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AGRICULTURAL COLLEGE.

BULLETIN NO. 82.

ORCHARD MANAGEMENT.

COVER CROPS IN ORCHARDS.

PRUNING OF ORCHARDS.

REPORT ON FRUITS.

APRIL, 1902.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

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HATCH EXPERIMENT STATION
OF THE
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AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

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HORTICULTURAL DIVISION.

S. T. MAYNARD AND GEO. A. DREW.

ORCHARD MANAGEMENT.

The questions oftenest asked this division of the Hatch Experiment Station are, "What is the best treatment for orchards as to cultivation, fertilization, pruning, training, cover crops," etc., etc. In this bulletin an attempt will be made to answer some of the above questions for the benefit of all. It is beyond question that the possibilities of profitable fruit growing in Massachusetts are very great for we have a population that consumes more of the comforts and luxuries of life than any people in the world.

The markets are at the very doors of the growers and there are to be found all conditions of soil and exposure, though not in large areas in any given tracts, that are favorable to the growth of the hardy fruits of a quality not excelled by that grown in any other section of the country. That most of our growers do not appreciate this advantage is evident, but this may be accounted for perhaps by the fact that there are more difficulties to contend with here, and that more skill and more energy are needed to produce profitable results than in other sections. It is my purpose in answering the above questions to discuss some of these advantages and obstacles, and to point out what will be the best practice to follow to produce the quantity and quality of fruit that will be profitable and secure the local markets for the local grower against those producing fruit in more favorable sections.

We may take it as an axiom or rule in fruit growing that "the more *good* fruit put into a market the greater will be the consumption and the better the prices in the end," for our people are not supplied with all the fruit they need or would like, and the more poor fruit put on the market the less the consumption and the lower the price, for if people cannot get good apples there are other choice kinds of fruits to be had, either in a fresh or a preserved condition and they will purchase these in preference to poor apples.

THE PRESENT CONDITION OF ORCHARDS.

There are few extensive orchards or fruit plantations in this State, the majority ranging from a few trees to a few thousand, and these are found under three conditions, 1st, those in stony land that cannot be cultivated, 2d, those in turf land that is smooth enough to cultivate and perhaps is in grass a part of the time and cultivated for a few years when the grass crop becomes light, and 3d those in land under cultivation all of the time. Nearly all of the orchards of the State are grown in connection with some other line of agriculture or horticulture, and do not receive the skilled attention of the specialist that is required to produce the best results in this or other lines of business.

1st. Among the trees growing on land that cannot be cultivated may often be found some that are vigorous and healthy and of desirable varieties, but the majority produce only cider apples. Those that are in a healthy condition are worth saving and if the trunks are not decayed, and the top is in a vigorous condition, with a little pruning, fertilizing and spraying, much good fruit will be produced; if, however, the trunks are decayed and the tops are in an unhealthy condition, it will be far better to cut them down, as they are only breeders of insects and fungous pests and any time spent upon them will be wasted. If we should make it a rule to cut down all the trees that we cannot properly care for, our profits would be much greater than they now are. Trees of undesirable varieties that are in a healthy condition and in good soil may be grafted with profitable kinds and in a few years be made to produce fruit of the best kinds. The process of cleft grafting is known to almost every one or can be learned very easily, but it will be found rather expensive if expert grafters are employed to do the work. It will pay however if economically done, for a well established tree in good soil after a new head is established should last a generation, if properly cared for; while a young tree cannot be brought up to full size under 20 or 25 years. Fig. 1 shows a regrafted tree after a growth of four years from the grafts. The fruit grown in good land under the above conditions has a reputation for high color, fine flavor and long keeping qualities, but it must be kept in mind that first class fruit cannot be grown under any condition of soil unless the trees are made to grow vigorously, and as there is no cultivation, by which plant food can be developed more fertilizing material must be used then if the land is cultivated. The amount of fertili-

FIG. 1.

zer to be applied must depend upon the growth of the trees. Good fertilizers under the above condition per tree are:

Formula No. 1.—1 lb. to 5 lbs. Nitrate of Soda, 1 lb. to 5 lbs. Sulphate of Potash and 2 lbs. to 10 lbs. Acid Phosphate.

Formula No. 2.—1 lb. to 5 lbs. Nitrate of Soda, and 10 lbs. to 25 lbs. good hard-wood ashes.

Formula No. 3.—Stable manure, 5 to 20 large forks full, applied in the fall or winter and the same amount of potash and phosphoric acid, or wood ashes as in formulas No. 1 or 2.

The amount of these materials that should be used per tree, will depend upon the size and the vigor of the trees. A good growth *must* be produced if large fruit is expected. A very good rule to follow in this matter is to use enough to produce a growth at the ends of the branches of from six to twelve inches each year.

2d. The orchards that are grown with a rotation of turf and cultivation are more numerous than those that are grown under con-

stant cultivation, and in most cases, unfortunately, this practice is carried out with the idea of obtaining both a crop of fruit and of grass or hay. This practice would be satisfactory in many cases, if it was realized that the amount of plant food required for the two crops is much larger than many growers are likely to apply. The greatest objection, however, to this method is, that after the land has been a long time in grass, in the attempt to turn over the turf, the roots, which have been working more and more to the surface the longer the trees are in grass, will be much cut and broken; and after this rotation is repeated a few times the trees are very seriously injured—and as long life cannot be expected as where they are either in turf all the time or under constant cultivation.

3d. Very few orchards of any considerable age are to be found in this State that have been cultivated from the beginning, but from what experiments have been made I think it is beyond question that the quickest returns and the greatest profits will result from this practice. The advantages of constant cultivation are that the moisture of the soil is preserved in severe drouths, and in very wet times the air is let into it, the latent plant food in the soil is made available and much less plant food will be required to produce the growth necessary for profit, the roots are kept deep in the soil and are not as liable to injury from heat or cold, and in well drained soil no injury need be feared during excessively wet seasons that might occur if it was not underdrained.

Of the three systems of orcharding as practiced in Massachusetts, that of continued turf culture, where cheap land can be utilized, an abundance of fertilizers used, and continued cultivation employed, with cover crops on the land from the middle of August to the first of May, is best adapted to produce profitable results.

CULTIVATION OF ORCHARDS.

With the modern tools for orchard cultivation this work can be done very thoroughly and cheaply. The work for a season has been variously estimated at from \$10 to \$25 per acre. In plowing an orchard that has been long in turf, the greatest care must be taken not to cut and tear the large roots and to plow only three or four inches deep, using shallow working tools after the plowing has been done. With the modern low-headed orchard tree, Fig. 18, it

will be impossible to plow close up to the trunks, and either the land will have to be plowed in strips only, or after the plow, may follow the wide-spreading harrows, Figs. 3, 4 and 5, which will keep down the weeds and keep the soil under the branches light and loose if the work is done early in the spring while the land is soft. A low-hanging landslide plow, similar to that shown in Fig. 6, with a long point and mold board will do much better work than the swivel or side-hill plow, though it may take more time to get about with it.

Many kinds of harrows have been tried, but those found most satisfactory are the acme or shears harrow, the wheel harrow and the spring-tooth harrow, all of which are arranged with the sections spread apart so that the horses will go outside the branches while the harrow will reach under them several feet, leaving but little hand hoeing to be done. Fig. 3, shows the acme harrow with the spring-tooth attachment, so that deep working may be done by the latter and shallow working by the former.

Fig. 3.

Fig. 4.

Fig. 4 shows the cutaway harrow with the spreader for orchard work.

Two sections of the common spring-tooth harrow, attached to the evener with a chain about two feet long, will work well where the trees are not too close together, being drawn in under the branches by swinging the horses around each tree, leaving but little hand hoeing to be done.

FIG. 5.

FIG. 6.

The California orchard harrow, Fig. 5, is largely used on the Pacific coast and would no doubt be of great value here if we had large areas to cultivate. The grape hoe, Fig. 7, is found of great value in orchard cultivation, for being drawn by one horse it can be more easily guided than with a pair of horses.

Fig. 7.

FIG. 7a.

The common weeder, Fig. 7a, is a great labor saver and if used frequently will keep the surface of the soil fine and mellow for about two inches in depth, but to give the best results, the spring-tooth or wheel harrow should be run once and then the weeder twice or three times. The weeders with straight teeth do better work in the orchard than those with curved teeth.

Some of these tools are perhaps too expensive for the small grower, and under such conditions two or more should join and purchase and use them together. Any of the above implements if properly housed when not in use and the wood parts kept painted should last a long time and do the work for many small growers.

FIG. 8.
COVER CROPS.

In growing fruit the most important question that we have to answer is how to obtain the necessary plant food to keep up a healthy growth and mature large crops. We may use the best tools and practice the best methods, and cultivation will in a measure supply plant food, but still the additional supply is one of the greatest sources of expense, and if we do not have an abundance of plant food in the soil, or if it is washed out during the fall, winter and spring we have much of our "labor for our pains".

The four important advantages of a cover crop in the orchard are: 1st, to supply nitrogen and organic matter or humus to the soil; 2d, to improve the mechanical condition of the soil, i. e., to lighten a heavy soil and make a light soil more retentive of moisture; 3d, to protect the roots from being injured by deep freezing, and 4th, to prevent the fine particles of soil and plant food from being washed away during the fall, winter and spring.

That "cover crops" do produce the above results has been proven by many experiments, and many kinds of plants have been employed. Those most used for this purpose are, rye, oats, barley, peas, soy bean, cow pea and hairy vetch. These may be divided into two classes, 1st, those that are hardy, i. e., live through the winter and make some growth in the spring before the trees start into growth, and 2d, those that make their growth in the fall and die in the winter, simply covering the ground and not absorbing any moisture from the soil by their spring growth. Of the former, the rye, Fig. 8, clovers, red and crimson, Fig. 9, and hairy vetch, Fig. 10, are shown sown in the vineyard and in the peach

FIG. 9.

FIG. 10.

FIG. 11.

FIG. 12.

FIG. 13.

FIG. 14.

orchard. Of the second group, peas and barley sown together are shown in Figs. 11 and 12, soy bean, Fig. 13, and the cow peas, Fig. 14.

It is a well settled fact that a rapidly growing cover crop, in a very dry time, may seriously injure the growth of the trees, and it is therefore important that such crops should be planted at a time when the trees are not growing rapidly or have nearly completed their growth, i. e., during the latter part of summer and through the fall, and before much growth of the trees is made in the spring. It may be said of these two groups that with the first no injury *can* come from the too rapid evaporation of moisture except in the fall, and that the ground will be protected from loss of moisture during the spring by the dead cover crop lying on the surface, and also that the land can be fitted in the spring with the wheel harrow at any time before tree growth has advanced much without any risk; while with the second, as there is some danger of serious loss of moisture in the spring, the crop must be turned under before it has made much growth and this work must be done with the plow, the wheel harrow not being heavy enough to cover it. The cover crops, about 1 acre each, represented by the above plates, were planted August 10th, broadcasted and harrowed in to a well prepared seed bed, the quantity of seed and cost being as follows:

Plot No. 1, Figs. 11 & 12, Canada Peas, 1 1-2 bu. per acre, cost,	\$2.10	
Barley, 1 1-2 bu. per acre, cost,	\$1.50	\$3.60
Plot No. 2, Fig. 9, Red Clover, 10 lbs. per acre, cost,	\$1.30	
Crimson Clover, 8 lbs. per acre, cost,	.96	\$2.26
Plot No. 3, Fig. 10, Hairy Vetch, 1 bu. per acre, cost,		\$7.00
Plot No. 4, Fig. 14, Cow Peas, 2 bu. per acre, cost,		\$4.80
Plot No. 5, Fig. 13, Soy Bean, 2 bu. per acre, cost,		\$5.70

The soil of the plots is a strong clay loam filled with small stones and having a hard-pan subsoil, naturally good grass land, but hard to cultivate.

In plot No. 1, Fig. 12, the growth was heavy, holding the snow well and furnishing a most thorough protection to the ground from cold and washing.

Plot No. 2, Fig. 9. The clovers of both kinds made a good catch with a growth of about three inches and served the purpose of preventing washing of the soil, but offered no protection from frost and did not hold the snow. Unless this crop is allowed to grow considerably next spring the amount of organic material to be turned under will be very small. It is yet too early to determine whether the crimson clover will prove hardy here or not.

Plot No. 3, Fig. 10. The growth in this plot was much greater than in the last, being about 8 inches high and well matted, so as to cover the land well but not to hold much body of snow. This crop starts early in the spring and should supply a good body of organic matter rich in nitrogen to turn under earlier than the clovers.

Plot No. 4, Fig. 14. This crop made the smallest growth of all,

probably due to the low temperature and abundant moisture that followed the planting for two or three weeks. Unless this crop can be sown very much earlier or will make a much larger growth in a warmer season it will be of little value.

Plot No. 5, Fig. 13. Next to the peas and barley this crop is the largest and holds the snow nearly as well, but from its coarse growth will not protect from frost as well. Its value in plant food is probably greater than that of No. 1 but the exact value under the present conditions can only be determined by several seasons' comparison.

PRUNING ORCHARDS.

The questions, "how to prune," "what to prune" and "when to prune," are what we will attempt to answer by a few illustrations. Many progressive orchardists are studying the problem very closely, and some of them have arrived at the conclusion that it is a very easy matter to prune too much and that it requires the *greatest* good judgment to prune just enough.

The following figures show some of the conditions found in many orchard trees. Fig. 15 illustrates a tree pruned up so that teams can work under the branches or so that cattle can be pastured

FIG. 15.

beneath them. There are serious objections to this severe pruning, for the exposure of the trunks and branches to the drying influences of the sun and air is a serious check to the circulation of the sap and consequently the growth of the trees.

Fig. 16 shows the result of close planting and the cutting out of the lower branches as they become weak, instead of heading in the top, and thus forcing the growth into the lateral branches where the fruit can be more easily gotten at, and spraying, thinning and harvesting done economically.

FIG. 16.

Fig. 17. A well formed young tree that has been headed in and none of the lower branches removed. Small branches have been removed from time to time but no large ones.

Fig. 18 shows a well formed tree 30 years old that has had an abundance of room and has been properly headed in at the top.

Fig. 19 shows a well formed tree, 30 years old headed in, but the picture was taken in such a position that it appears to be a very high topped tree, which is not the case, the tallest branches being not over 25 feet high.

FIG. 17.

FIG. 18.

FIG. 19.

Rules for Pruning. 1. Never cut away more wood than is necessary to obtain the end in view. Err on the side of cutting too little rather than too much, for if too much is taken off it cannot be replaced in many years. Large crops of fruit cannot be grown on trees with a few exposed branches. 2. Cut out all dead wood as soon as it is discovered. (Summer is a good time to do this work as dead branches can be then seen at a glance.) 3. If two branches rub together so as to injure one another, the weakest should be cut away. 4. If one

FIG. 20.

FIG. 21.

branch rests on the top of another, Fig. 20, one should be removed. 5. Head back and thin out the top rather than cut off the lower

branches to bring the fruit as low as possible on account of thinning, spraying, and harvesting, see Fig. 19. 6. Never remove side branches if it can be avoided. If it must be done, cut as shown in Fig. 22 B, and cover the injured parts with two coats of linseed oil paint, gas tar or grafting wax; cover all wounds over one-half inch in diameter with one of the above preservatives. 7. Remove branches that are too low or resting on the ground as in Fig. 21.

FIG. 22.

Time for Pruning. The winter is generally a time of most leisure to the farmer or orchardist, and it is a good time to prune, but if the work is done in the early part of the winter, more care must be given to protecting the injured parts, for with the freezing and thawing of several months the cut surface will dry in very deeply and the longer the exposure the greater the injury. If the work can be done the last of winter just before growth begins, the injury will be but little. The above practice will apply about equally to the apple, pear and plum, but perhaps should be applied with some variations to the peach.

The pruning of established peach trees is shown in the following photo engravings. Fig.

FIG. 23.

FIG. 24.

FIG. 25.

FIG. 26.

23 shows a peach orchard of three years old trees pruned ready for their fourth seasons' growth. Fig. 24 shows the same in full summer growth. Fig. 25 shows a four years old orchard with the trees pruned for their fifth season's growth and Fig. 26 shows the same in full foliage toward the last of the fifth season's growth. Fig. 27 shows a peach tree at the end of the fourth season and Fig. 28 the same pruned ready for the fifth season's growth.

Young trees like those in the figures will need but little more pruning, unless the shoots become thick as shown in Figs. 9 to 14, except to head back as shown; but as they grow older some of the small inside shoots must be removed or the head will become so close as not to produce the large healthy foliage needed to mature fruit of first quality. By this method of heading in, the tree is prevented from becoming "toppy" as in Fig. 29, and the fruit is borne where it can be easily cared for.

FIG. 27.

THINNING FRUIT.

Next to the proper fertilization and cultivation in orchard work, thinning of the fruit is of the most importance. It matters little how much we may enrich the ground, or prune our trees, there will be some seasons when well formed trees will set more fruit than they can properly mature to large size, good color and fine quality, and

if we wish to produce the finest fruit, all of the imperfect specimens, all of the wormy, gnarly, distorted surplus and very small fruit must be removed as soon as its character can be determined. This time for different varieties and seasons will be about the first of July. The cost of this work on trees with very high branches as in Figs. 16 and 19, will be so great as to consume all profits from the crop, but on properly formed, low headed trees as in Fig. 18 the work can be done at comparatively little expense, and results in much profit to the grower and satisfaction to both the grower and consumer. For the most rapid work, step-ladders, and common ladders of several lengths should be on hand ready for use and only active, quick-sighted help should be employed. The cost of thinning the fruit on large trees where a considerable number have been done has been from 25 to 50 cents each and the profit has, in many cases, been more than doubled.

Fig. 28.

SPRAYING FRUIT TREES.

The season of 1901 was unusually favorable to the growth of many of the fungi that attack our fruit crops, and where spraying was not thoroughly done or not done at the right times much loss resulted. The peach, plum and cherry were especially injured by the *Monilia* or brown-rot, the black knot was abundant on the plum

trees, and the apple scab on the apple leaves and fruit had not been so abundant for many years, but where spraying was thoroughly done the fruit was saved from injury.

No one can predict what the season will be, as affecting insect or fungous life, and it has become the practice of the most progressive growers to spray in such a way that no matter what the conditions of the season both insects and fungi shall be controlled. The Spraying Calendar of this division has been made up on this theory. See Bulletin No. 80.

FIG. 29.

VARIETY TESTING OF FRUITS.

The number of new varieties of large fruits that produced a crop was small, because of the imperfect fertilization of the flowers, owing to the abundance of rain at the time the flowers opened and perhaps to the conditions that in 1900 were unfavorable to the production of fruit buds.

The *Grape crop* was one of the best the vineyards have ever produced, but not one of the new varieties were shown to be superior to a few of the old standard sorts, the Worden, Campbell, Green Mountain, Concord and Delaware still retaining their place as the most valuable for Massachusetts.

Of the *Blackberries* the Agawam, Snyder, Taylor and Eldorado still retain their place among the old kinds, with Mersereau, and Rathbun as decidedly promising.

The *Raspberries* that stand at the head are the Cuthbert, King, Curtland, and London for a heavy soil.

Of the *Currants* the varieties stand as follows, Red Cross, Wilder, Fays, Cherry and Pomona.

Of the *Strawberries** fruiting the first time the following is the list with their yield per acre.

NEW VARIETIES.

Quarts per acre.

Brownie,	5287	Howard's No. 103,	5281
Howard's (Haverland Seedl'g)	4085	Pocomoke,	3999
Kansas,	3546	Pennell,	3260
Duff,	2612	Hitchcock's Seedl'g, No. 67,	2280
Leheman's Seedling, No. 1,	2036	Howard's (Bubach Seedl'g)	1780
Howard's (Clyde Seedling)	1680	Gibson,	1668
Wheeler's Seedling, . . .	1798	Lady Jane,	1524
Mammoth,	1400	Parson's Beauty,	1392
Hero,	1080		

OLDER VARIETIES IN PLOTS.

Quarts per acre.

Howard's Seedling, No. 36,	8956	Haverland,	7192
Clyde,	6968	Sample,	6692
Seedling, M. A. C., . . .	6563	Howard's No. 14,	6468
Glen Mary,	6156		

OLDER VARIETIES IN FIELD.

Quarts per acre.

Clyde,	9456	Haverland,	9546
Brandywine,	6364	Sample,	8000
Glen Mary,	7091	Gandy Belle,	7637
Howard's No. 14,	2910		

*A severe drought came on the first of June that seriously affected the yield, though with subsequent rains the last pickings were of good size and quality.

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