TILLAGE AND SOD MULCH IN THE HITCHINGS ORCHARD.

U. P. HEDRICK.
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Plate I.—General View of Hitchings Farm: Plat A in Foreground; B and C on Hillside, Center.
TILLAGE AND SOD MULCH IN THE HITCHINGS ORCHARD.
U. P. HEDRICK.

SUMMARY.

For ten years this Station has been comparing sod mulch and tillage in apple orchards. This bulletin is a brief account of the experience in the Hitchings orchard, the most notable exception which proves the rule that tillage is the most profitable method for orchard culture under general conditions. The Hitchings orchard is unique among the fruit plantations of the State. Both the lay of the land and the character of the soil differ from those in most orchards; and the trees have been planted, pruned and sprayed, the soil tilled, and the fruit harvested in very original ways. By the “Hitchings method” as applied by its owner, the ground is laid down to sod before or as soon as the trees are set and the grass is cut for a mulch once or twice a season as conditions demand; that is, the orchard remains in sod indefinitely.

In the experimental work three plats are included: Plat A lies on the floor of the valley and is comparatively level. It consists of eight rows of thirty-four trees each, two years old at the beginning of the experiment, the varieties being Wagener, Rhode Island Greening and Sutton. Plat B lies on the lower part of a rolling hill. It contains six rows, each of thirteen trees, the varieties being Alexander, Wealthy and Fameuse. The trees were nine years old when the experiment began. Plat C is higher up on the hillside and consists of four rows, each of six trees of Northern Spy. These trees were ten years of age at the beginning of the experiment. In each plat half the land is in tillage and half in sod. All three plats appear to be well supplied with phosphorus, potash and nitrogen; all are on deep soil; and B and C receive the hillside seepage. All these factors favor the sod-mulch method. All plats were given identical care except in the matter of soil treatment. The tilled plats were plowed early in the spring and cultivated from seven [55]
to eleven times, a cover crop, usually of clover, following. In the sod plats was a mixed growth of orchard grass and blue grass. These grasses were mowed once during the summer, usually about the middle of June, and left as they fell, to form the "sod mulch."

Mishaps and slow maturity have prevented crop yields in Plat A. In the other plats, also, the data regarding yields are not as satisfactory as could be desired, but, in brief: The trees in sod bore an average of a little less than four bushels while those in tillage bore a little more than three bushels per tree.

Taking diameter of the tree trunks as the gauge of the two treatments in the bearing orchard, we find that the trees thrive as well under one method as the other. Using the same measure for the trees in Plat A on the floor of the valley we must conclude that those under tillage are doing much the better. Why the difference? Because the hillside seepage furnishes an abundance of moisture for both trees and grass, but in the dryer soil of the valley trees in sod cannot compete successfully with the grass for moisture.

In comparing costs the data are disappointing. The extremes are too far apart. The cost of tilling Plat A was at the rate of $11.22 per acre, Plat B $13.30 per acre, and Plat C $24.33. We paid for cutting grass in plats A and B at the rate of 60 cents per acre and 96 cents per acre in Plat C. The average for the tilled plats was $16.28, for the sod plats 72 cents per acre. These figures bring out the point that the cost of tillage is bound to vary greatly, depending upon land, tools, teams, number of cultivations and other factors. The cost of cutting grass will be more nearly the same for all orchards.

In conclusion, while unquestionably tillage is the best method of caring for the majority of the apple orchards in New York, yet there are particular places, soils and economic conditions under which the Hitchings method of sod-mulching apple trees may be used advantageously:

1st. Orchards on steep hillsides where land would wash badly under tillage may often well be kept in sod.

2d. On land covered with rocks, trees may best stand in sod.

3d. The Hitchings method is adapted only to soils having suitable depth. On shallow soils it will usually prove a failure.

4th. Soils must be retentive of moisture. On land that annually suffers from summer droughts the sod-mulch treatment will almost certainly prove less beneficial to trees than tillage.
5th. Economic conditions may decide the choice between tillage and some mulching treatment, since the cost of caring for an orchard is so much less under the Hitchings mode of mulching than by tillage. Thus a larger acreage in sod may be made to counterbalance a greater productiveness under tillage, thereby bringing the net income to the same level.

INTRODUCTORY.

In March, 1909, this Station published, in Bulletin No. 314, a preliminary report on a comparative test of growing apples under tillage and the Hitchings sod-mulch method. The work of which this first report is an account was carried on in the Auchter orchard a few miles west of Rochester, in the heart of the apple belt of western New York. In this orchard tillage was found to be the better treatment. In the present Bulletin, the second report, the test was conducted in the Hitchings orchard, near Syracuse, under widely different conditions and as we shall see with very different results.

THE HITCHINGS ORCHARD.

The Hitchings apple orchard is unique among the fruit plantations of New York. The trees have been planted, pruned and sprayed, the soil treated and the fruit harvested in very original ways. It has the distinction of having produced in the last fifteen years more prize-winning apples at the annual State fairs in New York than any other orchard in the State. In it originated the Hitchings sod-mulch method of growing apples which made the orchard at once a debating ground as to the merits of the method. The lay of the land and the soil, as we shall see, are also unique. Commendations and condemnations of Mr. Hitchings’ methods in the press and on the platform have given the orchard distinction not only throughout New York but wherever apples are grown in the United States.

THE NEED OF A COMPARATIVE TEST.

It early became evident that before there could be a satisfactory interpretation of his results there must be some systematic study of Mr. Hitchings’ work. The published and verbal accounts of visitors, founded usually upon a few hours’ stay, were seldom adequate and were often distinctly misleading. To obtain a fuller and more
accurate collation of facts than those circulated by casual visitors, the New York Agricultural Experiment Station in 1903 rented for ten years plats for experimental work in the Hitchings orchards. The plats were selected in the autumn of the year named by Professor S. A. Beach, then Horticulturist of the Station, the chief end in view being a comparison of the Hitchings sod-mulch method with the more usual one of tillage and cover crops.

After carrying on the work two years Professor Beach left New York and the work fell into the hands of the writer, the succeeding Horticulturist. The Station’s ten year tenure has just passed and this Bulletin is an account of a comparison for a decade, side by side, of tillage and the Hitchings sod-mulch method in the Hitchings orchard.

THE HITCHINGS METHOD DEFINED.

What is the Hitchings method? The term has become the sound-symbool for a mixture of more or less vague practices connected with sod in an orchard: sod pastured with sheep, hogs or cows; sod of blue-grass, orchard-grass, clover, alfalfa, or weeds; sod from which the grass is cut for hay, or cut and piled about the trees, or left uncut; sod supplemented by straw, manure or other by-products; sod the growth of years and sod turned under more or less frequently. This confusion has spread obscurity over much that has been said about the method. Since our experiment is a comparison of tillage with sod mulching as carried on by Mr. Hitchings, his method, now to be described, and none of the modifications suggested above, must be kept in mind.

No easier treatment of the soil in an orchard, short of downright neglect, could be devised than the Hitchings method. It consists in laying the ground down to sod before or as soon as the trees are set and cutting the grass for a mulch once or twice, as conditions may demand, during each summer. The orchard is supposed to remain in sod indefinitely, plowing being detrimental to the formation of the mulch which is essential in the treatment. The cut grass is never removed from the land and until roots and branches utilize the space between plants it is raked and piled about the trees. Many who grow apples in sod supplement the cut grass with straw or similar material as a mulch about the trees — desirable, of course, but not practiced by Mr. Hitchings and not prac-
ticable in the apple regions of New York because it is impossible to get mulching material, since straw or other roughage is not largely grown.

With the particular treatment just outlined, in mind, we pass to two other factors which play equally important parts in the Hitchings orchard — the site and the soil. Indeed, it is impossible to separate these two factors from the treatment in accounting for the results Mr. Hitchings obtained; for all are fundamentals in his success.

OUTLINE OF EXPERIMENT.

SITE.

The Hitchings farm is in the south-central part of Onondaga County, a region noted for dairy products and alfalfa but not conspicuous for its apples. There are few or no commercial orchards within several miles of the Hitchings place and the nearest market for apples is in Syracuse, nine miles away, to which place the fruit is hauled by team. Previous to making a commercial planting of apples Mr. Hitchings had been a dairyman but gave up cows to grow apples, small fruits and vegetables. These statements are made because it is important to know that Mr. Hitchings is a pioneer apple-grower in his locality and that as a pioneer he has blazed a new and original trail in fruit-growing.

The Hitchings farm is in the slightly rolling bottom and on the foothills of a deep valley, poorly shown in the frontispiece because the camera does not give an adequate idea of the height of the hills surrounding. On the level valley-bottom is located Plat A of our experiment, consisting of young trees. The sides of the valley are long, steep hills, the slope, of which the farm is a part, rising to an altitude of 400 or 500 feet in a distance of about a half mile. At the foot of this great hill, and as a part of it, is the main orchard, in which Plat B and Plat C, consisting of older trees, are located. The land lies in too steep an incline in this orchard for convenient cultivation and under constant tillage the soil would wash more or less unless the work be carefully done. The ground, too, is a little uneven whereby some trees are on hummocks and others in hollows. This unevenness accounts in part for the lack of uniformity in the growth and productiveness of the trees conspicuous in the tables given later.
Inhabitants of hilly countries know well that moist, spongy land may be looked for at the foot or on the sides of high elevations of land. The expected happens in the Hitchings orchard, for the land, at all seasons of the year but especially in early spring, contains much water despite well constructed open ditches to carry it away. In fact there are several springs in the orchard, which, however, Mr. Hitchings says, usually dry up in June, and do not begin to flow again until late fall. In a heavier or shallower soil the same amount of water would saturate the land so thoroughly

**DIAGRAMS OF PLATS**

1. **Plat A.**

<table>
<thead>
<tr>
<th>Row</th>
<th>Sod</th>
<th>Tillage</th>
<th>Row</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>Wagener.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>R. I. Greening.</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>Sutton.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>R. I. Greening.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>Sutton.</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>R. I. Greening.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Sutton.</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>R. I. Greening.</td>
</tr>
</tbody>
</table>

2. **Plat B.**

<table>
<thead>
<tr>
<th>Row</th>
<th>Sod</th>
<th>Tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alexander.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wealthy.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fameuse.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Alexander.</td>
<td>Sod</td>
</tr>
<tr>
<td>5</td>
<td>Wealthy.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fameuse.</td>
<td></td>
</tr>
</tbody>
</table>

3. **Plat C.**

<table>
<thead>
<tr>
<th>Row</th>
<th>Tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Northern Spy.</td>
</tr>
<tr>
<td>2</td>
<td>Northern Spy.</td>
</tr>
<tr>
<td>3</td>
<td>Northern Spy.</td>
</tr>
<tr>
<td>4</td>
<td>Northern Spy.</td>
</tr>
<tr>
<td>5</td>
<td>Northern Spy.</td>
</tr>
</tbody>
</table>

as to make it unworkable. This seepage is one of the fundamental factors in the success of the sod mulch in Plat B and Plat C in the Hitchings orchards. In the plat on level ground, A, all the tests possible to apply at this time show the tilled trees to be the better; on the sidehill, in B and C, the tests show sod mulch to be the better. The chief environmental difference between Plat A and
the other plats is the greater moisture content of the soil in the former
plats, arising from the fact that they receive the seepage from the
high hill on whose base they are located whereas Plat A lies on level
ground to which the seepage, in summer at least, does not reach.

PLATS.

Two orchards have been mentioned — one on low, level ground
in the valley, the other on the lower part of the hill-slope. Plat A,
as before stated, is in the valley and plats B and C on the hill-slope.
Both orchards were planted before the Station began experimental
work with Mr. Hitchings. The trees in the valley orchard were set
in November, 1902, the young trees being two years old. The orchard
was seeded with a mixture of orchard grass and clover in the spring
of 1903. Plat B was put out in the fall of 1894 in a timothy and
clover sod from which one crop of hay had been taken. Plat C was
planted in the fall of 1893 and also on a timothy and clover sod.
The plats are outlined as follows:

Plat A.— This plat includes all of the valley orchard, consist-
ing of 8 rows of 34 trees each, the rows 30 feet apart and the trees
20 feet apart in the row. At the beginning of the experiment these
trees had been set two years. Diagram 1 is a plan of the orchard
showing the varieties, row numbers, and division of the orchard
into sod and tilled sections. The area of each section as computed
from the distance apart of trees is 1.87 acres.

The soil in Plat A is undoubtedly Miami loam. It is a dark brown,
clay loam of alluvial origin of which the surface soil varies from 8
to 14 inches and is comparatively free from gravel and stone. The
subsoil is at least several feet in depth and is a brownish-yellow
silt to clay loam. The surface soil contains a small proportion of
sand but not enough to prevent crustig over after rains so that it
is rather difficult of cultivation — a somewhat tenacious clay.

Plat B.— Plat B is in the lower part of the hillside orchard. The
rows are 33 feet apart and the trees 32 feet apart in the row, making
.95 acre in each section, one in tillage and one in sod. Diagram 2
shows the varieties, row numbers and cultural divisions. The trees
in B were nine years old when the experiment began. Unfortun-
ately two trees died in the early life of the orchard and their
places were given to other varieties. Thus, tree 12 in row 2 is
Pound Sweet and tree 5 in row 6 is Yellow Bellflower, both varieties
foreign to the experiment and therefore not henceforth to be considered.

The surface of Plat B is somewhat broken, but the main soil type is fairly uniform. The soil is Miami stony loam, shading in places into gravelly loam, exceedingly variable in depth, brown in color and more or less sandy in texture. In places on this plat the soil contains a high precentage of broken rock or shale fragments, especially on its higher portions. The subsoil is of fair depth and consists of a deep brownish-yellow clay loam with a considerable proportion of gravel and shale fragments.

*Plat C.*—Plat C is up the slope above Plat B. The trees were ten years of age at the beginning of the experiment and are set at the same distances apart as those in Plat B. The area of the tilled and sod plats is .27 acre each. Diagram 3 shows the plan of the plat. The sixth tree in row 3 could not be used and a tree in row 5 had to be substituted.

The soil in Plat C is Miami stony loam. It is not so gravelly as that of Plat B, is somewhat shallower in depth and contains more large stone but otherwise it is very similar.

A mechanical analysis of the soils in these plats was not made but their chemical constituents were carefully studied to see, if possible, under which of the two treatments the soil was most depleted of fertility. Table V, page 78, gives the results of chemical analyses of the soils at the end of the ten-year period. The analyses, it suffices to say here, show the soil to be fairly well supplied with phosphorus, potassium and nitrogen but rather deficient in lime.

That these plats are not suitable for accurate experimental work must be admitted at once. The defects are many. Thus, the trees in B and C are too few, the plats are of unequal areas, there are too many varieties, the trees in the several plats are of different ages, the land on the hillside is uneven and the soil is not uniform. But better plats could not be laid out in the Hitchings orchards and it was much desired that a comparison of sod mulch and tillage be made here where the mulch system had become most prominent in New York.

**MEASURING THE RESULTS.**

When the work in hand was turned over to the writer the plan of procedure had not developed further than the taking of notes on the yields and expenses of the several plats. As the project took
shape it became more and more apparent that small opportunity was offered for determining fundamental facts regarding the effects of sod mulch and tillage on trees for, beside the defects in the material mentioned in the preceding paragraphs, mishaps of various kinds, as the death of trees, began to occur.

For the reasons given it was early decided that crop performance and tree growth were to be the chief tests in the comparison of the two methods of culture as being the most satisfactory gauges under the conditions. After all, yield of fruit and growth of tree are the ultimate criteria of methods of management and if extended over sufficient time should be satisfactory to fruit-growers and ought to convince experimenters of the relative values in practice of the methods. These gauges may tell which is the better method, but they tell practically nothing as to why one method is better than another. The work in hand, then, is more demonstrational than experimental.

In this discussion of results, then, yield of fruit and growth of tree are to furnish chief evidence. Since cheapness is one of the great merits of the Hitchings method, statements of expenses must be compared. The writer feels that to attempt to go further is to raise more questions than can be answered — to stir up more hares than can be run down.

It remains to be said, before taking up the data, that while the care of the experimental plats had been directed from the Station, the work has been in the hands of Mr. Hitchings — done in his way and at his discretion. The records of yields and expenses were kept by him, being turned over to the Station at the end of each season. Perhaps this is the best place to express appreciation of the zeal and enthusiasm which Mr. Hitchings has shown in carrying on these experiments. If the work at any time has suffered, it is because a very busy man could do no more. If in places the data lack fullness, the same reason stands.

**PROGRESS AND RESULTS OF EXPERIMENT.**

**TREATMENT OF PLATS.**

The trees in the several plats under comparison have received identical care in all orchard operations excepting soil treatment, which has been as follows:
Sod plats.— The sod was established, as we have seen, before the experimental work was begun. It consisted in 1905, when the writer first saw it, of a rather diversified flora of the weeds commonly found in meadows; as, the docks, wild carrot, ox-eye daisy, mullein, flesbene and the plantains, with peppermint in the wettest places in the hillside orchard. In the ten years the sod-flora has varied but little. The character of the sod is shown in the several illustrations in this bulletin. The grass was mowed on the following dates:

**TIMES OF MOWING.**

<table>
<thead>
<tr>
<th></th>
<th>Plat A</th>
<th>Plat B and Plat C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1904, June 17 and August 20.</td>
<td></td>
<td>1904, Once — date not given.</td>
</tr>
<tr>
<td>1908, “ 1.</td>
<td></td>
<td>1908, July 17.</td>
</tr>
<tr>
<td>1909, Once — date not given.</td>
<td></td>
<td>1909, Once — date not given.</td>
</tr>
<tr>
<td>1911, “ date not given.</td>
<td></td>
<td>1911, Once — date not given.</td>
</tr>
</tbody>
</table>

In Plat A the mowed grass in 1904 was in part sold for hay, but was piled about the young trees in all of the succeeding seasons. The grass was put under the trees in B and C the first three summers but not afterwards, since the roots of these older trees at this age began to meet in the spaces between rows. It is hard to estimate the amount of hay the cut grass would have made per acre in the two orchards, but an average of one and one-half tons would probably be fair.

**Tilled plats.**— The following is a memorandum of the treatment of the tilled plats:

**TREATMENT OF TILLED PLATS.**

1904. All plats plowed in May and cultivated during the season seven times. Cover-crop of clover sown about August 1st; trees hoed three times.

1905. All plats plowed in May and cultivated seven times thereafter. Cover-crop of clover sown about August 1st; trees hoed five times.

1906. Plats plowed April 24–25 and Plat A cultivated nine times and B and C eight times. Trees in A hoed four times and in B and C three times; cover-crop of clover sown August 1st.

1907. Plats plowed April 30–May 2; A cultivated ten times and B and C eight times; trees in all plats spaded about once and those in A hoed about once; cover-crop of crimson clover sown August 3.

1908. Plats plowed April 22–23; A cultivated twelve times and hoed three times, B cultivated ten times and C eight times; cover-crop of crimson clover sown August 7 in A and on the 8th in B and C.
1909. Plats plowed April 27–28; A cultivated eleven times and trees hoed twice; B and C cultivated ten times; cover-crop of crimson clover sown August 23.
1910. Plats plowed April 24–26 and B cross-plowed May 30; A cultivated eleven times; and B and C seven times; cover-crop of wheat sown in A September 15.
1911. Plats plowed April 24; A cultivated twelve times and B and C eight times; trees in B hoed about once; no cover-crops this year.
1912. Plats plowed May 2 and 3; A and B cultivated eight times and C seven; cover-crops of wheat sown September 12.
1913. Plats plowed April 23 and 24; all plats cultivated five times.

The cultivation between rows one way was at all times most thorough. Many fruit-growers will say that the expense of cultivation, as shown by the number of times it was done and by the financial statement in Table IV, was much above that of the average tilled orchard. Strips of sod from ten to twelve feet wide were left in the tree rows in all of the plats. Mr. Hitchings maintained that cultivating could not be done between trees in the row without danger to the trees and that the roots were out beyond the sod strips at this time. Plates V, VI, VII, show the character of the cultivation.

DISASTERS.

Cherished projects seem doomed most often to disaster. Plat A in the Hitchings orchard is one of these. As the largest of the plats and because lay of land, soil, varieties, and, in fact, all conditions were most favorable at the beginning of the experiment, this plat was given the most watchful care. "But who can turn the stream of destiny?" Excessive cold in the winter of 1903–04, the first year of the experiment, killed a number of young trees in Plat A outright, so weakened several others that they died later, and unquestionably checked the growth of all. As the trees died their places were filled but these replantings could not be used for the tests under way. Out of the 272 trees in this plat, 52 were sooner or later discarded because of injury the first winter.

Seemingly through some malevolent influence, but probably because of unsuitability of valley land to fruit-growing in this region, the trees in Plat A show a strong aversion to bearing apples. Ten seasons passed without a crop of apples — only scattered specimens. The trees began their eleventh summer white with bloom and all seemed favorable for at least one test crop during the tenure of our experiment. But in the end, as at the beginning of the test, disaster came in a night and through the same agency — cold. The freeze in blossoming time, 1913, played havoc with the setting fruit and from
what promised to be a full crop the writer picked one apple at harvest time. The plats in the hillside orchards escaped both freezes.

The trees in all of the plats have had their full share of the usual insect and fungus troubles but so far as could be seen from careful observation, though not special study, pests were as numerous and troublesome in one section of the plats as another, with the single exception of blight. The Alexanders, always susceptible to blight, suffered more from this disease in the tilled than in the sodded sections. Seven trees under tillage were killed by the blight in Plat B. Red-bugs came in devastating numbers in B and C in 1905 and have reappeared every year since, preventing the division of the crops into market grades in accordance with size, since injured fruits, no matter what their size, had to be put into seconds or culls. In 1913, however, this pest was kept under control by spraying with Black Leaf 40. In two seasons the apple maggot was reported by Mr. Hitchings as having prevented a proper grading of all varieties in accordance with size.

Table I.—Average Yield, in Bushels of Apples per Tree, on Sod and Tilled Land:

<table>
<thead>
<tr>
<th>Year</th>
<th>Sod. Alexander</th>
<th>Sod. Fameuse</th>
<th>Sod. N. Spy</th>
<th>Tilled Alexander</th>
<th>Tilled Fameuse</th>
<th>Tilled N. Spy</th>
<th>Tilled Wealthy</th>
</tr>
</thead>
<tbody>
<tr>
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<td>7.33</td>
<td>2.83</td>
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<tr>
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<td>1.84</td>
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<td>2.73</td>
<td>5.12</td>
<td>1.33</td>
<td>4.48</td>
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</table>
Plate III.—Northern Spy Tree Typical of Those in B and C at Beginning of Experiment.
Plate VI.—Plat B in 1913: Upper Half, Tillage; Lower Half, Sod.
PLATE VII.—PLAT A: UPPER HALF, TILLAGE; LOWER HALF, SOD
CROP PRODUCTION.

In the long run crop production is of course the best measure of merit in a method of orchard management. Ten years, it might be thought, is a sufficiently long period to make yield of fruit almost an absolute test as to which of two methods is the better in a given orchard. Happily the ten years during which this work has been in progress have been seasons of abundant apple harvests. Crops have been good, bad and indifferent with some varieties, but total failure has not had to be recorded with any variety in the two bearing plats. Table I gives the yields of fruit for the ten years on plats B and C. The yields on Plat A may be briefly summarized as follows:

Yields in Plat A.—A glance at the chart of Plat A shows three varieties, of which we are considering but two, Rhode Island Greening and Sutton; because the third, Wagener, was under sod only. The Rhode Island Greenings bore no fruit until 1911 when the sodded trees bore one bushel of second-class fruit and the tilled trees a half bushel of culls, the crop in both cases having been ruined by insects. For some reason the sodded Greenings bore no apples in 1912, while those under tillage bore twelve bushels. In 1912 Sutton in sod bore one bushel; under tillage two bushels. These figures mean but little, probably being accidental variations.

Yields in plats B and C.—In the table submitted only the total quantity of fruit is given. It is doubtful whether any other figures than those of total yield are worth considering; for Mr. Hitchings' gauge of seconds and culls for his particular and peculiar market is different from that of most apple-growers, depending for one thing more largely upon color. So, too, red-bug was a disturbing factor, causing many seconds and culls in apples large enough to go as firsts. And, lastly, Mr. Hitchings' method of harvesting early apples over a somewhat lengthy period by allowing the fruit to drop or by shaking it on the ground would certainly cause more poor fruit in the tilled than the sod sections; thus we have the statement from Mr. Hitchings, "Harvesting the crop of apples under tillage is very unsatisfactory on account of the dirt which clings to the fruit as it drops from the trees. This is entirely avoided in the sod section." It should be added that another reason for this method of harvesting was that on the tilled land the apples were left until they dropped, with the hope that they would color better.
Summarizing the figures, we find that Alexanders growing in sod produced an average of 1.84 bushels per tree during the ten years, under tillage 1.33 bushels. Fameuse in sod bore an average of 6.1 bushels per tree, under tillage 4.5 per tree per year. Northern Spy in sod bore 2.7 bushels, under tillage 2.5 bushels per year. Wealthy in sod produced 5.1 bushels per year, under tillage 4.5 bushels. Averaging the figures for four varieties we find that the trees in sod, ten years set at the beginning and twenty at the end of the experiment, bore an average of a little less than four bushels per tree, while those in tillage bore a little more than three bushels per tree. To be exact, the difference between sod and tilled plats was four-fifths of a bushel per tree per year in favor of the sod mulch.

Taking, therefore, the difference in total yield of fruit between the two plats as the measure of value of the two treatments, the sod-mulch method is shown to be somewhat the better way of handling apple trees under the conditions prevailing in the Hitchings orchard.

**NUMBER AND SIZE OF APPLES.**

Year in and year out there was little difference in size between the apples in the two sections. In 1904 and 1905 counts were made of equal weights of varieties from the several sections, the results showing in 1904 a slight increase in size for the apples from the tilled sections. In 1905 a similar count showed the fruits from the sod plats to be a little the larger. In neither year were the differences beyond the range of accidental variation. In no season was it possible to determine, with the eye, differences in size in apples from tilled and sodded trees. Apples attain more than average size in the Hitching's orchards and probably less of these ten crops than in most orchards went into seconds and culls because of small size.

Size is worth considering, in these experiments, only as it has a bearing upon marketable quantity. The value of the whole crop was affected little, or not at all, by size. But in studying the table showing the amounts of fruit for the different years the question naturally arises: Is the increased quantity in any year or for any variety due to more apples or are the apples larger? We have no data to submit to settle this question but it was very apparent, in the years when a variety in one section gave a greater quantity of fruit than the same variety in the other section, that it was chiefly because of a greater number of fruits. An examination of Table I shows
an interesting alternation in most of the varieties — one year the variety produced most fruit in sod, the next under tillage. No reason appears for this biennial-bearing habit of varieties in which the off year for sod was the bearing year for tillage.

COLOR OF FRUIT.

It needs hardly to be said that the apples from the sodded plats were much more highly colored and therefore much more attractive in appearance than the fruit from the tilled plats. It may be laid down as a universal rule that sod heightens the color of apples in the orchards of New York. Another rule that very generally holds in this State is that the conditions which produce high color are antagonistic to yield of fruit and to growth of tree. The figures presented in Table I are not in accord with this rule as it applies to yield of fruit, but those showing the relative growth of trees, Table II, are in exact accord.

The correlations between color and quantity and color and growth of tree need further consideration, best given by way of illustration. Every orchardist of experience in this region knows that girdled, wounded, diseased, decrepit, poorly nourished, or somnolent trees bear more highly-colored fruit than healthy, normal trees growing near them. In this day of almost universal tillage in commercial apple orchards in New York, one of the common questions is, How can I check growth and obtain more highly-colored fruit? High color in red apples is as trustworthy an indication of ill-being in a tree as high pulse or high temperature in a human being — so dependable that its occurrence in any method of growing apples enables us at once to say that is is purchased at the expense of health or vigor of the tree.

The red of the several varieties under tillage and in sod varied a good deal with the season. The trees in sod ripen their fruit somewhat earlier than those under tillage and if in the last part of the season the weather is sunny and propitious for the coloring of apples, the tilled fruits, because they remain a little longer on the trees show less marked difference in color than otherwise.

The apples on the tilled plats are exceptionally well colored for tilled fruit because, possibly, of altitude, the soil, or of some unknown factor, or some combination of conditions which often gives tilled apples from the Hitchings farm a color and finish rivaling the best
western fruit though seldom as beautifully colored as the same variety from near-by sodded trees.

**Maturity and Keeping Quality of the Fruit.**

As stated in the last paragraph the fruit on the plats in sod ripens a little earlier, the difference being from a few days to two weeks, depending upon the season and the variety. In a wet, cool autumn there is but little difference in time of ripening, but if the weather be dry and warm the difference is considerable. The earlier-ripening Alexander and Wealthy mature more nearly at the same time in the two sections than the later-ripening Fameuse and Spy.

Little can be said of the keeping quality in common storage of the apples in this experiment. None of the varieties are late keepers and in the tests we were able to make, the quantities were so small and the disturbing factors so many — such as lack of data as to picking, sample sent selected for exhibition purposes, quantity not sufficient for a fair test — that we are not warranted in making definite statements. Mr. Hitchings reports that with him "the apples from the sod plats hold up much better than from those under tillage."

**Tree Growth.**

What effect have the two methods had on the growth of trees? In a ten-year period it would be expected that the method under which most fruit was produced would give greatest growth in trees. Yet such is not the case, from the figures we have to present. For, whereas our figures show the sodded trees to have yielded somewhat larger crops of fruit the data show the trees to have made much the same growth under the two treatments in the bearing orchard and a much larger growth under tillage with the young trees.

Thus, we find from a consideration of Table II, giving diameters, that in Plat A the Rhode Island Greenings and the Suttons average more than one inch each greater diameter than the trees in sod, a very considerable greater growth for trees but eleven years set. In Plat B the Alexanders in sod have made a gain of a little over an inch in diameter more than those under tillage, but this evidence should be ruled out because eight of the original thirteen tilled trees died and some of the remaining five were badly cut back because of blight. The Fameuse and Wealthy trees in this plat are almost
at a stand-off with the odds a little in favor of the trees in sod. The
tilled and sodded trees of Northern Spys in Plat C made almost
an identical average increase in diameter in the ten years, there being
but the insignificant difference of .01 of an inch. The diameters,
it should be said, were taken at one foot from the ground.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sod.</th>
<th>Tillage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1904</td>
<td>.87</td>
<td>.75</td>
</tr>
<tr>
<td>1913</td>
<td>5.16</td>
<td>4.73</td>
</tr>
<tr>
<td>Gain</td>
<td>4.29</td>
<td>3.98</td>
</tr>
</tbody>
</table>

Gains for Sod.

Fameuse................. .89 inch.
Northern Spy............. .01 "

Gains for Tillage.

R. I. Greening........ 1.09 inches.
Sutton.................. 1.22 "
Wealthy................ .73 "

Should we take growth in diameter of the tree trunk as the sole
gauge of the value of the two treatments in the sidehill orchard, we
should have to say that the trees thrive seemingly as well under one
method as the other. Using the same measure for the trees on the
floor of the valley, we must conclude that the trees are doing much
the better under tillage. Why the difference? We answer at once,
because the soil is deep enough to give the trees a much larger root-
run on the hillside, whereby they get away from the grass, and because
the hillside seepage furnishes an abundance of moisture for both
trees and grass. In the comparatively shallow and dry soil of the
valley, trees and grass compete in the sod for food and moisture
and the trees suffer.

There is a close agreement in the growth of parts or organs of trees
as affected by different treatments or conditions and when, as with
these trees, trunk diameters can be given for a series of seasons, there
is little need of other measurements to show vigor and health. There
might, however, be some difference in form of top whereby the trees, though larger in trunk diameter, would be possibly less desirable orchard plants. Spread of branch and height of tree ought to give all of the data in regard to form of top needed by a fruit-grower. It would have been too difficult a task to take these dimensions in the twenty-year-old trees in Plat B and Plat C and we can therefore but say that gauged by the eye, height of tree and spread of branch in the trees in these plats increased very closely in accordance with the increase in diameter of trunk. Plates V and VI show at least that the differences in these particulars are not very marked.

It was easier to measure the height and spread of the young trees in Plat A. Table III gives these dimensions and Plate VII shows them compared in photographs. The figures in the table need no amplification. They show a very material increase in both height and spread of branches for tilled trees.

Table III.—Height and Spread of Apple Trees on Sod and Tilled Land.

<table>
<thead>
<tr>
<th></th>
<th>Sod.</th>
<th>Tillage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height in feet</td>
<td>10.01</td>
<td>11.07</td>
</tr>
<tr>
<td>Spread in feet</td>
<td>11.8</td>
<td>7.64</td>
</tr>
<tr>
<td>Gain in height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain in spread</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Uniformity in Trees and Crops.

One of the best tests of any orchard treatment is uniformity of trees. In a plantation of trees of the same age uniformity is a financial asset. It is essential in good orcharding that trees bear annually, that the fruit be uniform in size and color, that the crop be well distributed on the tree and that the trees in the orchard bear approximately the same quantity of fruit. In growth of trunk and branches and of foliage there should also be as few departures as possible from the normal.

In the first report on sod mulch and tillage published by this Station, in all of these respects the honors went to the tilled trees. As regards the crops of fruit in the two kinds of culture in the Hitch-
ings orchards convincing data are lacking, but in tree growth, as could be seen by the eye, the trees in sod are less uniform in most of the varieties. In Plat A, in particular, the diameters, the heights and the spread of branches are all less uniform in the sod than in the tilled plat. Plates VI and VII, in which the two methods of culture are illustrated, show to the eye this greater uniformity of tilled trees.

For this superiority of tilled trees in uniformity we have the same reasons to offer as those set forth in the bulletin on the Auchter orchard; namely,¹ "No matter how uniform the sod there will be areas well grassed and areas poorly grassed; areas in which there is an admixture of some plant not to be found in the same quantity elsewhere. Now this lack of uniformity of environment cannot but bring about ununiformity in the trees themselves. On the contrary, tillage is conducive to a uniform environment as it secures surface uniformity of the field, equalizes the depth of soil, and tends to evenness in the amount and availability of moisture and food. One of the reasons for cultivating any crop is to secure an equally vigorous growth over the entire area cropped."

FOLIAGE.

The health and vigor of trees are readily determined in the growing season by the color of the foliage. The darker the green of the leaf the healthier and the more vigorous the tree. Most fruit-growers will agree that there is no test of the well-being of an orchard, outside of actual crop performance, more dependable than the color of the leaves. In determining the value of the two methods of culture under consideration, then, much weight must be given to leaf-color, keeping in mind, however, that there is the possibility of trees growing too vigorously for best fruit production.

In determining color of foliage reliance must be placed on observations by the experimenters, since there is no ready method of color measurement. The records of the various observers from the Station sent to the Hitchings orchard from time to time during the several seasons of our tenure show that at nearly every visit the color of the foliage of the tilled trees was darker and richer, indicating greater vigor than in the sodded trees. In no case was the foliage of the

trees in sod a darker green and in the few instances in which differences could not be discerned, the observation was either made very early in the season, or, and this is significant, after or during a period of wet weather. In particular, this was true of the young trees in Plat A. Thus, the color of the foliage is in agreement with the diameter of the trunk, the spread of branch and the height of head, in attesting the greater vigor of tilled trees.

A fact, possibly of little practical importance but quite suggestive, is that the tilled trees usually blossomed, and so far as our records go, always leafed-out from one to several days in advance of the trees in sod. This is in accord with the behavior of the trees under the two methods of treatment in the Auchter orchard.\(^1\) In the latter orchard temperatures taken throughout one summer showed that the tilled land was warmer than the sodded land, from which the assumption was made that the trees bloomed and leafed earlier in the tilled land because the soil was warmer. If the supposition for the Auchter orchard is correct, we may assume that the tilled land in the Hitchings orchards is warmer.

Observations on the time of dropping of leaves in the several plats could not be made by observers from the Station but from the following quotations from reports made by Mr. Hitchings it seems that foliage on the sodded trees dropped soonest:

November 14, 1904.— "The cultivated trees are still hanging on to their leaves."

October 31, 1905.— "Foliage on tilled plats dark green in color, very few leaves shed; on sod plats the foliage has almost all turned yellow and one-half or more is shed."

October 29, 1907.— "The foliage on the cultivated plats has held a good color up to date."

November 2, 1908.— "The foliage held better on the tilled plats; kept green until destroyed by frost."

In the reports for years other than the four from which the quotations given were taken, the time of the leaf-fall is not noted. There is an advantage and a disadvantage for trees retaining foliage late in the season without loss of color. When foliage takes on autumn colors and drops early, the growing season is cut short and the trees probably lose somewhat in growth and vigor. In late-ripening varieties there is also, no doubt, some loss in size of fruit and, since

maturity of leaves must coincide more or less with the ripening of fruit, we should expect, as has been the case in the Hitchings orchard, that the fruit would ripen earliest on the trees dropping their leaves soonest. On the other hand the lighter tints of maturing leaves and the earlier dropping of foliage give conditions under which the apples take on higher colors.

**SURFACE WASH.**

Plats B and C, it will be remembered, are on a fairly steep hillside. Since surface wash is one of the chief objections to tillage on hillsides, the tilled plats have been under close observation to see what harm might be done by washing. In none of the reports of any of the many visits made by various members of the Station staff, nor in any of the reports from Mr. Hitchings, is it shown that the tilled plats have suffered harm from washing. It must be said, however, that the cultivated plats are so narrow that washing would hardly take place as it might do on a wider area.

This opportunity cannot be permitted to pass without stating the writer’s opinion that the danger from surface washing on hilly lands in New York is greatly exaggerated. Torrential rains are comparatively infrequent in this State, orchard lands usually are more or less stony and stones impede washing, and June and July, the months that orchards are tilled, constitute but a short time, at a season of the year when rains are all too few, for washing to take place. A rather wide observation in the fruit-growing regions of New York has not shown many tilled orchards that wash badly. After several more years in observing orchards on hillsides in this State we can reiterate with emphasis the following statements made in Bulletin 314, page 112, in regard to washing on orchard lands.

“The land in the Auchter orchard is rolling, though nowhere are the slopes steep. In this respect it is a fair average of the apple orchards of western New York. At no time has there been any harmful surface wash in either of the two plats and we have not, therefore, had an opportunity to observe in this orchard the influence of cultivation on surface wash. Since tillage is objected to on hilly ground because it is supposed to favor surface wash, it may not be out of place to give observations from elsewhere in this regard.

“In all but the steepest locations in the climate and on the soils of New York, embracing practically all sites upon which trees can
be sprayed, harvested and pruned with sufficient ease to make fruit-growing profitable, proper cultivation may be made an efficient means of lessening the washing of land. Whatever contributes to the porosity of the soil prevents washing. It is obvious that cultivation makes a soil granular and porous. Plowing and tillage to check surface wash on steep slopes should be as deep as possible; furrows should run at right angles to the slope to impede the fall of the water; in some cases open furrows and ditches having a very gentle fall can well be maintained. If the above means of stopping surface wash be supplemented by cover-crops, which check the wash at the season when the rainfall is heaviest, it can be said that almost any land upon which it is practicable to grow fruit can be cultivated. Such deep-rooting cover-crops as the clovers and cow-horn turnips are of great value on land that washes because they form root tubes which help to take care of the water. Artificial drainage is sometimes necessary on hillsides to prevent land from becoming waterlogged which of course would favor washing. There need be little solicitude about surface wash on most of the fruit lands of New York if proper precautions are observed where it is menacing."

**COST OF THE TWO METHODS.**

Of the tests to determine the value of methods in commercial fruit-growing, the cap sheaf of the shock should be the cost of production. The curt dictum "the weakest goes to the wall" applies in apple-growing as well as to other financial enterprises. But unfortunately when we came to apply this test to the two methods under comparison, expectant as we have been, the data are most disappointing. The extremes are so far apart, not only between the two treatments, but between the different plats under the same treatment, that the figures are at once seen to mean but little. Let us run over the summaries as found in Table IV, the amounts being those charged the Station for the work by Mr. Hitchings.

A glance at the acre averages shows that it has cost the Station $60 per acre annually to have the grass cut in Plat A and Plat B and $96 for the same work in Plat C. The cost of cultivation per acre per year was $11.22 for A; $13.30 for B; and $24.33 for C. The average for the sod plats is $.72 per acre; for the tilled ones $16.28 per year. We can well believe that grass can be cut for $.72 per acre and that the average, though a little low, might pass for the
State, but we greatly doubt if there are many or any fruit-growers in New York who yearly pay $16.28 per acre for the cultivation of their orchards. The same operations in the Auchter orchard for the same ten years cost $80 annually per acre for cutting the grass and $7.39 per acre for cultivation.

Table IV.—Comparative Cost of Sod Mulch and Tillage Methods of Handling Apple Orchards.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sod.</th>
<th>Tillage.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plat A</td>
<td>Plat B</td>
</tr>
<tr>
<td>1904</td>
<td>$2.60</td>
<td>$0.50</td>
</tr>
<tr>
<td>1905</td>
<td>$2.60</td>
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</tr>
<tr>
<td>1906</td>
<td>$1.00</td>
<td>$0.50</td>
</tr>
<tr>
<td>1907</td>
<td>$1.10</td>
<td>$0.50</td>
</tr>
<tr>
<td>1908</td>
<td>$0.90</td>
<td>$0.50</td>
</tr>
<tr>
<td>1909</td>
<td>$0.60</td>
<td>$0.40</td>
</tr>
<tr>
<td>1910</td>
<td>$0.60</td>
<td>$0.80</td>
</tr>
<tr>
<td>1911</td>
<td>$0.60</td>
<td>$0.40</td>
</tr>
<tr>
<td>1912</td>
<td>$0.50</td>
<td>$0.50</td>
</tr>
<tr>
<td>1913</td>
<td>$0.75</td>
<td>$0.50</td>
</tr>
<tr>
<td>Average</td>
<td>$1.13</td>
<td>$0.57</td>
</tr>
<tr>
<td>Acre average</td>
<td>$60</td>
<td>$60</td>
</tr>
</tbody>
</table>

The differences in cost per acre of tillage are not due to prices of labor since the rate per hour in the two orchards averaged the same. The cost of the operation in the two orchards varied somewhat, of course, because of the diverse character of the soils and of the lay of the land—the Auchter orchard being the easier to cultivate. Then, too, the smallness of the plats has made cultivation more expensive in the Hitchings orchard, and, lastly, whereas the average number of cultivations which Mr. Auchter considered sufficient to keep the land in good tilth was seven, Mr. Hitchings thought his land required nine cultivations. This brings out the point that the cost of tillage is bound to vary greatly depending upon land, tools, teams, number of cultivations and other factors, whereas the cost of cutting grass in the orchard will be approximately the same in all parts of the State.
EFFECTS OF THE TWO TREATMENTS ON THE SOIL.

It is important to know how the two treatments have affected the food and humus content of the soil in the three plats. Table V shows the chemical analyses of soils in the sod and tillage sections of the plats at the close of the experiment. Only the columns in the table showing total carbon and nitrogen content need be considered in the present inquiry, the amounts of other substances being given chiefly to show the character of the soil. None of the constituents of the soils, excepting the two selected, in quantities as large as the analyses show them to exist, may reasonably be expected to have been appreciably changed in the ten years of this experiment.

**Table V.—Analyses of Soil from Hitchings Orchard.**

<table>
<thead>
<tr>
<th>Location</th>
<th>$P_2O_5$</th>
<th>P</th>
<th>CaO</th>
<th>Ca</th>
<th>MgO</th>
<th>Mg</th>
<th>K$_2$O</th>
<th>K</th>
<th>CaCO$_3$</th>
<th>CO$_2$</th>
<th>Total carbon</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platt A:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sod</td>
<td>4,440</td>
<td>1.94</td>
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<td>9.000</td>
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<td>13.800</td>
<td>46.000</td>
<td>38.200</td>
<td>1,860</td>
<td>840</td>
<td>50,200</td>
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<tr>
<td>Tilled</td>
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<td>8,800</td>
<td>6,400</td>
<td>11.200</td>
<td>6,800</td>
<td>48,400</td>
<td>40,200</td>
<td>1,760</td>
<td>780</td>
<td>48,000</td>
<td>5,400</td>
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<tr>
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<td>2.02</td>
<td>10,800</td>
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<td>18.600</td>
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<td>55.600</td>
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<td>1.86</td>
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<td>23.200</td>
<td>14,000</td>
<td>52,400</td>
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<td>Platt C:</td>
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<tr>
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<td>16,600</td>
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<td>47,600</td>
<td>1,340</td>
<td>600</td>
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**POUNDS PER ACRE IN SECOND SEVEN INCHES.**

<table>
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<th>Location</th>
<th>$P_2O_5$</th>
<th>P</th>
<th>CaO</th>
<th>Ca</th>
<th>MgO</th>
<th>Mg</th>
<th>K$_2$O</th>
<th>K</th>
<th>CaCO$_3$</th>
<th>CO$_2$</th>
<th>Total carbon</th>
<th>N</th>
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<tbody>
<tr>
<td>Platt A:</td>
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<td></td>
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<td></td>
</tr>
<tr>
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<td>1.54</td>
<td>9,600</td>
<td>6,800</td>
<td>21,600</td>
<td>13,000</td>
<td>49,600</td>
<td>41,200</td>
<td>1,520</td>
<td>680</td>
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<td>7,600</td>
<td>5,400</td>
<td>15,000</td>
<td>9,000</td>
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<td>900</td>
<td>400</td>
<td>26,800</td>
<td>3,600</td>
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<td>Platt B:</td>
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<td>Sod</td>
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<td>55,200</td>
<td>45,800</td>
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<td>740</td>
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<tr>
<td>Tillage</td>
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<td>1,260</td>
<td>560</td>
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The amounts of carbon found in the analyses of tilled and sodded soils indicate that there is considerably less humus in the tilled land than in that kept in sod. The same is true of nitrogen. Whether the quantities of humus and nitrogen found in the tilled land are sufficient for the needs of the apple we do not know. Neither do we know whether humus and nitrogen are increasing or decreasing in the, several plats, since, unfortunately, analyses were not made at the beginning of the experiment. It may reasonably be assumed, however, that under the action of tillage and with the comparatively sparse cover crops turned under in the tilled plats, both humus and nitrogen have decreased more than is good for apple
land. This leads to the statement of a conviction that has been forming in the writer's mind for several years past. Namely, it is becoming more and more apparent that cover crops alone in many cases are not sufficient to supply tilled orchards with the humus and nitrogen, humus in particular, that trees need and that the deficiency must be made up by an occasional application of stable manure, or by occasionally keeping the orchard in a clover sod for a season.

INFERENCES FOR NEW YORK APPLE-GROWERS.

From the behavior of the Hitchings orchards, New York apple-growers may infer that there are particular places, soils and economic conditions under which the Hitchings method of sod-mulching apple trees may be used advantageously. Since the prerequisites for the success of the method, as indicated by the Auchter and Hitchings orchards, are not very generally found in this State, the situations in which sod may be given preference over tillage should be set forth with exactitude. These are:

1st. *Orchards on steep hillsides where land would wash badly under tillage may be kept in sod.*—As we have tried to show in the paragraphs on surface washing, page 75, cultivation may be so managed that there are few commercial apple orchards in New York in which cultivation need be prevented by soil erosion. It is probable that clover or some other legume might be substituted advantageously for the blue grass and orchard grass of the Hitchings method where sod is desired to keep water from wearing the land away.

2d. *Land covered with rocks, whether steep or not, must often be kept in sod because of the impossibility of tilling.*—There are not a few such orchards in New York.

3d. *The Hitchings method is best suited to soils having considerable depth.*—It is adapted only to soils in which grass roots and tree root do not come in too intimate contact and too direct competition for food and moisture. The commercial apple orchards of New York are at present on lands the top soil of which averages less than a foot in depth. On these shallow soils the Hitchings method will prove a failure.

4th. *Soils must be retentive of moisture.*—To sustain trees at their best under the Hitchings method, soils must not only be deep but must be very retentive of moisture, or have the water table compar-
atively close to the root run of the trees, or, as in the case of the orchards under discussion, must be fed by seepage from higher ground nearby. On land that suffers from summer drouths, this sod-mulch treatment will almost certainly prove less beneficial to trees than tillage.

5th. Economic conditions may decide the choice between tillage and some mulching treatment.—The cost of caring for a sodded orchard is materially less, under this mode of mulching at least, than by tillage. If, then, a man chooses to grow apples extensively rather than intensively he may make larger acreage in sod counterbalance greater production under tillage thereby bringing the cost of production to the same level.

THE LESSON OF THE HITCHINGS ORCHARD.

We end as we began, by saying the Hitchings orchard is unique. The chief lesson it teaches is that a man may break away from the common practice, when circumstances render such practices difficult or impossible, and yet attain a high degree of success. The method of orcharding which takes its name from the Hitchings orchard is not as valuable to the fruit-growers of New York as is the demonstration by Mr. Hitchings that new paths to success may be blazed — new practices devised to meet new conditions, old obstacles overcome in new ways. It is a splendid and successful example of resourceful pioneering and of persistent endeavor to attain the highest success. The pith and the point of the work in this orchard, so different from other orchards in the State, is that fruit-growing is intensely individual. The prime factor is the man.

But from the success of Mr. Hitchings the apple-grower must not be led away from the general truth, that the individual problem can be solved most often by the rational application of the laws of nutrition and growth which plants generally follow. Applied to the problem of growing apples in New York, the general law is, that the apple, like other orchard, field and garden plants, responds to cultivation.