherry trees, especially those having light flesh, nevertheless I am convinced that more large cherry trees die from neglect than from any other cause.

There is a varied market for the output. They can be packed and shipped east, canned, dried and pickled for Maraschino cherries. More attention should be given to this industry. Pre-cooling plants should be established for shipping points. The industry offers an attractive investment. The production at times is extremely heavy, the yield reaching as high as from 500 to 800 pounds of fruit on a single tree. One should fairly expect to net from $100 to $200 per acre on cherries, although undoubtedly at times much better figures are realized, such as $600 to $700 per acre.

PEARS.

Oregon has one of the largest pear areas to be found in any state of the union. At the present time this industry is largely confined to the Rogue River Valley, but the industry is still in its infancy even in the Rogue River Valley. There are large areas of land in that valley and in the Umpqua and Willamette valleys that are especially adapted for this class of fruit.

Pears will often grow on heavier soils than apples, though they respond handsomely when placed on deep, well drained rich soils. Varieties like Bartlett have a wide range of adaptability, growing on heavy adobe soils on the one hand, and on the lighter soils on the other. Winter Nelis should be planted only on the richest soils. Pears should be planted about 25 feet apart, and be given common orchard cultivation as indicated in the headings on tillage, cover crops, etc.

After the trees come into bearing be cautious about over stimulating the trees by furnishing too much nitrogen or practicing too severe pruning or too much cultivation, since such practices encourage the growth of coarse grained sappy wood, and such wood succumbs to blight attack very readily. It has been demonstrated in Western and Southern Oregon that when blight is handled carefully and according to our best knowledge of the subject it can be controlled. Climatic conditions are

such that blight does not develop as rapidly as it does in some of the warmer heavily irrigated districts.

There is a splendid market for pears, varieties like the Bartlett coming into fairly good bearing about the fifth year, though the Winter Nelis and Comice are much slower to come into bearing. Profits do, and will, probably for the next 20 years, exceed those of apple culture. Oregon pears are not only known all over the United States, but are being sent to European markets, and wherever they are entered, are receiving the highest market prices.

PEACHES.

The peach industry in Oregon is still in its infancy. Considerable area adapted to this crop is found at The Dalles and in Southern Oregon at such points as Merlin and Ashland; also the sandy silt loams found along the banks of the Willamette River and its tributaries. These latter locations are famous for their large sure crop productions. One of our principal peach growers claims never to have had an absolute loss of fruit in 29 years. Others claim no failure in 15 years. While at times the local markets might be overstocked, as was true the past summer owing to forest fires that interfered with the Eastern shipments, nevertheless there is a good investment to be found in peach growing. They will have to be grown in carload lots and shipped by means of refrigeration. From Ashland peaches have been sent in splendid condition to many Missouri River points.

The industry pays handsome dividends, many local orchards claiming a very high average; one should be reasonably expected to net from $100 to $200 year in and year out. Many of our growers are doing a great deal better than this.

GRAPES.

The grape culture has not, as yet, been very highly developed in Oregon; this industry should receive much more attention. There are two sections in the state that are especially adapted for the production of the Vinifera or European grape as it is commonly called; near The Dalles and in parts of Southern Oregon in such regions as the Rogue River Valley. The best areas are found principally on red hill lands that are provided with good air and soil drainage, have a warm sunny exposure and are out of the fog and frost belt. Such

grapes as Tokay, Muscat, Thompson Seedling, etc., grow to the highest degree of perfection, possesses splendid quality and are unexcelled by any grapes the writer has ever tasted. There is a large demand for the product and much more attention should be given to this industry.

These lands can also grow the American or table grapes. Much more attention should be given to this product, as we are steadily importing grapes from eastern points. The Umpqua Valley offers a good field for early table or American grapes like the Worden, Concord, Delaware, Niagara and Breighton. These varieties also succeed well in the Willamette Valley on the silt loams along the rivers and on the sunny, rich hill lands when such lands are not exposed to cold winds. winds.

Grapes should be given similar preparation and tillage as stated under these headings in this bulletin. The vines are planted in rows about five to six feet apart and the plants from six to eight feet apart in the row, according to the system of pruning. The renewal systems of pruning, in which bearing wood is cut away each year and new bearing wood produced, are the better. Part of the canes should be removed. A strong vine can stand four canes, while some of the weaker growing sorts should have but two canes. At times it is best to limit the number of bunches the vine is allowed to produce, and throw greater vitality into the remaining bunches.

Grapes must be given exceedingly good care the first three years and not be allowed to bear during that period, so that more vitality may be thrown into the growing vines. They will need severe cutting back the first few years and when pruned upright each will produce arms for fruiting. European varieties are usually grown on stumps, although sometimes they are placed on wires, while the American varieties are always grown according to the latter method.

THE HOME ORCHARD.

Not enough attention is being given in Oregon to the home orchard. While the starting and maintaining of an orchard requires much care and work, and while it is thought by some that it will be better and cheaper to buy the supply of fruit, yet no farm home is complete without an orchard and garden and probably no family in a rural community will have a desirable amount of fruit unless they grow it, to a large extent, themselves. Many of our farmers have been making

this mistake—they have tried to maintain too large orchards. An average orchard will, with proper care, produce enough fruit for ten families instead of one. The remedy will be to use less trees and in the majority of cases to grow more varieties. The aim should be to furnish a supply of fruit the year around. It will not be necessary to devote an entire tree to a single variety, for in many cases four or five varieties can be grown on the same tree. The dwarf fruit may offer a partial solution of the problem. A small orchard containing just enough trees and varieties to keep the family and give a supply throughout the season will be much more appreciated, will be easier to care for, and will be much more desirable than the average farmer's orchard. In many cases I would advise farmers to plant a new orchard and after these come into bearing to discard the old orchards, which are often in such condition that it is impossible to put them in good shape. Where the farmer cannot practice cultivation of his orchard, he could allow chickens to run through it, and even after the trees became mature and there is no danger of injury, hogs could be kept in the orchards. They will work the ground into good shape and it will be much better than no cultivation at all. Some spraying will be necessary, not so much as with many commercial orchards, however. The aim should be to keep down the majority of the prevalent diseases and insect pests, such as the codling moth, scale, anthracnose and blight. On the average farmer's orchard a good double action hand sprayer will suffice. With a little care splendid results will be realized.

POLLINATION.

Notes on pollination in bulletin form have been published from time to time from this Station. The principal advice that we would give at present is not to plant varieties in large square blocks. Many of our commercial varieties of apples are evidently sterile, and we find that even some fertile varieties like the Yellow Newtown seem to be improved by crossing. Where two or three varieties are being grown we would recommend that such varieties be planted in oblong blocks, containing from two to six rows each. Where one wishes to plant a single variety that is to be pollenized, every fifth tree in every third row would be ample. Where varieties bloom at the same time, fair results can generally be obtained by planting them together. The Spitzenberg and Yellow Newtown inter-pol-

lenate nicely, also the Jonathan goes well with such varieties. The Yellow Newtown is pollinized very nicely by the Ortley or Grimes Golden, and especially well by the White Winter Pearmain. This latter variety has so far proved to be a splendid pollinizer upon every variety tried. The Ben Davis, on the other hand, has proved at times to be rather poor with most varieties, being somewhat weak in vitality.

While many of our varieties of pears are self-fertile in Oregon, nevertheless practically all are improved by crossing, and such varieties as Comice, which are absolutely sterile, must be crossed with other pears if good crops are to be realized. The Bartlett and d'Anjou intercrop very nicely, also Winter Nelis and Comice. Howell and Winter Nelis seem to go well with any varieties that bloom at the same time. We would not recommend the interplanting of the Bartlett and Bosc, as the crossing of the Bartlett by the Bosc has given us unsatisfactory results.

WINTER KILLING.

While winter killing is not generally experienced in the Northwest, nevertheless the last three years we have had a great deal more of this trouble than we desire. Winter killing takes many forms, and the Departments of Horticulture and Botany of this Station are now investigating this condition. The so-called condition may be due at times to true winter killing, or it may perhaps be attributed to other causes. The difficulty seems to be very abundant on young trees that are over cultivated, especially in the fall of the year, and are not allowed to go into dormancy early. It is found quite abundantly in orchards that are on poorly drained soils and subsoils that are supplied with streams of cold seepage water. It occurs at times east of the Cascades where dry freezing takes place, or during severe cold weather when the ground is bare and contains little moisture. This is especially fatal to young trees.

Forms of it will also be caused at times by pruning trees that are frozen, resulting, in many cases, in considerable dieback. It takes many forms. It may show itself in the complete killing of the tree to the ground line; at times a freezing to the snow line; at other times a certain percentage of buds are killed; again there is a discoloration under the bark, while often only certain branches of the tree die. Often the wood is

darkened and weakened so that large branches when heavily laden with fruit break off.

The entire effect of winter killing is not always shown immediately; some trees recover the first year, others are two or three years in recovering, and in some cases even succumb, and at times there is considerable breaking of branches, probably due to former freezes.

Treatment: First be sure that all fruit trees are placed on properly drained soil and watch out especially for seepage water. With young orchards intensive cultivation should cease by the first or middle of August and the trees allowed to harden and go into dormancy. The amount of pruning that injured trees should receive is a question to be determined by experimenting. With very young trees we would advise leaving them alone. With trees from four to five years and in heavy bearing, often heavy spring pruning may be desirable. Where trunks are split or merely a crack indicated, I would seal it over immediately with the solution of grafting wax given in the appendix. Where splitting has occurred to such an extent that wide cracks are formed, the wounds should be cut down to the live issue with a sharp knife, sterilized and filled with grafting wax.

FROST AND FROST FIGHTING.

While most of our fruit districts are fortunate in being free from killing frosts, some localities at times suffer from frost injury. This injury is principally in the spring time at blooming or soon afterward. The damage at times means a total loss of the crop, while at other times it results in merely a disfiguration of the fruit, a consequent injury to its sale value. One of the best ways to fight frosts is to choose lands that have good air drainage. Such frosts are experienced more in lower elevations, pockets, draws, etc. With good air circulation, under ordinary conditions in our Oregon fruit districts very little damage will ever be experienced from frosts.

Frost damage occurs principally on clear, cool nights, especially when the atmosphere is dry and the radiation of the heat from the earth's surface is very rapid. The appearance of frost may be foretold by means of an instrument known as the sling psychrometer. This consists of two thermometers, that have been thoroughly tested, fastened on a board. On one of these thermometers a damp cloth or a little damp cotton is placed.

The instrument is used in this way: The handle should be fastened to a board upon which the thermometers are fastened so that the instrument can be rapidly swung in the air. Moisten the cloth, whirl the apparatus rapidly and read the thermometer immediately after whirling. Unless the air be perfectly saturated with moisture the wet bulb will always show a lower temperature than the dry bulb. Subtract the degrees of the wet bulb from those of the dry bulb and the difference will show the degree of cold produced by evaporation. We obtain in this way what is known as the "dew-point," and whenever the dew-point and temperature register below 32 degrees there will be frost. The way to use the dew-point table is as follows:

Suppose for example that we swing the psychrometer several times until the mercury has ceased to drop in the wet bulb; the dry bulb reads 50 degrees and the wet bulb 40 degrees. This gives a difference of ten degrees. Turn to your dew-point table. Follow down to No. 10 and then across to the right until you come under the 50 degrees, which was the temperature of the dry bulb. You will note 25 is the result. The probabilities are that the temperature will fall down to 25 before morning. You then know that it is reasonably sure that there will be killing frosts and means can be taken for protection.

DEW-POINT TABLE COPIED FROM BAILEY'S "PRINCIPLES OF FRUIT GROWING."

Difference of reading of dry and wet bulbs	TEMPERATURE OF AIR—FARENHEIT.											
	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
1.....	11	16	22	27	32	38	43	48	53	58	63	69
2.....	6	12	18	24	30	35	41	46	52	57	62	67
3.....		7	14	21	27	33	39	44	50	55	60	66
4.....		1	10	17	24	30	36	42	48	53	59	64
5.....			4	13	20	27	33	40	46	51	57	62
6.....				7	16	24	30	37	43	49	55	61
7.....				1	11	20	27	34	41	47	53	59
8.....					5	16	24	31	39	45	51	57
9.....						11	20	28	36	43	49	55
10.....						4	16	25	33	40	47	53
11.....							11	21	30	38	45	51
12.....							4	17	27	35	42	49
13.....								11	23	32	40	47
14.....								5	18	28	37	45
15.....									12	24	34	42

Considerable work has been done in frost fighting, but there is still a great field for investigation, as the majority of this work has not been done carefully enough and proper checks kept to find out the real limits of smudging or heating. Undoubtedly the temperature can be raised, but how much and under what conditions this will succeed is still more or less in an experimental stage. Formerly smudging was used considerably and this was generally practiced before daylight; heavy smoke sufficient to cover the entire orchard was furnished, and the trees had a chance to thaw out before sunlight struck them. This probably would not be an assurance against freezing, and at times frosts become so severe as to be virtually a freeze. Under certain conditions heating will be a prevention against freezing. Often oil pots are used. It will take from 40 to 150 pots to the acre, according to climatic conditions, type of fuel used, etc. A gallon of oil will last from three to six hours. Be careful in selecting the oil; ordinary locomotive oil is unsatisfactry. There is one oil put on the market that is guaranteed to contain only 2 per cent water, and may be purchased for a few cents per gallon. This is said to be very good. Some use distillate, but the latter may be more expensive.

When one feels fairly certain that frost is to be experienced it would be well to start pots before the temperature gets down to the freezing point, as it is easier to maintain a certain temperature than to raise an already low temperature to the safety point.

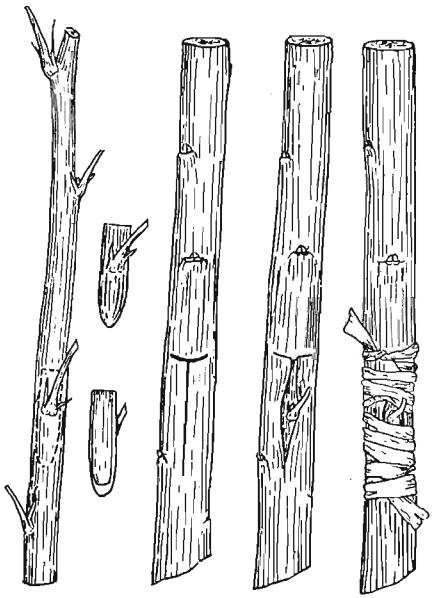
Where large amounts of oil are to be used it will be necessary to provide some container—wooden tanks are often unsatisfactory. Cement tanks have been tried and when well constructed are fairly satisfactory. Galvanized iron tanks are used considerably. Heavy oil at times will not flow or pump easily, and will need to be removed by gravity. It should be placed in pots in the orchard and a flannel cloth or similar material which has been soaked in kerosene used for lighting the pots.

The most dangerous times for frost and frost injury are apt to be from 2 o'clock in the morning until usually after sunrise. For additional information see Bulletin 110, Oregon Experiment Station.

BUDDING AND GRAFTING.

There are many orchardists in the Northwest who have made the mistake of planting varieties that are not adapted to their locations, and under such circumstances the trees should be grafted or budded over to some other varieties.

There is considerable demand for information from time to time concerning the method of handling nursery stock. I will say that with nursery stock, budding is practiced more commonly than grafting. Pears, peaches, prunes and cherries



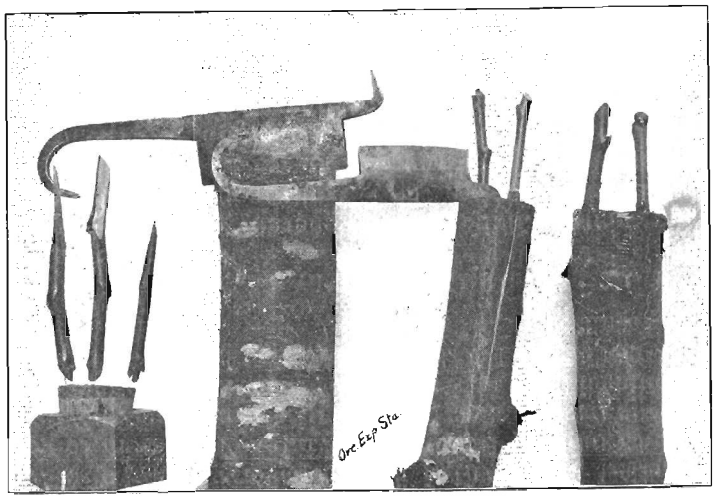
No. 34.—T budding, showing bud stick, the bud removed, stock cut, the bud inserted, bud bound.

are nearly always budded. In this climate the budding is generally done the latter part of the summer at the time the bark will slip nicely. This time varies according to elevation, soil, and similar conditions. Occasionally spring budding can be practiced, although it is not to be recommended for general practice.

The grafting of young nursery trees is generally performed by what is known as the bench graft. This is simply a modification of the whip graft, and in irrigated sections it is often possible to grow a large tree from a piece root. In Western

Oregon and in most unirrigated districts we would much prefer to use the whole root for either bud or graft. Where piece roots are used it will often take more than one season to obtain desirable trees.

The form of budding usually employed is what is known as the T or shield bud. It is inserted on the north side of the tree generally just above the ground. Make a vertical cut from an inch to an inch and a half long and then a horizontal cut about one inch in length. With the back of the knife or some smooth instrument turn back the portions of the bark that have been loosened by making the T cut. Obtain a bud which you will find in the axil of the leaf. In cutting this, we



No. 35.—Illustrating method of cleft grafting, cions cut and shaped, cions inserted, the graft waxed and completed.

leave just enough wood to give it firmness to insure easy handling. Slip the bud in under the flaps that were rolled back, tie securely with raffia or yarn until the bud has taken, which will be about two weeks. After the bud has taken securely the bands for tying are loosened by simply slitting with a knife on the side of the tree opposite the bud. In the spring of the year, generally before the growth starts, the tree is cut off just above the bud and this forces growth into the latter, which will grow into a shoot immediately. This same method of budding can be used in working over the branches of a young tree that is from two to five years of age when you

wish to top work it with other varieties. This system can also be used to advantage when we cut back old trees quite severely and allow sprouts to grow, and wish to bud the sprouts.

The whip graft can be used in root grafting and top working young trees and shoots. In using this we prefer small twigs, not over one-half inch in diameter. A slanting cut is made on the stock and then a tongue cut into that. A cut of similar angle is made on your scion and a tongue cut in that. The two tongues are forced firmly together, the graft firmly tied,

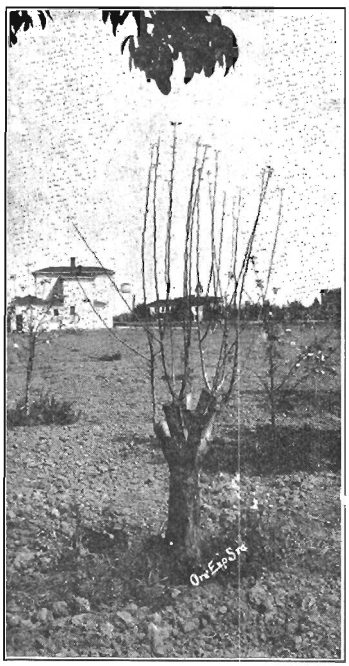
No. 36.—Result of two cions on a small stock. The stock is decayed in the center. Practically lost. One cion would have prevented this.

No. 37.—Top worked old apple tree. The grafts set.

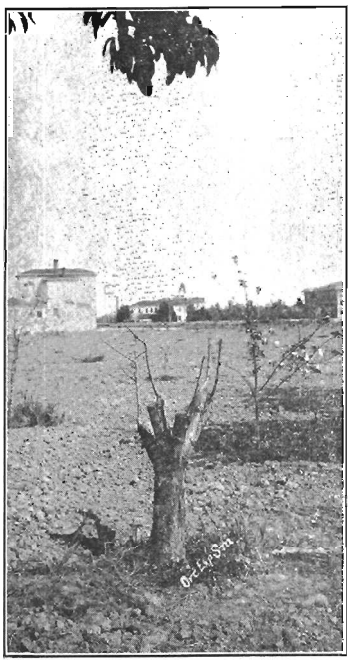
and in many cases waxed, certainly so if above the ground. It is done during the winter for root grafting and just before the shoot sprouts in the spring for top working. While one can work over trees after the leaves have attained considerable size, it is advantageous to have the cions dormant in any case. They can be kept dormant by cutting in January and February and stratifying in sand. Be careful not to let them get too moist or they will decay, and if they are too dry they will shrivel. Occasionally it is necessary to place cions on

ice in order to keep them dormant. Especially is this often practiced on walnut cions.

In working over old trees a number of methods can be tried. A common way where large branches are cut back is to use what is known as bark grafting. The cions are cut sloping at the base and the smooth surface slipped down between the bark and the wood of the stock. These are tied in securely and waxed carefully. Use this method for large



No. 38.—The new top after first season's growth.



No. 39.—The new top after one year's growth headed back and thinned.

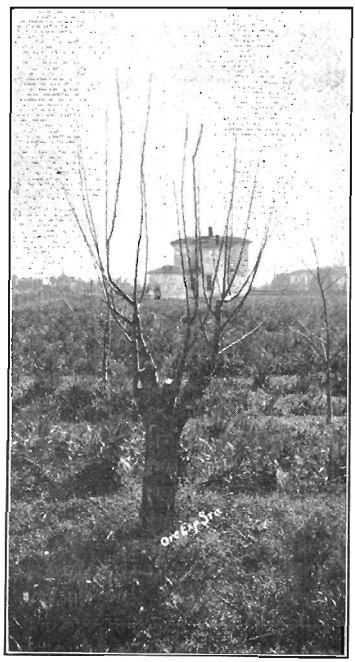
cuts. For medium sized cuts the cleft graft is to be recommended. In the cleft graft we saw off the branch to be grafted and generally split it in the center wide enough to allow the entrance of two cions, one for each end of the cut. For this kind of grafting a special tool is necessary for splitting, and you will need a wedge or two to keep the stock open until the cion is inserted. Choose cions from last year's growth, using lengths containing about two buds. The cion is cut in the form

of a wedge, the narrower edge of the wedge to point inward. In placing the cions put them so that the growing surfaces will come in contact with that of the stock. In some cases it is well to wax over the ends of the cions. All wounds should be very carefully waxed.

CARE OF THE GRAFTS.

Many people make the mistake of grafting successfully and then allowing the grafts to take care of themselves. You

No. 40.—The new top at end of second searon's growth.



No. 41.—The new top headed back after second season's growth.

will need to watch them very carefully when young. They are often attacked by insects that will eat out the buds. In most cases you will only need to allow one cion to grow; however, we occasionally allow two to remain for a couple of years in order to help callous over large wounds. The grafts should be headed back the first summer early in July, otherwise they will run up a rank growth and become too high headed, and there is also greater danger from strong winds, birds, etc.

By heading back, laterals are forced out and you can develop a strong spreading tree. The grafts should be pruned the first few years in much the same way that the young trees are handled. There are many methods of grafting trees, all of which have considerable merit and all of which may be recommended, whenever they can be practiced successfully. In a publication of this kind it is impossible to go into detail, but some simple practices that the average man can use have been outlined.

WALNUT GRAFTING.

Walnut grafting is more or less of a difficult proposition. Many men have been successful for a year or two, and then have made a dismal failure in succeeding years. One of the most successful men in this locality has been Mr. George C. Payne, of Campbell, California, and the methods that he has used are outlined in the following description:

"For cions select round wood with buds not too far apart. Use upright or horizontal wood and never drooping wood. Avoid terminal buds. Spurs on young trees a foot or less in length make good wood.

"When possible, leave cion wood on trees until two or three weeks before they show signs of starting, which would be about April first to tenth. Cut in lengths from twelve to fourteen inches and stratify carefully in sand.

"Before grafting, wait until buds on stock show signs of bursting. If placed in position before the sap starts they may dry out. One can start in earlier on English walnuts than on Blacks, but Blacks will permit a longer grafting season.

"Bright, extra sharp tools are necessary. Good knives are the IXL, the Henckel, budding knife large size, Joseph Rogers' iron handled grafting knife; and a shoemakers knife is very desirable. For a splitting knife use Rogers' butcher knives. A splitting maul like an old-fashioned potato masher is good, dimensions 11x4½x3. Hickory or hardwood wedges, six inches in length, of different widths, are desirable for splitting. Have the edges a little thinner than the center. Have a sharp saw. Use oil stones, emeries, etc., to keep tools always sharp.

"Never make a concave cut on cion. Choose a piece of wood having two eyes of straight growth. Cut off 2½ inches below bud, with slanting cut. Turn lower bud upward. Begin with knife on opposite or a little lower than bud. Cut just through the bark to wood. Continue downward, very gradually cutting deeper, until two-thirds of cut is completed. The remaining one-third is cut considerably more abrupt. Turn the cion over

and treat the other side the same. Have cion a little thicker on the outside. After cion is cut, prepare stock. Saw off straight, then take butcher's knife and split very lightly through center then bear heavily on handle of knife and split the opposite side of stock. Now drive in wedge. One must now carefully fit stock to cion. It is generally necessary to cut out a little wood on each side of split in such a way that when wedge is released the cion is caught firmly and perfectly. The cion should be inserted as with other grafts, so as to bring growing layers together. Next, stuff newspaper down in the chink between the two cions. Now wax. Cover entire cut surface. It is fatal to leave it exposed. It is sometimes necessary to rewax three or four times. If cion buds are slightly covered with wax it will do no harm. After waxing, tie an inflated paper bag over graft, leaving an inch or two for cions to grow.

NURSERY GRAFTING.

"The work is done at the same season as top working. When possible, avoid doing the grafting in the early morning hours, or following a heavy rain, for at such times considerable bleeding may take place.

"Pick away the dirt from around the tree with a sharp band shear, cut off the tree about two inches above the ground. In making the cut always have the blade down. Then with a shoemaker's knife make a vertical cut from an inch to an inch and one-half in length, the cut terminating at the stub of the stock. The cut is very shallow at the lower end and ends deeply at the center. Now make a cut at right angles to the first. The result will be that you will take out a right-angled piece from the stock, the cut being broad and deep at the top and shallow and drawn to a point at the lower end.

"A cion is so cut as to fit this right-angled notch in the stock very closely. First cut the cion off sharply, then make a cut at right angles to this, which will be from an inch to an inch and one-half in length. Draw it in slightly toward the point. If the cion and stock do not fit absolutely smooth, make new cuts until you get a true, smooth connection. Now take some coarse twine or yarn and wrap the two together securely, finally tying with a half hitch. This being done, wax over very carefully, probably at least two or three times, as per directions given for cleft grafting. Use paper bags and treat as in previous method."

A successful method of budding the walnut is described in circular bulletin No. 16, Oregon Experiment Station.

RABBITS, MICE, GOPHERS, ETC.

During the early years of the orchard's life one will need to watch out continually for certain animal pests. Rabbits at times become quite destructive. There are several methods of controlling them. One method is to put in a rabbit fence, but this is quite expensive. Another method is to protect the base of the trees with wire gauze used as a screen; some authorities report that they have kept rabbits away from trees by rubbing the bark with hog or sheep liver.

Rats and mice are apt to be found in alfalfa sod lands. They are very hard to control; perhaps one of the most satisfactory methods is to use poisoned grains, carrots, etc., soaked in strichnine or arsenic. Traps can be used to advantage at times. The problem, however, is a vexatious one, and needs constant study.

Often gophers can be shot to good advantage, as they generally have definite periods when they come out, and sometimes it is necessary to go to the extremes of watching and timing them. We have found this quite effective in some of our work at the College. It does not necessitate long hours of waiting, as when we see them at certain hours we can jot it down and then get them the next day.

Flooding has been tried on ground rodents where irrigation is practiced, with more or less success.

SUNSCALD.

In some sections of the state sunscald becomes serious, especially in those sections where the light soils reflect the light and heat too pronouncedly. It generally occurs during the spring of the year when there is an unequal range of temperature, the days being warm and the nights cold. It occurs at times in summer on the main branches of the trees. It is generally confined to one side of the tree and may lead to other complications, such as attack of borers or certain diseases and the like.

In regions subject to sunscald the young tree should be protected during the first few years by placing a slab or board on the south side of it. The buds of the tree can be protected from sunscald by proper pruning. Where injury has taken place from sunscald the wound should be cut out to clean live

tissue, then thoroughly sterilized and cleaned out and sealed over with walnut grafting wax.

APPENDIX I.

LIST OF RELIABLE WORKS OF INTEREST TO HORTICULTURISTS.

The Principles of Fruit Growing	Bailey
The Principles of Vegetable Gardening	Bailey
Plant Breeding	Bailey
The Horticulturalists' Rule Book	Bailey
The Pruning Book	Bailey
The Nursery Book	Bailey
Cyclopedia of Horticulture	Bailey
Barry's Fruit Garden	Barry
Bush Fruits	Card
Irrigation Farming	Wilcox
How to Make a Fruit Garden	Fletcher
American Fruit Culturist	Thomas
Strawberry Culturist	Fuller
Nut Culturist	Fuller
Spraying of Plants	Lodeman
Irrigation and Drainage	King
The Soil	King
Fertility of the Land	Roberts
Hedges and Wind-Breaks	Powell
Insects Injurious to Fruits	Saunders
Fungi and Fungicides	Weed
Insects and Insectides	Weed
Plums and Plum Culture	Waugh
American Horticulture a l Manual (2 vols.)	Budd & Hansen
Successful Fruit Culture	Maynard
California Fruits	Wickson
Fruit Growing in Arid Regions	Paddock & Whipple
American Apple Orchard	Waugh
Popular Fruit Growing	Green
Apples of New York	Beach
Grapes of New York	Hedrick

APPENDIX II.

LIST OF PAPERS AND PUBLICATIONS.

A list of some of the papers and publications of interest in horticulture, sample copies of which can generally be obtained by writing to the publisher.

Better Fruit	Hood River
Oregon Agriculturalist and Rural Northwest	Portland
Northwest Horticulturalist	Seattle
Pacific Homestead	Salem

Orchard and Farm	San Francisco
Western Fruit Grower	St. Joseph, Mo.
Rural New Yorker	New York
Washington Fruit Grower	N. Yakima, Wash.
California Fruit Grower	San Francisco
Market Growers' Journal	Louisville, Ky.
The Fruit Grower	St. Louis, Mo.
Oregon Countryman	Corvallis
The National Nurseryman	Rochester, N. Y.
The Garden Magazine—Doubleday, Page & Co	N. Y., 133 16th St.
Suburban Life—44 East 23rd St	New York
American Fruit and Nut Culture	Petersburg, Va.
The Rogue River Fruit Grower	Medford
The Pacific Coast Packer	Kansas City, Mo.
Chicago Produce News	New York
New Produce Bulletin	New York
Fruit Trade Journal	New York
Oregon Agriculturalist	Portland
Wallaces' Farmer	Des Moines, Ia.
Southern Orchards & Homes	Houston, Texas
Horticulture	Boston
The Fruitman and Gardener	Mt. Vernon, Iowa
The Irrigation Age	Chicago
The Canned Goods Trade	Baltimore, Md.
Gem State Rural	Caldwell, Idaho
The Pacific Northwest	Portland, Oregon
The California Cultivator	San Francisco, Cal.
The Rural Californian	Los Angeles, Cal.
The National Horticulturalist	Council Bluffs, Iowa
The Florists' Exchange	New York
Opportunity Magazine	Spokane, Wash.
Northwest Farm and Home	Seattle, Wash.
Cold	Watertown, N. J.
The Ranch	Seattle, Wash.
The Southern Fruit Grower	Chattanooga, Tenn.
The Westerner	Earlington, Wash.
Farm and Orchard	Keyser, W. Virginia
Farmers Digest	Columbia, Pa.

APPENDIX III.

LIST OF FRUIT GROWERS' ASSOCIATIONS.

OREGON

Eugene Fruit Growers' Association	Eugene
Ashland Fruit and Produce Association	Ashland
Hood River Fruit Growers' Union	Hood River
Hood River Apple Growers' Union	Hood River
Grande Ronde Valley Fruit Growers' Union	LaGrande

Milton Fruit Growers' Union.....Milton
Douglas County Fruit Growers' Association.....Roseburg
Willamette Valley Prune Association.....Salem
Mosier Fruit Growers' Association.....Mosier
The Dalles Fruit Growers' Union.....The Dalles
Salem Fruit Union .....Salem
Albany Fruit Growers' Union.....Albany
Coos Bay Fruit Growers' Association.....Marshfield
Estacada Fruit Growers' Association.....Estacada
Umpqua Valley Fruit Growers' Association.....Myrtle Creek
Hyland Fruit Growers of Yamhill County.....Sheridan
Newberg Apple Growers' Association.....Newberg
Dufur Valley Fruit Growers' Union.....Dufur
McMinnville Fruit Growers' Association.....McMinnville
Coquille Valley Fruit Growers' Union.....Myrtle Point
Stanfield Fruit Growers' Association.....Stanfield
The Oregon City Produce Association.....Oregon City
Lincoln County Fruit Growers' Union.....Toledo
Rogue River Valley Fruit and Produce Association.Medford
Mount Hood Fruit Growers' Association.....Sandy
Corvallis Fruit Growers' Association.....Corvallis

APPENDIX IV.

GRAFTING WAX FORMULA—WALNUT WAX.

Resin, 5 pounds
Beeswax, 1 pound
Finely pulverized charcoal, ½ lb.
Rawlinseed oil, 1 gill

After melting the beeswax and resin over a fire that is not too hot, add the charcoal, stirring steadily, then add the oil. After moulding the bricks it should be placed in greased pans. As one needs to use the wax it may be broken off in lumps and melted in suitable dishes. It should be in liquid form when applied.

COMMON GRAFTING WAX.

1. Four pounds resin
   Two pounds beeswax
   One pound tallow

2. Four pounds resin
   One pound beeswax
   One pound tallow

THE HORTICULTURAL LAW MAY BE OBTAINED BY WRITING TO THE SECRETARY OF THE STATE BOARD OF HORTICULTURE, PORTLAND.