CULTIVATION AND FERTILIZATION OF PEACH ORCHARDS.

By M. B. Waite,

PREPARATION OF THE LAND FOR ORCHARDS.

Commercial peach orchards in the United States have been planted out under all sorts of conditions. Very frequently the land is cleared of its timber during the winter and roughly broken up and planted at once to peaches. Even the peach orchardists who are doing this, however, will almost invariably admit that they prefer well-cleared and well-cultivated land. Wherever possible this should be secured. The great peach orchards of Georgia are mainly located on old, well-worn cotton plantations, although in the north of Georgia, in the mountain peach belt, new land is being freely used. The best method, where time is not too limited, is to cultivate the land in corn or cotton or some other crop suitable to the locality for two or three years before planting out the peaches. This is done to take the excess of nitrogen and general rawness out of the soil. Old, worn-out land, however, had better be sown to clover, cowpeas, or some cover crop, and this plowed under the year before planting. Any method adapted to the locality which will bring the land into good tilth is desirable. If the land is extra rich, cropping with an exhaustive crop like corn is good, but if it is poor, like most of the land best suited to peach culture, the method of plowing under clover, cowpeas, or some green manure is the better practice. Where feasible, it is better to grow potatoes or some truck crop, especially if the latter requires manuring and fertilizing, and thus bring the land into a garden condition. Most soils require deepening in order to grow peaches and other fruits to best advantage. It is a wise plan where poor land is being made fertile by plowing under clover or other cover crops, to plow the land an inch deeper than the natural depth of the soil each year for two or three years. By this means the surface soil can gradually be deepened. Subsoiling is undoubtedly of great benefit in preparing land for planting peaches. While the soil can only be plowed to a certain depth, the subsoil plow can be run 6, 8, or 10 inches deeper, simply loosening the subsoil without throwing it to the surface. In preparing land for planting out peaches the
tillage should be as deep and thorough as possible, for the reason that after the trees are planted and when they are growing there will be no opportunity for deep plowing. Any wet spots or poorly drained areas in the peach orchard should be looked after and thoroughly under-drained. While it might be unwise to plant peaches on areas requiring underdrainage, there is frequently a small corner or pocket in an orchard that it would not be profitable to work around which might be brought into condition for planting by drainage.

PLANTING ON OLD PEACH LAND.

One of the problems which confronts the peach growers in the older sections is the question of planting peaches on land that has previously been in peach orchards. There is no doubt that new land which has never been in peaches is distinctly better than land where peach orchards have been pulled out, and some growers advise not to plant at all on old peach land. However, the writer has seen some very successful orchards on land that had formerly been in peaches. The best method, however, is not to replant at once, but to pull out the trees by the roots and crop the land for two or three years at least before again setting out peaches. If the land is poor it is desirable to use the methods previously mentioned in preparing the land, giving special attention to the plowing under of cover crops and green manures and to deep plowing and subsoiling. One of the disadvantages of replanting peach orchards is in the parasites which remain over in the soil, such as root aphis, root-rot fungi, nematodes, and doubtless other unknown pests. An interval between the plantings will give an opportunity for the parasites to starve out or die out. Of course, the question of soil fertility is also important, but this is less serious, as it can be remedied by the application of manures and fertilizers. Where a peach orchard has been pulled out because of the yellows, there is usually less trouble in replanting than where the orchard has lived to maturity and the trees have died of old age. In case of root rot and nematodes the replanting is almost certain to be a failure, as these parasites live over in the ground and attack the young trees. Thrifty, mature peach trees frequently carry on their roots large numbers of root aphides and other root parasites without becoming seriously affected. However, when these large trees are pulled out and small young trees are planted on the same space, the number of roots available for the parasites to feed upon is so much reduced that trouble ensues. Young peach trees planted on old peach land should always be heavily fertilized in order to stimulate them to push growth vigorously and rapidly, so as to outgrow the parasites. A good plan, especially in the Northern States, is to dig the holes in the fall considerably larger than required for the trees, and fill them full of stable manure. Then in the early spring, fork out the stable manure and plant the tree in the enriched
FIG. 1.—CORNER OF A BLOCK IN HALE'S ORCHARD, FORT VALLEY, GA., WITH PEACH PACKING HOUSE IN THE DISTANCE.

FIG. 2.—PLANTATION OF HALE'S ORCHARD, FORT VALLEY, GA., SHOWING A PORTION OF THE ORCHARD OF 365,000 PEACH TREES.
FIG. 1.—Block of 7-year-old Elberta Peaches in Roland Morrill's Orchard, Benton Harbor, Mich.

FIG. 2.—Block of 3-year-old Peaches in Roland Morrill's Orchard, Benton Harbor, Mich.

[Photographed in September.]
ground, leaving the remnants of the manure in the immediate vicinity of the tree. It is certainly more difficult to secure a good stand and a uniform, thrifty growth on old peach land, but by giving extra care good results can frequently be secured. Wherever there is plenty of new land available, the old land had better not be used.

DISTANCES FOR PLANTING ORCHARDS.

The standard distance for planting the peach is 20 by 20 feet. Peach trees are very rarely planted any farther apart than this. The distance, however, varies greatly in different parts of the country on account of the soil, climate, and other conditions, and it also varies with the individual planter. In the Northern sections 18 by 18 feet is frequently used, and as one goes eastward the tendency is to shorten the distance to 15 by 15, and some growers, notably Mr. J. H. Hale, even advocate the planting of trees as close as 13 by 13 feet. (Pl. LXXXII.) Distances under 16 feet square are suitable for the growth of the young orchard up to perhaps about four or five years, and where the greatest yield per acre is desired of the first few crops these close distances answer very well. After the trees reach bearing age they very shortly begin to crowd at these close distances, and it is very doubtful whether ultimate results are as good as where a distance of at least 20 by 20 feet is used. In fact, in looking through some of the finest of the young peach orchards of Michigan, the writer has noticed that trees only seven or eight years old have completely filled the space of 20 by 20 feet and are already so crowded that they are not giving the best results. (Pl. LXXXIII, fig. 1.) In this sort of orchard it seems that 25 by 25 feet would be required. However, in many sections of the country peach yellows and other diseases are expected to kill out the young orchards, and the peach is looked upon as a short-lived tree, so that the planter feels safer in getting a crop from the young orchard than from his older trees. The result is that the whole policy is made to fit the young orchard rather than the mature orchard. (Pl. LXXXIII, fig. 2.)

THE RECTANGULAR SYSTEM OF PLANTING.

Undoubtedly, if the orchard is to be planted close, a better way is to plant on the rectangular system, rather than the square, and provide for taking out every other row of trees when they become crowded. This has been designated the filler system of planting. For instance, instead of planting 13 by 13, plant 12 by 16 feet, and then when the orchard becomes crowded take out the 12-foot row, leaving the trees 16 by 24 feet apart. In this way more or less of the advantages of both the close planting and the wide planting can be secured. The filler system is not so great a success with the peach as it is with the apple, pear, and some other fruits, for the reason that.
the peach grows so rapidly and reaches maturity in such a few years that it seems hardly worth while to plant fillers for so short a time. The fillers will probably begin to crowd at four to five years of age. From the financial point of view, however, it frequently happens that a three or four year old orchard will bear a bushel or more of fruit per tree, and the net returns from one crop may be sufficient to more than pay for the entire cost of the orchard, including the land, and leave a handsome profit besides.

The rectangular system of planting is also a rather convenient method of planting out the orchard, regardless of the filler system, although it is particularly suitable to the requirements of the latter. The writer is planting out a peach orchard on a rather good piece of land 18 by 21 feet apart, leaving the trees, therefore, 6 feet wider one way than the other. This gives a better opportunity for spraying, plowing, cultivating, and hauling out the fruit. The rectangular orchards are particularly more convenient in spraying. The tendency of mature peach orchards is to form a complete canopy of twigs and branches, so that there is little opportunity to get between or around them. In some cases, however, the rectangular system is carried to an extreme; for instance, rows 24 to 30 or even 40 feet apart, and trees planted from 10 to 14 feet in the row. This, of course, makes a rather queer-looking orchard, and of an undesirable form. The object of the grower usually is to utilize the space between the trees, but such unreasonable distances are beyond the capacity of the tree to fully occupy. In the case of a moderate rectangle, such as 16 by 24 feet, there is no good reason why the trees can not properly adjust themselves to this space just as well as to a space 18 by 18, or a circle 18 feet in diameter. The peach tree is a voracious feeder and a vigorous grower in both root and top; the roots will find every available space of unoccupied soil and will utilize it to the best of their ability.

**THE CONTOUR SYSTEM.**

On steep hillsides and mountain sides, where the soil is likely to be washed by heavy rains and where it is difficult, frequently, to plow or cultivate the orchard up and down the hills, peach orchards should be planted out on the contour system, that is, the lines of peach trees should be laid out on contour lines, or lines of equal level, running around the hill.

In this case it is unwise to adopt any definite distance, but the endeavor should be to give each tree approximately the equivalent of, say, 20 by 20 feet. The contour lines need not be followed with absolute accuracy where the land is very uneven; otherwise the irregularities in the orchard will be a little too great to be overcome. Where the slope is fairly even, however, it is advisable to lay the contours accurately. About 20 to 24 feet is a proper distance for placing the contour rows apart, and about 18 to 20 feet will do for the distance between the trees. As the contour lines approach each other, and the
space becomes narrower, the distance between the trees may be increased; and where the contours are separated by the nature of the slope from 25 to 30 feet they may be placed at a shorter distance. In case the lines separate to 35 or 40 feet, a short additional row may be inserted in the best manner to utilize this space.

METHODS OF PLANTING IN DIFFERENT SECTIONS.

The method of planting out the orchards varies greatly in different parts of the country and with different orchardists. The writer's preferences as to planting out are either the stake method or, on a very level piece of ground, simply laying off the land in furrows. The stake method has been fully described in a previous article on "Commercial pear culture" in the Yearbook for 1900. The furrow method is only applicable to level land, and where a careful man can be secured to lay out the rows. In many horticultural text-books and papers there are very carefully described methods of planting with a notched board and other similar methods. Such practices have no place in the work of a commercial orchardist. With a little practice and a proper method, especially with the stake method, men can plant out the trees rapidly and accurately, and the labor would only be doubled by introducing the notched board. In the Southern States, notably in Georgia and Florida, the large growers have used for several years a very simple method of planting by spade. The land is very carefully prepared and the trees are trimmed to a straight cane; and the branches and roots cut to within an inch of the main root. One man thrusts down the spade and moves it back and forth until a sufficient hole is made to insert the closely-trimmed tree. The spade is withdrawn, the tree inserted, and the spade thrust beside the previous opening, forcing the dirt over against the tree. Trampling with the feet finishes the operation. Two men, by this method, can plant out more than a thousand trees per day. Such close trimming is not advisable with large trees, and is probably not advisable in more northern States, where spring comes on rapidly and where the demand on the roots is rather sudden and intense. On the light soils and under the climatic conditions of the Gulf States, root growth proceeds during the winter, and when spring causes the buds to push forth, the roots are ready to supply them with moisture. This method has been taken up in Texas and widely discussed by Mr. Stringfellow, and in its most intense form has been called the Stringfellow method. The discussion of the Stringfellow method in recent years may be summed up about as follows: With small trees and in the warm soils of the Gulf Coast States the close-pruning method is successful and has been extensively used for years. In the Northern States, and especially in the heavier soils, it is not a desirable method.

In planting out it should be remembered that in very light soils the peach can be set deeper than on heavy soils. The peach is a
shallow-rooted tree, and as a general rule should be planted rather shallow. However, many mistakes have been made in getting the peach tree planted too shallow, especially on hillsides and mountain slopes where some of the soil is washed away. The disadvantages of the too shallow planting of the peach are two. In the first place, if the trees are attacked by borers, the borers on shallow-planted trees are apt to get down between the roots and even sometimes under the main roots, where they can not be reached. In the second place, a very slight amount of washing of the surface soil soon exposes the roots and the collar of the tree to a dangerous extent. It is usually advisable to have the main roots of the tree at least 6 to 8 inches below the general level of the soil at the time it is planted. This will generally put the union of the body with the stock a couple of inches below the surface of the soil. On light soils, and in the Gulf States on both light and heavy soils, there is little to be feared in getting the peach tree 2 or 3 inches deeper than it stood in the nursery. In the extreme Southern States, and especially in Texas, the peach tree does not stand deep planting so well. For some reason, under the conditions there, possibly the extreme heat of summer, or perhaps the mildness of the winters, the tree does not do well when the earth is piled up too deeply around the collar or when the young tree is planted too deeply below the surface of the soil. In regard to aeration, the peach roots seem to require more air and better access to the air than any of the fruit trees, or, perhaps, than almost any other tree. They are very sensitive to smothering, either by heavy soil or by water, and this tendency seems to reach its extreme in Texas and other Gulf States.

CULTIVATION OF THE ORCHARD.

A grower in the mountain peach region of Maryland sows wheat in his orchard the first year and seeds down to common red clover in the wheat, giving no cultivation whatever the first season. The second season he plows two furrows with a one-horse plow around the trees, cultivates three or four times with a one-horse cultivator, and mows the clover for hay, and even in a favorable season saves a crop of clover seed as a second crop. The third year he plows three furrows instead of two around the tree rows and pastures the clover with hogs. This may be stated as an extreme case of noncultivation of the peach. The man who carries out this practice does it intelligently, apparently realizing fully that it is an unusual practice, and yet it shows financial returns to justify him in the process. On the other hand, in other sections of the country nothing whatever is planted in the orchard even the first and second year. Absolutely clean cultivation is given during the growing season, the cultivators and harrows being kept running, so that not even a weed is allowed to grow.

Between these two extremes there are all sorts of variations. (Pls. LXXXIV and LXXXV.) It is certain that the noncultivation method
FIG. 1.—LARGE BLOCK OF YOUNG PEACH TREES IN NURSERY OF HALE'S ORCHARD, FORT VALLEY, GA.

[Photographed in August.]

FIG. 2.—BLOCK OF EMMA PEACHES IN SAMUEL H. RUMPF'S ORCHARD AT MARSHALLVILLE, GA.
FIG. 1.—VIEW OF FRANK G. CARPENTER'S PEACH ORCHARD IN THE MOUNTAINS OF VIRGINIA, WITH CREST OF THE BLUE RIDGE IN THE DISTANCE.

FIG. 2.—THREE-YEAR-OLD PEACH ORCHARD OF FRANK G. CARPENTER, SHOWING THRIFTY TREES WITH LITTLE CULTIVATION.

[From photographs taken in October.]
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can only succeed in particularly favored sections of the country, and even in these favored localities, where the soil is deep and moist, yet well aerated, it is extremely doubtful whether at least moderate cultivation would not be profitable and yield better results than non-cultivation. No tree is more sensitive to good cultivation than the peach. It requires more cultivation, better aeration of the soil, and a lighter, looser condition of the surface soil than any other fruit tree. Some of the best peach orchardists, and especially some of the best writers on horticulture, advocate the giving up of the entire ground in the peach orchard to the culture of the trees. They will grow no crop whatever among the young trees except cover crops. On the other hand, most practical peach growers advise the use of some crop for profit between the trees. In considering the question of the cultivation of the peach tree the orchard will be divided into two periods, first the cultivation of the young orchard, and second the cultivation of the bearing orchard.

CULTIVATION OF THE YOUNG ORCHARD.

In the cultivation of the young orchard it is advisable to grow some crop for profit among the trees. This need not necessarily be injurious to the orchard if the crop be properly selected. In fact, with the proper type of crop for interculture and the proper use of fertilizers on poor soils the orchard may be actually benefited by the crop which becomes a nurse crop. As a rule, grasses and grains are the most undesirable crops to grow in the orchard. Wheat, oats, and rye are particularly objectionable, for the reason that they prevent the cultivation of the soil during the critical growing season of the peach trees; they also occupy every available inch of soil space, and their draft on the soil moisture is very severe. Grass is still more objectionable than the cereal crops, because with it the ground is not even plowed annually. Even the clovers, which get part of their nitrogen from the air and add to the fertility of the soil, are objectionable on account of preventing cultivation. Indian corn is very commonly grown in peach orchards the first and second years (Pl. LXXXV, fig. 1), and on very rich, moist soils it is, perhaps, not especially objectionable. The disadvantage of Indian corn is its heavy draft on the fertility of the soil, and especially its tall-growing qualities. During the early part of the summer it is not objectionable, but from midsummer on it completely overshadows the young trees. However, it somewhat protects the young orchard and seems to have no objectionable features except its exhaustion of the soil. The cultivation of the corn crop is about the same cultivation that the young orchard needs, except that it frequently does not continue late enough in the season. Most soils, however, that are well adapted to peach culture are not rich enough to stand the heavy draft of the corn crop, and as a rule corn culture in the orchard is to be
condemned on this account. Cotton is less objectionable than corn. (Pl. LXXXVI, fig. 1.) It seems to grow with the peach orchard very well, and is used extensively in the Southern States from Georgia to Texas. It has not quite the exhaustive power of corn, and seems to be equally favorable to the growth of the peach tree. Cantaloupes and watermelons are used quite extensively as an orchard nurse crop. Where the melons are properly fertilized they do not exhaust the soil and are an excellent crop for the orchard. This applies especially to the Middle and Northern States, where the melons are grown rather late in the season. In Georgia and the other Southern States cantaloupes are extensively grown in the peach orchards, but are somewhat objectionable, principally, no doubt, from the fact that they are planted as early in the season as possible, and the growth of vines prevents cultivation very early in the spring before the peach trees are through with vigorous growth. Watermelons, squashes, and other cucurbits are also grown occasionally in the orchard and with fairly good results. In New York State late cabbage is a very popular crop to grow in the peach orchard. (Pl. LXXXVI, fig. 2.) It is a very excellent crop for the orchard, the land being usually manured and fertilized to some extent. Its cultivation corresponds to the period of cultivation of the peach trees. Other vegetables, such as beets, onions, radishes, and miscellaneous vegetable crops, are occasionally used, but not on such a large scale. No crop has more advantages for cultivation in the Northern States, such as New York and Michigan, than beans. The ordinary navy bean is grown quite extensively in the peach orchards and has everything to commend it. It is not planted early, giving time for several harrowings or cultivation of the orchard before the seed is even put in. It is low growing and not very exhaustive. It gathers a large part of its own nitrogen. It calls for clean culture and requires very little disturbing of the soil at harvest time.

In Virginia peanuts are occasionally grown in peach orchards in the lower country, while garden peas are frequently seen in various parts of the State. Both of these are desirable crops for the orchard. In the Middle States tomatoes are a very popular crop for cultivation in the orchards; they are not objectionable, especially when they are grown late, and their cultivation is continued until midsummer. One advantage of the tomato crop is the fact that crimson clover can be sown at the last cultivation of the tomatoes and a cover crop grown as well as a nurse crop. Potatoes are grown occasionally in the peach orchard, but have been condemned by many peach growers. The reason seems to be that the roots of the Irish potato interfere with the peach, or, perhaps, the stirring of the ground at the digging time is injurious. Potatoes are usually dug with a plow or a potato digger, and the disturbing of the soil in the fall is supposed to be unfavorable, as it cuts a good many roots of the peach tree, injures
others, and probably stimulates development of roots at the wrong time. However, the writer is informed by several Michigan growers that if potatoes are grown in the orchard and dug with a fork late in the season there is no noticeable injury. Sweet potatoes are also a very good crop for cultivation in the orchard. Their principal growth of vine is late in the season, after the orchard has had abundant opportunity to make its annual growth. The quantity of manure and fertilizer which is applied is usually very large, and the trees are especially benefited by it. In digging sweet potatoes early there would probably be the same objection as in the case of the Irish potatoes, although the writer has never heard the point raised by a peach grower; but the digging of sweet potatoes late in the season, about the time of or after the first frost, would probably cause no injury. At any rate, that has been the writer's experience with this crop. Strawberries are one of the undesirable crops to grow in the peach orchard, for the reason that they prevent the proper plowing and stirring of the soil at critical periods. Other small fruits, such as the bush fruits—raspberries, blackberries, currants, etc.—are still more objectionable in the peach orchard. While small fruits and berries may be occasionally grown in orchards of apple and pear with good results, especially if the land is deep, rich, and moist, it is not desirable to attempt the culture of these fruits in the peach orchard. The peach is too gross a feeder to withstand the competition of such perennial plants, and will either suffer itself or greatly diminish the vigor of the small fruits.

In the use of nurse crops and other crops in the peach orchard it is not advisable to continue the cultivation after the second season. Occasionally cotton is grown between the trees the third and fourth year, but it is usually a very light crop of cotton; it is doubtful, if the trees have made a good growth the first and second years, whether anything should be attempted the third year. In fact, the peach tree itself is so vigorous that usually attempts to grow other crops after the third year end in failure. Crops which are grown in the orchard for profit and yet cultivated for the benefit of the orchard may be called nurse crops. The term "nurse crops" could hardly be used for those crops which are grown solely for profit and not for the benefit of the orchard, such as Indian corn or cereals; but such crops as the hoed crops, potatoes, beans, peas, etc., especially when they are fertilized and given high cultivation, are properly designated as nurse crops.

Cover Crops.

Another class of crops is grown in the orchard, namely, those grown entirely for the benefit of the orchard soil, and as these are usually left on the ground and serve as a winter protection for the soil, they have been commonly called cover crops. These cover crops are of two main types, leguminous and nonleguminous. They may be also divided into two other classes, namely, those which are winter annuals
or perennials, remaining green over winter and therefore furnishing a living cover, and those which, either from their tenderness or from their annual character, die down at the end of the year and furnish only a dead covering during the cold months.

**CRIMSON CLOVER AND HAIRY VETCH.**

Under conditions of high culture and where it is adapted to the locality, crimson clover is undoubtedly the nearest to an ideal cover crop. (Pl. LXXXVII, fig. 1.) In the Middle States crimson clover may be sown at the last cultivation of the peach orchard in August, or even September, and it will make a good growth, covering the ground before cold weather, by which time it frequently attains a height of from 6 to 8 inches. It forms a very large root growth during the autumn, and only ceases growing during the coldest winter weather. When the mild weather of early spring approaches it starts into activity; by the time the peaches are in blossom it is growing vigorously and a few days later comes into bloom. The very best results are secured by plowing the clover under early, before it has come into blossom, although by so doing a part of the fertilizing value of the clover is sacrificed. However, the enormous root system is of great benefit, and the thick coating of stems and leaves furnishes an excellent green manure. It is often desirable in the young orchard to plow three or four furrows around the trees at an early date, about the blooming time or slightly before the blooming time of trees, and then allow the clover to head out before plowing out the middles. By this means the greatest possible amount of fertilizing value is secured.

Hairy vetch (*Vicia villosa*) is about the only real rival to crimson clover. It makes a very rank growth in the fall, and has been found by some to be easier to seed and to be even more successful than crimson clover. However, the seed is more expensive and harder to save, and it is doubtful, where crimson clover will survive the winter and prosper, whether hairy vetch will ever drive it out of use. The common red clover, either the medium or the mammoth, can be used in the same way as crimson clover. By seeding it late in July or in August it will form a good cover before cold weather. It has the advantage of being more hardy than crimson clover and starts later in the spring. Its use is gaining ground distinctly every year in New York State and Michigan. There is one trouble with both these clovers, and that is the temptation to let them remain too long before plowing in order to obtain the greatest possible results, but the experience of practical growers is that it is better to plow them under when the proper time for plowing arrives, or very shortly after, regardless of the growth the clover has made. If a dry spring comes on and clover is allowed to remain until it comes into blossom it draws too heavily on the moisture content of the soil. Even though thoroughly cut down with a disk harrow the surface soil is so dry that the effect on the trees is unfavorable.
FIG. 1.—COTTON GROWING IN A 3-YEAR-OLD PEACH ORCHARD AT SAMUEL H. RUMPF'S PLACE, MARSHALLVILLE, GA.

[Photographed in November.]

FIG. 2.—CABBAGE GROWING IN A 2-YEAR-OLD PEACH ORCHARD IN WESTERN NEW YORK.

[Photographed in September.]
FIG. 1.—A NIAGARA COUNTY, N. Y., PEACH ORCHARD, SHOWING CRIMSON CLOVER AS A COVER CROP.

[Photographed in September.]

FIG. 2.—COWPEAS GROWN AS A COVER CROP IN HALE’S YOUNG ORCHARD, FORT VALLEY, GA.

[Photographed in August.]
Of the leguminous cover crops, which do not survive the winter, the cowpea is undoubtedly the most important one for use in the peach orchard. (Pl. LXXXVII, fig. 2.) It is extensively grown all through the Southern States and even as far north as southern New York and Michigan. It is essentially a hot-weather plant and should not be sown until late corn planting. Its principal advantage is in the young peach orchard, where it should be sown in drills from 2½ to 4 feet apart and kept cultivated during the season. It is advisable generally to allow a greater space for the tree row. Frequently the cowpea is grown in drills in a three-year and four-year old orchard after the abandonment of the growth of nurse crops. In Georgia the writer has seen in a good peach orchard one row of corn in the middle and a row of cowpeas each side of the corn. When the corn matures it is cut and removed and the cowpeas are allowed to cover the entire ground. One advantage of cowpeas in Southern peach orchards is that they may be sown quite late in the season. Occasionally, however, in a dry, cool summer the results from late sowings are not all that could be desired. It is a debatable question whether cowpeas should be plowed under while still green or left on the ground to decay. The experience of the best fruit growers is that cowpeas should not be plowed under in the peach orchard while they are still green, but that they should always be dead and somewhat decayed. There is no objection to plowing them under during the winter, but as a general rule it is better, in the North, to wait at least until after the frost has killed them, or, in the South, until they have died naturally; or perhaps it may be preferable to leave them on the ground during the winter and plow them under in the spring. The greater part of the value of the cowpea vines will then have leached out into the soil, and the soil will plow up in excellent mechanical condition as the result of the protection of the vines.

The velvet bean is grown to some extent in south Georgia and the other Gulf States in peach orchards, and within its natural range, which only reaches about 150 miles from the Gulf, it exceeds the cowpea in growth of vines and in quantity of fertilizing material. It grows the whole season through, and consequently has more opportunity for putting on vegetative material than the pea vines, which reach their full growth and die from maturity before the close of the season. One objection to the velvet bean is that it climbs all over the trees and forms a tangle of vines which is more or less troublesome to remove. Another objection is that it can only be plowed under by efficient sulky plows, which are not very convenient to use in the orchard. One way to handle the vines, however, is to cut them to pieces by driving over them several times with a disk harrow before attempting to plow. North of the belt adapted to the velvet bean the plant is not satisfactory as a cover crop, for the reason that it does
not reach its full maturity and the hot weather does not last long enough. The soy bean has even a greater range northward than the cowpea, but it does not seem to be quite as well adapted to the purposes of a cover crop as the cowpea. It is more upright in growth and more convenient to cut for hay, but this upright growth is rather objectionable in a cover crop, as the ground is left more or less exposed between the plants when the leaves have fallen.

**NONLEGUMINOUS COVER CROPS.**

Of the nonleguminous cover crops, in Michigan and New York State, oats are very commonly sown in the orchard at the last cultivation. They are either sown broadcast and harrowed in or else put in with a disk or other form of grain drill. The oats are generally planted about the first of September, and before cold weather they have reached 5 or 6 inches in height. They serve not only to prevent the sandy soil from blowing away, but prevent washing, and catch the leaves of the peach trees when they fall to the ground. The oats used in the Northern States are commonly the ordinary spring varieties grown in the neighborhood, which kill down on the approach of winter. (Pl. LXXXIII, fig. 2.) This cover crop, therefore, is a dead one, and it interferes but little with plowing the following spring. Winter oats are sometimes used in the Middle States, and it seems to the writer they would be superior to the Northern oats in the peach orchards of the Lake region. These winter oats are hardy strains and, like rye and winter wheat, survive Southern winter weather. Rye is also grown extensively as a cover crop in the orchard. It has been objected to by some growers, on account of the fact that if plowing is delayed in the spring rye makes a very rank growth and draws the moisture from the soil to the detriment of the tree; but if rye is plowed under when it is just shooting up its flower stems, this objection, of course, does not obtain. Dwarf Essex rape, cowhorn turnips, buckwheat, and even Indian corn are frequently sown in midsummer or later as cover crops in the orchard.

The nonleguminous cover crops, while theoretically of not much value, in actual practice turn out to be very useful. While they are not as valuable as the crimson clover and other leguminous crops in gathering free nitrogen from the air, still they do gather a large quantity of nitrogen from the soil which would otherwise leach away; they also make a large amount of humus or organic matter and serve an excellent purpose in improving the mechanical condition of the soil. They are usually easier to sow and cheaper to grow and handle than the leguminous crops, and where soils are not notably deficient in nitrogen are frequently the best to use. It is not so easy to grow cover crops in the peach orchard successfully as in the pear or apple orchard, for two reasons: First, the peach trees, as soon as they attain bearing size, are very vigorous feeders and are very shallow
CULTIVATION AND FERTILIZATION OF PEACH ORCHARDS.

CULTIVATION OF THE BEARING ORCHARD.

The annual practice in cultivating the bearing orchard will now be described. There are some who maintain that the ordinary turning plow should never be used in the orchard, and who advocate the use of disk harrows and spring-tooth and other cultivators as the sole implements. However right this may appear theoretically, in actual practice most peach orchardists have found it necessary to use the plow, and it is very doubtful whether the much-abused turning plow is so objectionable after all. Whenever there is a large quantity of weeds or trash or a successful cover crop or turf to turn under, the ordinary turning plow is by all odds the most important implement that can be used. Where the ground has had clean culture the year before and no cover crop has been used, any of the various types of disks or cutaway disks can be used to put the ground into practically the same condition as the plow. The advantage of the disk over the plow is that the feeding roots are not cut off clean at any definite depth, but that many of them which would be cut with the turning plow at a given depth may survive. If the disk-harrow method of plowing is used it is advisable to go over the orchard once or twice each way and then follow with a spring-tooth harrow. If the soil is light, and if the operation is begun when the soil is first in condition after being lightened and softened by winter freezing, excellent results may be secured. Some large orchardists depend entirely on disk harrows to cultivate the bearing orchards. However, the majority of the growers plow the orchard first with the turning plow. A good practice is to plow two or three furrows around the trees with a one-horse plow so arranged as not to injure the trees, either by adjustment of a side-block with the clevis or by having a very short single-tree and wrapping the traces with burlap to prevent scarring the bodies of the trees. After about three furrows have been made with a one-horse plow, a two-horse or even a three-horse plow can be used to plow out the middles. A very excellent tool for plowing the first three furrows around the trees is the so-called California orchard plow. This plow, made in two sizes, with either three or five disks,
with a good team of horses, performs the whole operation at one trip. Great pains should be taken in plowing the first strip around the trees to keep from injuring them and to avoid tearing up the roots. A skillful plowman will discover at once whether the plow is catching on the roots, and will throw it out of the ground or slightly to one side just as he passes the trees. A very ingenious though simple modification of the common plow is in use in Georgia orchards. A pole 9 feet long, with a slight crook about 2 feet from the end, is fastened into the plow as a substitute for the handles. This pole extends outward from the plow at an angle of about 30 degrees, enabling the plowman to walk alongside the trees and pull the plow to one side just at the instant the tree is passed.

There are special plows, called vineyard and nursery plows, which have a wide range of adjustment and can be swung to one side or the other of the line over which the horse is driven. These are very convenient, especially in plowing away from the trees. Various modifications of the harness are in use to prevent injuring the trees, and several forms of two-horse traceless harness have been designed to enable a span of horses to be driven quite close to the trees without injury. As a rule, the peach orchards should be plowed very shallow, not over 3 or 4 inches, and frequently this will be considered too deep. The writer's idea is that by beginning fairly deep plowing on the young orchard a greater depth of plowing can be done in later years than is commonly practiced. By plowing 4 inches next the trees and 6 inches in the middles while the orchard is young a depth of 3 inches close to the tree and from 4 to 5 inches in the middles can be maintained in the older orchards, resulting in a deeper soil for the trees to grow in. Plowing always cuts more or less of the tree roots when done to the depth of even 3 or 4 inches, but as a rule these small roots are only annual roots of the year before and can be readily spared, being quickly replaced by the tree. Moderately deep plowing is doubtless of more benefit than harm. After the soil has been plowed toward the trees a rather deep dead furrow results. Sometimes it is advisable to turn this in with a one-horse plow by making two trips around it. Usually, however, the best practice is to begin promptly with the spring-tooth cultivator and with the teeth set so deeply that they go to the full depth of the soil as turned by the plow.

It is usually best to alternate the different types of harrows, and wherever a cover crop, especially clover, is turned under, the disk harrow is more effective than the spike-tooth or spring-tooth, as it cuts the turf and vegetable matter to better advantage. However, if the soil has been pounded down quite hard by rain, even without a cover crop in it, the disk harrow is more like a plow in its action in turning it up. After the disk or the cutaway, if a dry spell comes on, the acme or the ordinary spike-tooth can be used to good advantage in smoothing and fining the surface and perfecting the dust mulch. If dry
weather still continues the acme can be followed by the weeder, and even when a very light rain forms a slight crust the weeder can be used to good advantage. As cultivation proceeds in the summer, it should be lighter and shallower, depending mainly on the spike-tooth and the weeder unless very heavy pounding rains come; then the disk or the spring-tooth harrow may be required to lighten up the soil.

Many peach-orchard soils are so rocky and stony that the disk harrow can not be used. As a rule, the spring-tooth harrow is found to be best in such situations. The question of how late to cultivate is much debated among growers and the practice varies in different parts of the country. As a rule, the more thoughtful and careful the peach grower, the greater the number of times he cultivates. Taking into account the use of the weeder as well as the plowing and harrowing, it is not rare that the orchard is gone over 20 or 30 times in a single season, and, in fact, some of the best cultivated orchards are gone over once or twice a week until the close of summer. Frequently a heavy load of fruit prevents cultivation for some time before picking. The weight of the fruit bends down the branches so that the peaches may be knocked off by the team, or in extreme cases so that a horse can not be driven through the orchard. In Georgia and other Southern commercial orchards it is usually impracticable to cultivate when the picking season begins, for the reason that every available man and horse is pressed into service to handle the fruit, but in new plantations or where there is a failure to fruit, and full opportunity is given, cultivation should proceed right along until the middle of August or even into September. In the Northern States, where the main varieties of peaches do not begin to ripen until the latter part of August, cultivation normally can continue up to that time, after which it is not desirable to force the trees into heavy growth; but they should have an opportunity to ripen up and mature their wood. In some of the newer peach sections of the mountain region of Virginia, and notably in the orchards of Texas, the soil being very favorable and the natural conditions suitable to the peach, the minimum cultivation is given. Sometimes the only cultivation is two or three plowings with a one-horse turning plow. The weeds between the plowings grow so high that no other tool than a turning plow is suitable for the work. As a rule, however, such methods are not gaining ground, and those who pursue them are not the most successful growers of the peach. The tendency is more and more toward high cultivation, for the reason that the profits in fancy peaches as compared with poorly grown fruit are annually becoming better.

**Fertilization of the Orchard.**

In connection with the use of fertilizers for the peach orchard the natural fertility of the soil is, of course, the first consideration.
In some Northern and Western States and in a portion of the mountain peach orchards from Pennsylvania and Maryland southward the soil naturally carries sufficient plant food to meet the demands of heavy crops of fruit. Of special importance in this regard is the subsoil. If the subsoil is deep and rich and well supplied with phosphoric acid and potash, trees are able to carry immense crops of fruit and still maintain a fairly vigorous condition. However, as a general rule, soils that are suited for peach growing are more or less deficient in the elements of fertility, and it is rare that maximum crops can be secured without to some degree supplying plant food artificially. In many of the orchards in the more fertile parts of the country but little mineral fertilizer is commonly added. The plowing under of green manures or, perhaps, the occasional application of suitable manure or wood ashes supplied from the farm are about the only fertilizers that are deemed necessary. But often in the more fertile sections the progressive fruit grower has found that while good crops may be secured by good cultivation without the use of fertilizers, still better crops of finer fruit can be secured by supplementing the natural fertility. In all the less fertile sections of the country, especially in the East and South, the fertilizer problem in the peach orchard is one of prime importance. The residual effect of manures and fertilizers used on nurse crops has already been mentioned in connection with cultivation. Nurse crops play an important part, and frequently, when well manured and fertilized, their cultivation for two or three years in the orchard has resulted in ample growth of the trees until a heavy crop of fruit is borne. In fact, the bearing of a heavy crop of small fruit and the subsequent impoverishment of the trees are frequently the first indications the grower receives that his trees are suffering from lack of fertility. It is better, however, not to allow the trees to suffer, but to anticipate the difficulty and fertilize or manure in advance.

Green manures and cover crops should be utilized to the fullest possible extent in the orchard. There are some soils so well supplied with humus that the annual use of green manures is not essential, or, perhaps, in some cases not even desirable, as the amount of humus and nitrogen might be unduly increased and an excessive or belated, immature growth of twigs and buds result. However, in most peach orchards, especially in the sandy and poorer soils, this condition is not to be feared, and annual cover crops should be plowed under. On a moderately rich soil perhaps all or nearly all the nitrogen necessary can be supplied with leguminous cover crops, but even here it is not always safe to depend entirely on the cover crops. Perhaps a dry year may come, with a heavy crop of fruit, and while an unusual draft is made by the trees on the nitrogen of the soil very little is returned to it; therefore the nitrogen should be replaced artificially.
Indirect fertilization, therefore, from nurse crops and from cover crops, combined with the natural fertility of the soil, can not be depended upon for maximum crops over most sections of the country. Direct fertilization may be necessary. In the young orchard, where the soil is very fertile, it may not be necessary to fertilize the young trees till they come into bearing.

On poor, sandy land about a third of a pound of fertilizer thrown immediately around the tree is desirable the first year. It should not be in actual contact with the tree, but should be scattered so as to cover a circle about 3 feet in diameter. The second year the fertilizer can be added after the first furrow has been plowed around the trees, and can be thrown in the furrows on each side of the tree. From a half pound to a pound is desirable at this stage, and it should be strewn from a distance of 4 to 6 feet along the furrow. The third year at least a pound or more should be used, and it should be applied in the second or third furrow from the tree in the same manner. Occasionally, on very light land, it is desirable to apply stable manure in the second or third furrow, as above described. The plowing of the next furrow completely covers the manure or fertilizer, which is thus placed in a good position to be reached by the roots. If the orchard is plowed and fertilized in an east-and-west direction the first year it will probably be desirable to plow north and south the second year, the fertilizer thus being distributed on all sides of the tree.

STABLE MANURE.

The use of stable manure in the peach orchard is a much-debated question. It should never be used on young orchards, except on very poor, light land, and then should always be applied in winter or early in the spring. On bearing orchards stable manure has much effect, stimulating the twig growth and leaf growth more or less at the expense of the fruit. If the soil is already moderately fertile it may distinctly overstimulate the vegetative tendencies of the tree. It has the same effect as other nitrogenous fertilizers in belating the fruit, with a tendency to prevent the high coloring of the product. The fruit is also rendered more liable to the attacks of peach-rot fungus. In extreme cases the effect is distinctly injurious to the general health of the tree, causing gummy exudations from the bark. This is very frequently seen around barnyards and where drainage water from barnyards settles around the trees. Trees are frequently killed outright during a cold winter following an excessive application of stable manure or other nitrogenous fertilizer. On the other hand, trees which have a pale, yellow color, and are suffering from lack of nitrogen on poor, light, droughty soils, are so far below the standard of vegetative growth that they need the stimulus of stable manure
to bring them up to the proper level. Here stable manure finds its proper application.

This form of manure is also beneficial in case of several diseases which have an effect similar to poverty of the soil, namely, root aphis and sour soil, and perhaps, also, root rot and some other root diseases. Trees suffering from root aphis and other root troubles are very apt to exhibit symptoms of starvation, and usually respond favorably to the application of stable manure. They can stand very much more manure and profit by it than a normal, healthy tree.

CHEMICAL FERTILIZERS.

As to chemical fertilizers, many old-time peach growers in the Northern States are positive that wood ashes and bone meal are the best fertilizers for the peach orchard. These materials are undoubtedly very excellent for the purpose, and it is very doubtful whether, all things considered, any of the more strictly chemical fertilizers can ever produce as uniformly good results. However, the effect of most experimenting has been to show that potash in the form of muriate or carbonate or sulphate is indistinguishable in efficiency from wood ashes, and the same is true of bone meal. The soluble acid phosphate, or acidulated bone, or bone charcoal, have about the same effect as the bone meal, except that they are more quickly available, on account of their increased solubility. At any rate, there is no doubt but that the peach responds very favorably to liberal applications of acid phosphate and muriate of potash, as well as to bone meal and ashes. A very good fertilizer for the peach on land fairly rich in nitrogen, or which is well supplied with nitrogen from leguminous cover crops or stable manure, is a mixture containing 1 part of muriate of potash to 3 parts of acid phosphate. This should analyze about 12 per cent actual potash and 10 per cent phosphoric acid. If a slower action of phosphoric acid is desired bone meal may be substituted for part of the phosphate. This will also increase the nitrogen to some extent in the combination. Bone meal supplies the soil with a very desirable form of nitrogen for the peach tree. If, however, a greater quantity of nitrogen is desired, as on very poor, light, sandy land, bone tankage may be used instead of bone meal or along with the bone meal, and nitrate of soda may be also added to the fertilizer. As a general rule, however, it is better to leave out the nitrate of soda and apply it later, when the leaves are pushing out in the spring. The standard mixture for the peach, consisting of potash, phosphoric acid, and insoluble forms of nitrogen, may be applied in the fall, or, in the Southern States, at any time during the winter. At any rate, if applied in the spring this mixture should be put in very early and preferably plowed under, or if the land is plowed very early it may be sown broadcast and harrowed in. Very good results are secured by
drilling with a grain drill which has a fertilizer attachment. The following formula may be considered a very excellent fertilizer for poor land, deficient in nitrogen:

10 to 12 per cent of potash from the muriate.
7 to 8 per cent of phosphoric acid from acid phosphate.
3 per cent of nitrogen from bone tankage and nitrate of soda.

An application of 400 to 600 pounds per acre should be considered the minimum where it is only desirable to use a little fertilizer to supplement the natural fertility. On poor, sandy lands, in which the fertilizer is looked upon as the main basis of the fruit production, 1,000 to 1,200 pounds is the proper amount to use. One important consideration should always be borne in mind by the peach grower in planning the fertilization of the orchard, and that is the intelligent use of nitrogen. As already stated, the peach tree is the most vigorous feeder and active grower of any of the fruit trees, and is the most sensitive and easily disturbed by nitrogenous fertilizers. While safer in the long run to withhold nitrogen and allow the trees to slightly suffer for lack of it, yet for best results it is necessary to give the trees just enough of this important ingredient. Barring diseases, nitrogen starvation is indicated by lack of size and color of the foliage, by a slender and weak growth of twigs, and a shortness of joints between the leaves. The annual growth of young trees from one to three years old with good cultivation should be at least 3 or 4 feet, and the foliage should be dark green in color. After three years of age, when the orchard comes into bearing, and up to twelve years, the annual growth should be at least 18 inches, and better, from 2 to 3 feet, especially if heading back is practiced. Anything less than this will indicate lack of nitrogen. On the other hand, too much nitrogen is indicated by a very rank growth of the trees, an unusually dark green color of the foliage, immaturity of the tips of the twigs at the close of the season, by late fruit, with lack of color and poor flavor, and in extreme cases by the gumming of the bodies of the trees without apparent cause. Trees will stand more nitrogen in a dry season than in a wet one. In a rainy year on rich soil the effect of excessive nitrogen seems to be increased by the heavy rainfall, and vice versa in a dry season. Good cultivation has an effect on the fruit and foliage similar to nitrogen fertilization, while lack of cultivation gives somewhat the same symptoms as nitrogen starvation. In both the young orchard and in the bearing orchard the skillful grower will watch his trees when they are pushing out into growth during the month following blooming, and on the bare, sandy knolls and impoverished places will give additional fertilizer—especially additional nitrogenous fertilizer. Nitrate of soda is the most effective fertilizer for quick stimulation of impoverished trees.

Much of the land of the Eastern States best adapted to peach grow-
ing, especially sandy upland, is deficient in lime and is considerably improved by the application of from 20 to 40 bushels, of 80 pounds each, of stone lime, per acre. The lime has rather a general effect on the soil than an immediate effect on the trees, although it acts as a fertilizer to some extent by freeing potash from insoluble combinations in the soil, and is distinctly beneficial to the peach. It is of benefit in many ways to the peach-orchard soil, improving its mechanical, chemical, and biological condition. It flocculates very light, sandy soils, and renders them more compact and more capable of retaining moisture, while it prevents clayey soils from becoming pasty and cloddy by causing them to crumble on drying. Lime is especially desirable where crimson clover is to be grown as a cover crop. The liming of these light, sandy soils greatly favors the "catch" of clover and the development of the clover plants. Its effect on the cowpea is slightly injurious, but good crops of cowpeas may be grown even on the limed land.

Where newly cleared land is planted to peaches in the sections of country benefited by lime, it is especially important to lime such land. It is better to apply lime where needed as a part of the preparation of the land for peaches. Where this has not been done, lime can be used at any time in the young orchard, preferably after a cover crop of cowpeas has been plowed under in early spring. The beneficial effects of an application of lime are supposed to last from five to ten or even twenty years.