

POPULAR EDITION.

BULLETIN No. 383.

APRIL, 1914.

---

# New York Agricultural Experiment Station.

GENEVA, N. Y.



TILLAGE.

SOD MULCH.

## HOW SOD AFFECTED AN APPLE ORCHARD. II.

---

SUMMARIZED BY  
F. H. HALL  
FROM BULLETIN BY  
U. P. HEDRICK.

---

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE.

## BOARD OF CONTROL.

GOVERNOR MARTIN H. GLYNN, Albany.  
COMMISSIONER CALVIN J. HUSON, Albany.  
THOMAS B. WILSON, Hall.  
BURT E. SMALLEY, Interlaken.  
G. HYDE CLARKE, Cooperstown.  
HENRY C. HARPENDING, Dundee.  
EUGENE M. ANDREWS, Union.  
C. WILLARD RICE, Geneva.  
ADRIAN TUTTLE, Watkins.

## OFFICERS OF THE BOARD.

BURT E. SMALLEY, *President*  
WILLIAM O'HANLON, *Secretary and Treasurer.*

## STATION STAFF.

WHITMAN H. JORDAN, Sc.D., LL.D., *Director.*  
GEORGE W. CHURCHILL, *Agriculturist and Superintendent of Labor.*  
GEORGE A. SMITH, *Dairy Expert.*  
FRANK H. HALL, B.S., *Vice-Director; Editor and Librarian.*  
JOSEPH F. BARKER, M.S., *Agronomist.*  
RICHARD F. KEELER, A.B., *Assistant Chemist (Soils).*  
PERCIVAL J. PARROTT, M.A., *Entomologist.*  
REGINALD C. COLLISON, M.S., *Assistant Chemist (Soils and Horticulture).*  
HUGH GLASGOW, Ph.D.,  
§FRED Z. HARTZELL, M.A., *Associate Entomologists.*  
WILLIAM P. WHEELER, *First Assistant (Animal Industry).*  
HAROLD E. HODGEISS, B.S.,  
BENTLEY B. FULTON, B.A., *Assistant Entomologists.*  
ROBERT S. BREED, Ph.D., *Bacteriologist.*  
ULYSSES P. HEDRICK, Sc.D., *Horticulturist.*  
HAROLD J. CONN, Ph.D., *Associate Bacteriologist.*  
ROY D. ANTHONY, M.S.A.,  
§FRED E. GLADWIN, B.S., *Associate Horticulturists.*  
GODFREY L. A. RUEHLE, M.S.,  
JAMES D. BREW, B.S., *Assistant Bacteriologists.*  
GEORGE H. HOWE, B.S.A.,  
CHARLES B. TUBERGEN, B.S.,  
JOSEPH W. WELLINGTON, B.S., *Assistant Horticulturists.*  
FRED C. STEWART, M.S., *Botanist.*  
WALTER O. GLOYER, A.M.,  
\*\*FOREST M. BLODGETT, B.S.A., *Associate Botanists.*  
ORRIN M. TAYLOR, *Foreman in Horticulture.*  
MANCEL T. MUNN, B.S., *Assistant Botanist.*  
†F. ATWOOD SIRRINE, M.S., *Special Agent.*  
LUCIUS L. VAN SLYKE, Ph.D., *Chemist.*  
JESSIE A. SPERRY, *Director's Secretary.*  
ALFRED W. BOSWORTH, A.M.,  
FRANK E. NEWTON,  
RUDOLPH J. ANDERSON, B.S., *Associate Chemists.*  
WILLARD F. PATCHIN,  
ARTHUR W. CLARK, B.S.,  
LENA G. CURTIS,  
MORGAN P. SWEENEY, A.M.,  
AGNES E. RYAN,  
OTTO McCREARY, B.S.,  
ESTHER F. HAWKINS, *Clerks and Stenographers.*  
ALFRED K. BURKE, B.S.,  
ADIN H. HORTON, *Computer and Mailing Clerk.*  
CLARENCE D. PARKER, A.B., *Assistant Chemists.*

Address all correspondence, not to individual members of the staff, but to the NEW YORK AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.

The Bulletins published by the Station will be sent free to any farmer applying for them.

† Riverhead N. Y. § Connected with Grape Culture Investigations. \*\* Connected with Hop Culture Investigations; absent on leave.

POPULAR EDITION \*

OF

BULLETIN No. 383.

HOW SOD AFFECTED AN APPLE ORCHARD. II.

F. H. HALL.

**Tillage  
superior to  
sod mulch.**

Five years ago a bulletin of this Station, No. 314, announced that in the Auchter orchard, typical of the great majority of commercial apple orchards of western New York, the tillage-and-cover-crop system of soil management was, in practically every way, superior to the sod-mulch system. Five additional crops have confirmed this conclusion and strengthened the belief that grass roots above apple-tree roots are detrimental to the health of the trees and a menace to good crops.

Under exceptional circumstances, as in the Hitchings orchards, discussed in Bulletin No. 375, deep soils well supplied with moisture may grow both apples and grass successfully and to the financial advantage of the orchardist; but such conditions are so uncommon in commercial orcharding in the great New York apple-belt that the only safe practice is to adopt the tillage-and-cover-crop system unless careful study of all factors has proved sod-mulch better for the particular combination of topographical, soil, labor and market conditions in individual orchards.

**Auchter  
orchard and  
its management.**

The Auchter orchard, in which the experiment here reported was located, is near Rochester, in the heart of the "apple belt" and was chosen because it was uniform in soil and topography and quite typical of the apple orchards of western New York. The land is slightly rolling and is a fertile Dunkirk loam, about ten inches deep, underlaid by a sandy subsoil. The orchard includes nine and one-half acres, set to Baldwin apple trees, 40 feet apart each way, which were 27 years old when the experiment began in 1903. About 120 trees were included in each half of the experiment. On the sections devoted to tillage the land was plowed each spring and cultivated from four to seven times, after which

---

\* This is a brief review of Bulletin No. 383 of this Station on A Comparison of Tillage and Sod Mulch in an Apple Orchard, by U. P. Hedrick. Anyone interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete bulletin, so long as these are available.

Names of those who so request will be placed on the Station mailing list to receive future bulletins, popular or complete as desired.

a cover crop was sown, usually during the last week in July. During all but the last year of the past five-year period the cover crop has been medium or mammoth red clover, but in 1913 oats were sown. On the sod-mulch plats the orchard grass and blue grass were cut once, sometimes twice, and the crop allowed to lie where it fell. In all other respects except the application of fertilizers in certain sub-sections, the treatment of the plats has been alike and such as prevails in the best commercial orchards.

**Experimental  
conditions  
and results.**

During the first five years of the experiment the orchard was divided into east and west halves for the cultural operations and during the last five years into north and south halves. In this way, at the close of the ten years the northeast quarter of the orchard has been tilled ten years, the northwest quarter in sod five years and then tilled five years, the southwest quarter in sod ten years and the southeast quarter cultivated five years and then in sod five years. About one-half of the area in sod during the last half of the test — a section through the middle of the area — received annual applications of nitrate of soda in an effort to overcome the unfavorable influence of the grass.

In considering results, of course yield comes first, since orcharding is a commercial proposition and upon the amount of fruit harvested must largely depend the income; but in comparing systems where production cost differs as greatly as in sod-mulch and tillage methods of soil management, it is essential to associate these costs with the yields.

The average yield on the plat left in sod for ten years was 69.16 barrels per acre, on the plat tilled for ten years 116.8 barrels, a difference in favor of the tilled plat of 47.64 barrels per acre. These apples were sold at varying prices but averaged \$2.60 for barreled stock and 72 cents for evaporator and cider stock, from which sales there was secured an average annual return of \$126.04 per acre for the apples grown on sod and of \$224.15 from those under tillage. The average acre-cost of growing the apples on sod was \$51.73 and under tillage \$83.48. Subtracting these figures from the gross return we have a "balance" per acre for the sodded plats of \$74.31 and for the tilled plats of \$140.67, an increase in favor of tillage of \$66.36. For every dollar taken from the sodded trees, after deducting growing and harvesting expenses, the tilled trees gave one dollar and eighty-nine cents.

In general quality, also, the fruit from the trees under tillage was much better, being crisper, juicier and of better flavor; and it kept from two to four weeks longer than the fruit from trees in sod. In color, however, the apples grown on sod were superior to those from tilled trees, and they matured from one to three weeks earlier.

The difference in the effect of the two systems on the trees was

almost as great as on the fruit. The trees in sod gained 2.4 inches in tree diameter, taking the average of the measurements, while those under tillage gained an inch and a half more than this, or 3.9 inches. This difference extended in a similar ratio to gain in height and spread of branches; and the foliage of the tilled trees was so much more abundant, and of such dark, rich, green color, that the line between the two plats could be recognized more than half a mile away.

Closer view showed more plainly the sparseness of foliage, irregularity of branches, presence of dead branches and lack of plump, healthy, bright-colored new wood on the trees grown in sod. The trees under tillage, on the other hand, were very uniform in development, with new growth and fruit well and evenly distributed, and notable for their vigor and health.

At the close of the first five years one quarter of the orchard was changed from sod to tillage and another quarter from tillage to sod. In each case the effect of the change was almost instantaneous. Before midsummer the trees released from the influence of the sod showed plainly the benefit of the added moisture and available plant food furnished them by tillage. Both trees and foliage improved notably, and the apples on them grew as large as any in the orchard. The number setting was, however, influenced by the previous poor conditions so that the first year's crop was below normal; but the average for the entire five years was as great as that of the trees continuously under tillage. The change for the worse was quite as remarkable and as immediate in the section of the orchard turned from tillage to sod; for the average yield per tree on this section during the first year was less than three-quarters of a barrel, while even the trees continuously in sod yielded twice this amount.

The use of nitrate of soda on the sod helped matters somewhat, and was a paying investment, yet for the whole five years the trees in sod thus fertilized yielded less than half as much as the tilled trees without any fertilizer.

Since the trees under tillage have borne heavy crops annually for ten years, without any addition to the soil except the seed of the cover crops used, it might be supposed that the soil would show the draft. Careful analyses made at the close of the test prove that this is not the case. The mineral elements of fertility are practically alike throughout the plats, and the nitrogen and humus are much greater on the tilled plats. Though analyses were not made at the start it is not probable that material differences then existed, for the soil is apparently quite uniform, and previous treatment had been the same for years. It is fair to conclude that the tillage and cover-crop treatment conserves nitrogen and humus

**Change of conditions.**

**Does tillage exhaust the soil?**

better than the sod-mulch treatment, while it also gives much larger crops.

**Why is grass harmful?** Grass in an apple orchard is evidently a detriment, and it acts against the best interests of the trees in several ways. These ways have been so fully discussed in Bulletin No. 314 that it

is only necessary to state them here.

(1) The growing grass lowers the water supply, since every plant uses and evaporates many score of times its own weight of water. Under rare conditions this reduction of the water content of the soil might be an advantage to the trees, but in ordinary seasons, on soils neither very deep nor specially retentive of moisture, as in most New York orchards, the trees need all the rain that falls during the growing season, and the draft of the grass roots on the supply of water left near the surface by showers is robbery that affects both the crop of apples and the trees that bear them.

(2) With the water there goes into the grass a certain amount of plant food, which will become available to the tree roots only after a considerable time and some of it probably never. The use of fertilizers in certain portions of the Auchter orchard proved this factor of plant food of less consequence than that of water; yet the trees in sod responded promptly and profitably to applications of nitrate of soda. Trees under tillage, on the other hand, seemed to have enough and to spare of nitrogen, as well as all the other food elements they needed.

(4) The growth of grass on a soil reduces its temperature. Whether this is a serious disadvantage we cannot say, but most New York apple soils are comparatively cold; so it would seem reasonable to suppose any additional cooling influence harmful, as heat causes the food substances in the soil to dissolve more rapidly, hastens their diffusion through the soil water, aids soil ventilation, stimulates the absorptive action of the roots, and helps to form nitrates in the soil. Thermometer readings made over a considerable period showed that the tilled soil in June and July is more than a degree warmer than the sodded soil in the morning and more than two degrees warmer at night.

(5) The supply of air is less in a sodded soil than in a tilled soil; and good soil ventilation is essential not only to the life of the plant itself, but also to the activity of the bacteria which make certain forms of plant food available.

(6) Sod affects deleteriously the beneficial micro-organisms in the soil. The experiment given supplies no definite data to support this statement; but the lowering of the humus content of the soil, restriction of the air supply, cooler temperature and smaller moisture content of the soil under the sod are all factors unfavorable to the development of those bacteria whose action in the soil we know to be beneficial to plants.

(7) Sod may "poison" apple trees. This conclusion has been reached by very careful investigators in England, who assign to this factor, principally, the evil effects which they have found to follow attempts to grow apple trees in sod land. The sudden changes from good to ill results when trees in the Aucter orchard were changed from tillage to sod, and from ill to good when changed from sod to tillage, lend some support to this theory that the grass roots excrete some substance harmful to apple trees; but the other factors previously mentioned, particularly the lowering of the water content of the soil, seem quite sufficient to account for the evil influence of sod without laying much stress upon its excretion of an actual "poison."

**Deductions  
from these  
tests.**

It is hardly necessary to repeat again, or to emphasize the main conclusion from this ten-year test, that tillage and cover crops rather than sod-mulch should be generally adopted by commercial orchardists in New York State.

But some other statements may be made regarding the application of this experiment in other directions.

In orchards on deep soils the sod-mulch method is less of a detriment than on shallow soils. In the deep soil the tree roots have some chance to escape the drought-producing influence of the grass roots. Under some conditions, as where moisture is over abundant and apple trees make too luxuriant growth, sod may occasionally be used with benefit to check growth and promote fruitfulness. There is, however, nothing in the experiment to indicate that on ordinary soils the grass roots and tree roots ever establish amicable relations; for the difference between the tilled and sodded plats was greater at the end of ten years than during the first half of the test. That is, apples do not become adapted to grass. The injurious effects of the grass on apple trees occur, no matter what the variety or age of the tree or other cultural treatment; and are even more liable to be shown by dwarfs than by standard trees because of the shallow root systems of the trees on dwarf stocks. Pasturing orchards in sod may reduce the injury from the grass just to the extent that the pasturing reduces the growth of the grass; but it can never wholly overcome the evil. The owners of sod orchards may not realize how their trees are weakened and their crops lessened by the growth of the grass, since they have no tilled trees under the same conditions to compare with them; but a trained observer can usually detect, even from a distance, signs of poor health and diminished vitality in the light color of the foliage.

The sod-mulch system is bad enough; but grass grown in the orchard, not for a mulch, is all but fatal — it makes the trees sterile and paralyzes their growth. It is the chief cause of unprofitable orchards in New York State.