

# WINTER-KILLING OF PEACH TREES.

REPORT OF INVESTIGATIONS IN THE LAKE ERIE FRUIT BELT.

## OHIO Agricultural Experiment Station.

WOOSTER, OHIO, U. S. A., DECEMBER, 1904,

BULLETIN 157,



*Photo by Houser*

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<sup>1</sup>In cooperation with the College of Agriculture, Ohio State University, Columbus.

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# BULLETIN

OF THE

## Ohio Agricultural Experiment Station

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No. 157.

DECEMBER, 1904.

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### WINTER-KILLING OF PEACH TREES.

#### REPORT OF INVESTIGATIONS IN THE LAKE ERIE FRUIT BELT.

BY W. J. GREEN AND F. H. BALLOU.

The great loss sustained by the peach growers of the Lake Erie peach belt and especially those of Catawba Island and the peninsula of eastern Ottawa county, through injury done to the trees by the severe winter of 1903-4, is almost beyond calculation. The situation is truly alarming to those orchardists who, during the past season, instead of harvesting the usual great crops of peaches, have helplessly beheld their orchards wither and die. Not only is the loss of the season just past working a hardship upon those who depend upon their fruits for their annual income, but the fact that in some cases small farms are left barren of trees, that the promise of revenue is absolutely cut off for several seasons, or until new orchards may be planted and brought into profitable bearing, makes the loss a very serious matter, and one that is truly discouraging. More than one orchardist striving, upon a small area of ground, to pay for his home, finds himself facing the problem of meeting relentless expenses with the source of income gone and no cash available with which to purchase trees for replacing those that perished. Especially are such conditions found on Catawba Island where farms, as a rule, are small and the injury by the winter most severe.

Upon the Peninsula the situation, though serious in many places, is not so generally discouraging. Many orchards are apparently uninjured, healthy and promising for a long life of fruit-

fulness. Others have suffered severely yet contain blocks, rows, sections of rows or single trees, here and there, that passed the trying winter unharmed. With these conditions prevailing, the great problem of the day, among peach growers of northern Ohio is—"How may the eccentricities of the cold of the winter of 1903-4 be explained? By what process of reasoning may we account for the fact that one orchard should be totally destroyed and a neighboring or adjoining one, upon a supposed similar soil and location and receiving practically the same care, be left unharmed? How may the perplexing condition of things be intelligently interpreted that a recurrence of such blighting and widespread injury may, in the future, be avoided?"

Among the growers themselves theories are many and conflicting. The apparent cause of injury in one orchard by no means holds good in a neighboring orchard. The theory of imperfect drainage in one orchard, as the cause of the trees dying, receives direct refutation in an area nearby, where trees standing in spots well known to be imperfectly drained came through the winter not only alive but vigorous. Again, trees on certain elevated locations came through the winter safely and "perfect drainage" was thought to be the secret of their good fortune. Nearby, however, would be a block, row or section of a row of trees, occupying the highest, most perfectly drained ground in the orchard—all dead!

Where blocks, rows or single trees of different varieties stood side by side, one variety being destroyed and another left uninjured, the problem was a simple one—a mere question of different degrees of hardiness of different varieties. But where, as in many cases, the trees of the same variety varied so greatly in their individual susceptibility or resistance to the cold, the problem became a decidedly complex one—one that has not yet received a *popular* solution and, the chances are, never will. After an entire season's study of and reflection upon the situation a multitude of conflicting opinions and conclusions leave the orchardists in confusion. Only upon one point do a number of conservative peach growers seem to agree, and it must be admitted that it is one that appeals most forcibly to an outside, unprejudiced student of the matter, viz., that *trees and orchards of low vitality, generally speaking, suffered most severely.*

While it was hardly hoped that anything substantially helpful could be suggested or done by the Experiment Station, after such a thorough study of the question by the orchardists themselves, many of whom are keen, intelligent horticulturists, it was deemed

wise that the great peach injury of the past winter should be carefully studied by representatives of the horticultural department of the Station. In accordance with this decision, the Station horticulturist and his assistants visited many orchards, both injured and uninjured on Catawba Island and the Peninsula. As a result of these investigations the impression prevails that, aside from the evident truth that the *general or direct* cause of the injury was the intense and prolonged cold and deep and hard freezing, accompanied, perhaps, by peculiar conditions not fully understood, the *specific* causes of various phases and degrees of injury in different orchards were almost as various as the orchards themselves. As before intimated, in a *general* way and from an impartial study of the situation it seems safe to conclude that if, from any cause whatsoever, the vitality of a tree or orchard had been lowered during the previous year or years, by that cause and in proportion to the injury sustained were the chances of surviving the trying conditions of the winter lessened.

Chief among the various causes of low or declining vitality, as existing or seeming to have existed at different places in the region in which observations have been made are, first, exhausted, partially exhausted, or an insufficient degree of fertility; second, a low physical condition of the soil, due to the absence of vegetable matter or fiber; third, the prevalence of San Jose scale which, in some sections of the area visited, has killed many thousands of trees and left other thousands, upon which this pernicious enemy has been more or less successfully combated, in so weakened a condition as to be an easy mark for a trying winter; fourth, the leaf curl which, by practically defoliating the orchards, in many places, had been a standing menace to the life of such orchards, and which had left great areas of orchards in so debilitated a condition that recovery had been slow and in many cases incomplete; fifth, the work of the peach tree borer which, it is safe to say, was in many cases responsible for the winter injury or killing of individual trees here and there throughout some orchards; sixth, the extremely dry condition of the ground which, upon many light or gravelly ridges or elevations, contained practically no moisture when the continued cold, freezing weather of winter arrived, thus cutting off the supply which under normal conditions is continually taken up by the root system and circulated throughout the stem and branches of the tree even in freezing weather; seventh, the opposite extreme of a wet or "water-logged" soil, in which peach trees cannot and should not be expected to survive many years.

With the kindest feeling and deepest sympathy for the peach growers of Catawba Island, who have sustained seemingly almost irreparable losses from the winter-killing of their orchards, it must be admitted that, in many instances, the orchards do not show the earmarks of the painstaking labor and care that one observes more generally on the greater Peninsula, and which one would naturally expect to see bestowed by a class of orchardists whose fruits, for a third of a century or more, have been a source of wealth and the means of gaining for the little island a most enviable and far-reaching reputation.

Through location and rare climatic conditions the owners of land on the Island have been providentially favored in the production of choice fruits. For a quarter of a century great areas of vineyards yielded thousands of tons of grapes. All these years, under the stimulus of success, these same areas of land received clean, annual and (may we not truthfully add) *merciless* cultivation. The natural fertility of the soil was gradually reduced by enormous crops of fruit and its physical condition lowered year by year, without the restoration of any considerable amount of plant food or vegetable matter. After the lapse of many years, from various troubles and diseases, the vigor and fruitfulness of the vineyards waned and the industry began to languish. Hundreds of acres of vines were pulled out and the land immediately and without improvement set to peach trees which, for another long term of years, and under the usual relentless culture without the addition of humus in any form, thrived and produced numerous, heavy crops of fruit. Again, as the remaining store of fertility became further depleted by the searching root systems of adult peach trees, enemies began to appear and make their presence felt. San Jose scale and leaf curl fell upon the Island as a scourge and came near writing the final chapter in the history of successful peach culture there. With destruction of great areas of orchards by the scale and the injury of thousands upon thousands of trees, upon which the scale was not quite successfully combatted, it is only natural that great discouragement and depression should overtake the orchardists, so long accustomed to bountiful rewards for labor performed under such favorable conditions.

It is just possible, too, that conditions, so extremely favorable to the best results in orcharding, were the cause of a gradual relaxation in painstaking care on the part of a few land owners. Maximum returns for a minimum of labor might naturally cause this laxity of endeavor. However that may be, the fact is apparent—

the situation on Catawba Island is deplorable, with but few exceptions. Disease and the scale scourge, climaxed by the winter's icy grasp, has left orchard after orchard in solid blocks of dead or dying trees. A great percentage of both old and young trees surviving the cold are in a discouraging condition for renewal. The bodies and branches are in many cases diseased, rough, burst by the cold and unsightly from masses of gummy exudations.

Just how far a possible failure to follow out best known and most thorough modern methods and practices in tillage, fertilizing, pruning and spraying is responsible for the present sad state of affairs on the Island no one can or cares to venture to say. True it is that a few of the most enthusiastic and up to date peach growers of this section, whose orchards are models of modern cultural ideas, have lost trees by the cold; but these have, as a rule, fared very much better than their careless neighbors. However, no matter how thoroughly and cleanly these orchards have been cultivated in the past, such culture may be a conscientious adherence and continuation of the practices of past generations, which tilled scrupulously but not consistently, and failed to realize the importance and real necessity of returning to the soil something that would restore the fertility and humus lost through continued culture and cropping.

Indeed the matter of Catawba Island's great catastrophe seems naturally to resolve itself into this momentous question: Have not the ultra important issues of the maintenance of fertility and the perpetuation of a good physical condition of the soil of the Island, as a whole, been so little taken into consideration *as almost to invite, at some critical period, just such a disaster as has occurred?*

Indeed, to the physical condition of the soil alone may very reasonably be attributed a greater or lesser degree of severity and depth of freezing. It is easy to understand this—why an exhausted soil, a cold, lifeless mass of particles lying compactly together without the insulation of intervening vegetable fiber, will freeze more quickly and much harder and deeper than a composition abounding in decaying vegetable matter.

In no instance was observed any injury from the winter where the previous season's clean cultivation had been followed by an application of even a light mulching of barnyard manure or other material.

Upon the farm of Mr. Hadden, of Catawba Island, was found a striking illustration of the value of annual cover crops, in comparison with an adjoining area that has been under continual, clean annual cultivation. Eighteen years ago was planted this orchard,

which is divided into two sections by the orchard driveway. For ten years the entire orchard was given clean cultivation throughout the growing seasons. At the end of this period the section lying south of the driveway was cultivated during the early part of the season and then sown to Crimson clover which was plowed down the following season when the seed-heads were sufficiently developed or matured to again effectually seed the ground for a succeeding season's cover crop. For eight years now, this treatment has been given the south part of the orchard, each season plowing down the clover, which produced luxuriant plants, while the other half of the orchard, just across the drive, has been receiving clean annual cultivation. Now, at the age of eighteen years, the difference between the two sections is very marked. Upon the clean culture area there was a much greater percentage of injury from the cold of the winter than upon the Crimson clover section. Where the clover crops had been grown and plowed down the trees showed remarkably healthy, heavy, dark green foliage, contrasting sharply with the yellowish, sickly foliage of the clean culture plot on the opposite side of the driveway.

Digressing for a moment from the winter injury discussion, we wish to mention another very striking feature of peach orchard culture. At the south-west corner of Mr. Hadden's orchard is a considerable area covered with his first plantation of peach trees, all of which are dead and gone, being killed by a disease attacking the orchard from that quarter and spreading in all directions. The soil of that part of the orchard is light and gravelly, and presumably very low in fertility and content of vegetable matter, having been cultivated year after year since the original planting was made. Here, with a notable exception which will be mentioned directly, Mr. Hadden has been trying in vain to get a stand of peach trees for some time. He cannot, however, get the trees beyond the age of two years, when they sicken and die from a disease that still abounds and continues to spread—the young shoots growing slender and weakly and the leaves narrow, "wiry" and yellow with curled, brown margins—very like "*yellows*" indeed! The remarkable exception to this discouraging condition of things, and a striking example of some strange and favorable force at work in the midst of disaster, is found in a shallow, broad bottomed ravine coursing irregularly through this part of the orchard. In the cultivation of the orchard the broad bottom of this winding ravine has not and could not have been broken because of the desperately stony surface presented. So stony is it that no plowshare can gain



an entrance, and the plow has to be dragged over the rocky surface until the gravelly, more tillable soil at either boundary is reached. As a result the bluegrass has matted the ravine, seeming to flourish as it gained possession of crevices between the stones. In this "blue grass bottom" of the ravine, also slightly mulched with coarse material, such as mown weeds, etc., every peach tree planted is growing clean, dark-foliaged, vigorous and promising. The contrast is so strongly and clearly marked as to be wonderful as viewed from a slight elevation nearby.

Near Marblehead, near the eastern extremity of the Peninsula, practically the same conditions exist as at Catawba Island. Many orchards are entirely dead and others are desperately injured. Here, too, the scale has done its part well in the devitalization of hundreds of thousands of peach trees, which the cold of winter finished. This part of the Peninsula is quite elevated and is practically a great limestone bluff, covered over with a few inches of soil. In places, indeed, the limestone comes to the surface. Cultivation on this rocky ground is out of the question, and the trees are planted, in not a few cases, only by making excavations by the aid of a crow-bar and dynamite. Soil is hauled and the excavations filled as the trees are planted.

Necessarily "sod culture" is forced upon the peach growers of this section, and happy are those and fortunate, who, by indolence and negligence, do not bring reproach upon this much discussed and increasingly popular method of growing fine fruit.

At the well known farm formerly owned by Duroy & Yule, now by Duroy alone, was found a thirteen-year-old orchard of six hundred and sixty trees, standing on a very shallow, limestone soil covered with a very dense, heavy, velvety carpeting of bluegrass. A photograph of a corner of this orchard is shown in Fig. 1. While San Jose scale, as before stated, abounds and has wrought havoc in this neighborhood, it has been controlled in Duroy's orchard by careful spraying, partially at least, under the direction of the Experiment Station, and not a tree in the whole block is dead or injured from the effects of the cold.

Just across the road from the Duroy orchard is another, growing under practically the same conditions, but owned by another party. Upon this, however, the scale had not been controlled. The story is told in two words—entirely dead. While this orchard, too, is in sod, it had not been nearly so neatly kept—the weeds remaining uncut making it unsightly.

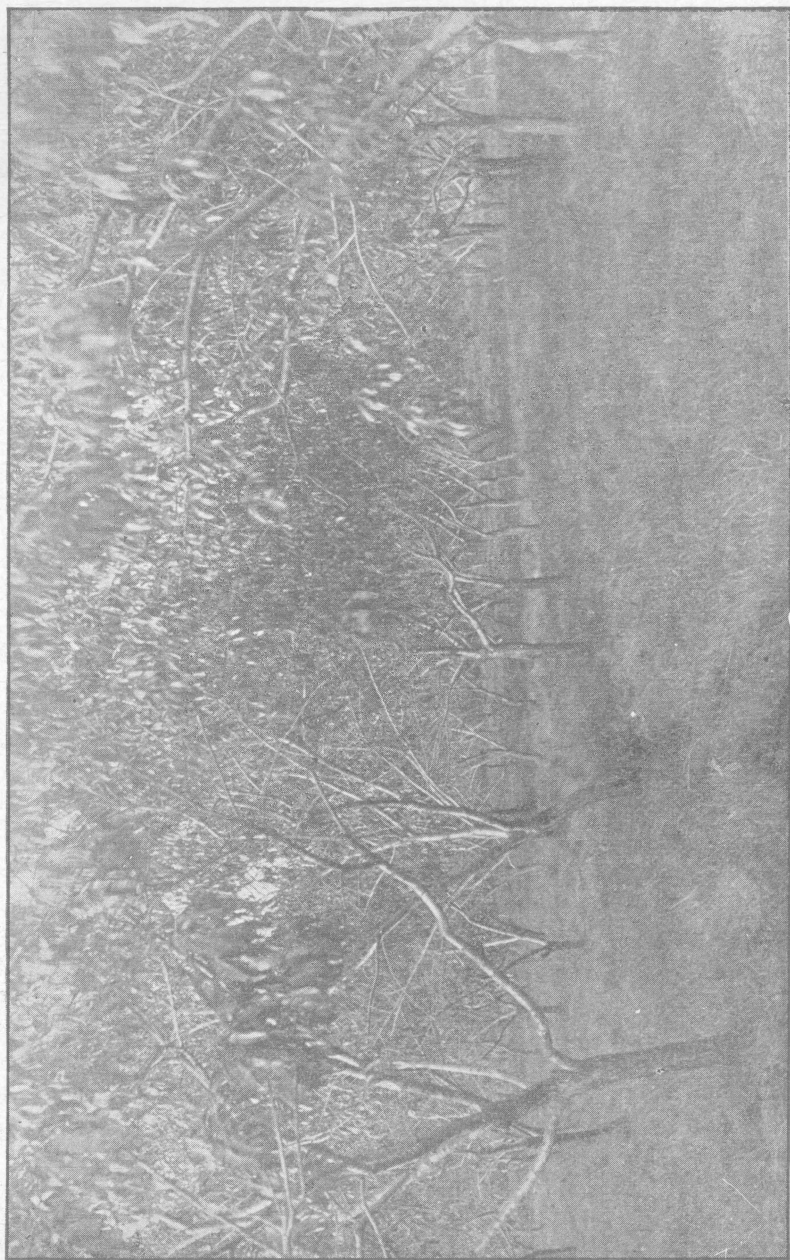


FIG. 1. A velvety carpeting of blue-grass. Orchard of Mr. Duroy, near Marblehead.



*Photo by Ballou*

FIG. 2. Where San Jose scale and leaf curl were successfully combatted in 1902 and 1903. Orchard of Mr. Allen Kelly, Gypsum, O.



*Photo by Ballou*

Where the spraying of 1902 was omitted. Orchard of Mr. Allen Kelly, Gypsum, Ohio.

While driving from Gypsum to Port Clinton, farther west on the Peninsula, we observed an orchard in which three men were just finishing, with a traction engine, the pulling out of a section of dead peach trees that had previously been "topped" with an ax. The dead area comprised three rows of trees running directly through the middle of the orchard. Upon either side of these three rows, every tree of which was either dead or seriously injured by the cold of last winter, the two sections of the orchard stood sound, vigorous and healthy. Nowhere were the blocks broken by a single dead or injured tree. Here, we decided, was a clear cut illustration of some fact that might aid us in the solution of the many sided problem under consideration—providing that the apparent great difference in the resistance of the different blocks did not prove to be due to *varieties*. The owner, who proved to be Mr. Allen Kelly, was interviewed and the facts relating to the winter injury were reported as follows:

In the early spring of 1902 Mr. Kelly became aware of the presence of San Jose scale in this orchard. Being advised to spray with lime, sulphur and salt he sprayed all the trees in his orchard *with the exception of the three rows through the middle of the block, which, by an oversight, were left unsprayed*. The result was that upon these three rows not only did the scale multiply alarmingly, but the *leaf curl* practically defoliated the trees, so desperate were its ravages. In the season of 1903 *all of the trees were sprayed*, yet the rows upon which the leaf curl had not been combated the previous year were so weakened that the good care later bestowed upon them was unavailing. In Fig. 2 is shown a photograph of the edge of one of the unbroken blocks of trees—those that were sprayed both seasons, while in Fig. 3 is pictured, with but a quarter turn of the camera on its tripod, a view diagonally across the section occupied by the three rows of dead trees, which had all been pulled out when the photograph was taken. The varieties in Mr. Kelly's orchard proved to be Smock and Elberta. Both varieties suffered equally, as the three rows killed included both. The lesson learned in this orchard was a striking one, and indicative of the fact that anything that in the past had lowered the vitality of a tree was responsible for its death under trying conditions. Mr. Kelly is much interested in the study of the causes leading to the winter injury, and declared that not a single orchard or section of an orchard of which he knew, that had received even a light dressing of barnyard manure within the last year or two, had suffered noticeably from cold. He is more than ever satisfied

that he can profitably combine cattle feeding and peach growing, even though he be obliged to buy both cattle and feed—simply for the barnyard manure thus obtainable.

The orchard of Mr. Thomas Gill of near Port Clinton, was totally dead and being cut down when our visit was made. The dead brush, as it was being piled for burning, showed a serious prevalence of scale amounting on many trees, to an actual incrustation.

The orchard of Mr. Geo. Sloane, south of Port Clinton, was found very seriously injured by freezing—the injury being distributed heavily throughout the entire area. Mr. Sloane has been in ill health for some time and his orchards have suffered for want



*Photo by Ballou*

FIG. 4. The difference in hardiness of different varieties. Lady Ingolds on the left, Elbertas on the right. Orchard of Mr. William Miller, Gypsum, O.

of his personal attention to details of spraying. The scale was found to be preying on many trees and both foliage and fruit were, at the late date of October 12th, withering from its effect.

In the orchards of Wm. Miller, of Gypsum, there was some loss from winter killing, but it was slight when compared with numerous neighboring orchards. His most serious loss was sustained on a section of loose, deep, black soil upon which it is only reasonable to suppose that the peach wood, though rank in growth, lacked the essential qualities of firmness and maturity at the arrival of the early and unprecedented winter. Small exposed sections of other

blocks of trees on Mr. Miller's farm suffered more or less from various specific causes, the most of which he could reasonably account for. Near Mr. Miller's packing house there stood a block of peach trees composed of Elbertas and Lady Ingolds. This block presented a clearcut example of the difference in the hardiness of different varieties. Of this block there is shown a photograph at Fig. 4, in which it will be seen that the Lady Ingolds have been topped for pulling. The Ingolds were all dead while not a single Elberta suffered.

Mr. Miller is becoming heartily interested in the "cover crop idea" of orchard cultivation and has successfully sown a mixture of rye and millet which, at the time of our visit, during the middle of October, had already made a fine growth. He is well pleased with the prospective outcome of the combination. He is well satisfied that there is an urgent need of returning to the soil a generous supply of fertility and vegetable matter before it becomes exhausted by cultivation and cropping.

The fruit farm of Mr. Bert Lockwood is situated south of Gypsum on the north shore of Sandusky Bay. Mr. Lockwood is pretty generally conceded by his neighbors to be one of the most careful, skillful, thorough, painstaking, hardworking and successful fruit farmers on the Peninsula. Certain it is that his orchards are almost perfect examples of the highest culture and thrift. Mr. Lockwood's peach orchards are growing almost wholly upon the vast "dump grounds" from former extensive gypsum or plaster mines. He considers his soil practically inexhaustible in fertility, so deep is it and so rich in the elements of plant food essential to the highest development of the peach tree and its fruit. Yet from its nature, his ground, which is almost wholly a mass of gypsum refuse, resembling coarse, white gravel, freezes very deeply and severely.

At Mr. Lockwood's we observed some very impressive and varied phases of winter-killing, as well as some surprising examples of a simple, easy and apparently very effective means of affording protection from the peculiar conditions of cold, such as prevailed during the winter of 1903-4. Very fortunately, Mr. Lockwood had, in the autumn of 1903, hauled barnyard manure upon a part of his home orchard. Instead of scattering it beneath the trees in the usual way, he threw or banked a very few forkfuls immediately about the stem of the tree. Using all the manure available in this way and not having enough to bank all of the orchard, he continued the work by hauling "muck" or peat, a few shovelfuls of

which were piled about the stem or "collar" of each tree. The approach of cold weather made haste necessary and finally he finished by hauling soil and banking the remainder of the trees—there being no soil in the orchard beneath or between the trees available so stony is the surface. The results from the use of these materials were uniform; and surprising as it may seem, every tree that received this simple treatment survived the winter without the least injury from cold, while the few trees and sections of rows, left here and there unbanked and serving as "checks" in the experiment, *died almost to a tree.*

This example of tree protection seems clear-cut and unmistakable. It is but stating the simple truth plainly to say that every one of the two thousand or more trees protected was, the past season, lively examples of vigor and fruitfulness, while every tree not thus protected died. An orchard of some five hundred trees, a little farther west on Mr. Lockwood's farm, which had received the same high culture and good care *with the exception of the simple banking process, was almost a total loss.* It should be said that the extreme vigor of these orchards and their rankly vigorous growth, together with the character of the ground upon which they are situated, combined to make Mr. Lockwood's trees peculiarly susceptible to injury by freezing.

As a direct result of this experience is it to be wondered at that Mr. Lockwood has become an enthusiastic "banker?"

Again, upon Mr. Lockwood's farm is a rough, steep, very stony piece of ground that simply cannot be plowed. Here we found his peach trees, which had borne a fine crop of fruit this season, vigorous and healthy and furnishing a striking illustration of the true "sod and mulch" method of growing fruit. The steep, much broken surface of this orchard was carpeted with a dense matting of bluegrass, and about the stem of each tree was a heavy mulch of coarse material, such as cornstalks, barnyard litter etc. In this block of about two hundred trees there was no injury by the winter.

At the time of our visit, the middle of October, Mr. Lockwood was harvesting his great crop of Salway peaches, a very large percentage of which were grading "Fancy."

In illustration of Mr. Lockwood's results from the banking of his trees we secured a few photographs from his orchards. The pictures almost explain themselves and tell a very interesting story. Figs. 5 and 6 represent, respectively, the banked and unbanked trees. Fig 7 shows a clearcut example of trees or a section of a row left unbanked. Every tree which did not receive its "muffler" of manure, "muck" or soil, died.



FIG. 5. Trees that were banked with manure, muck or soil. Orchard of Mr. Lockwood.

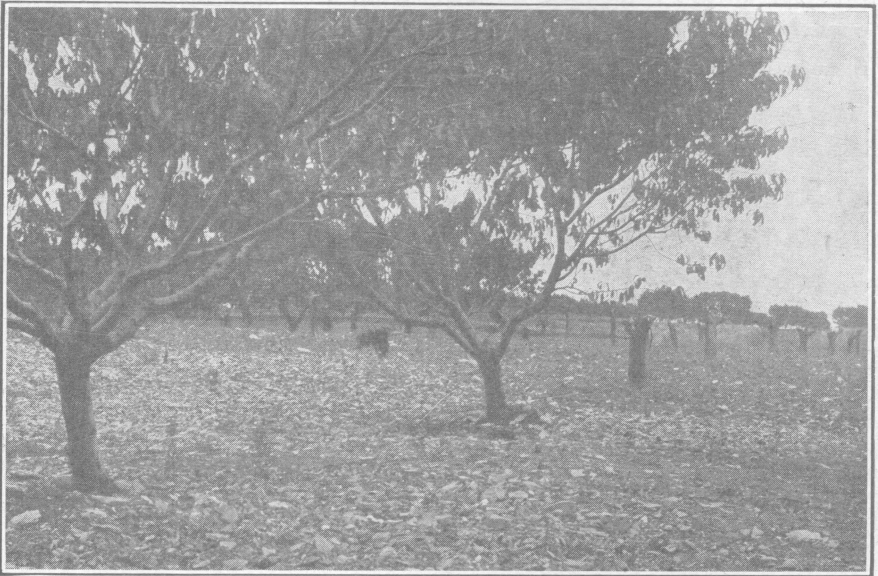




FIG. 6. Trees that were not banked. Orchard of Mr. Lockwood.

Another feature that impressed us strongly, so sharply was the contrast in evidence, was the difference in methods and practices in spraying, and a corresponding difference in results. Without reflection upon any person, it is nevertheless true that there are conscientious, energetic, and progressive adherents to thorough methods and practices, as well as careless adherents to careless practices.

In the orchards of Mr. Wm. Miller and Mr. Bert Lockwood the trunks or bodies of their trees as well as the larger branches are, as a rule, smooth, sound, free from gummy exudations and present almost an "oak-like" exterior. When their trees begin to need renewal by "heading-back" they have a substantial, vigorous found-



*Photo by Ballou*

FIG. 7. Clear-cut illustration of "banked" and "unbanked" trees. Orchard of Mr. Lockwood.

ation upon which to rear a new top. The secret is an open one, so far as these gentlemen are concerned. Their trees are sprayed thoroughly and conscientiously—not only the tops and branches, *but the bodies as well*. Indeed the trees in these orchards are completely "washed" in every spot and crevice—neither time nor material being spared to make a perfect finish. This idea is carried out to the letter, no matter whether it be the lime and sulphur spraying for scale or the later sprayings with the Bordeaux mixture for peach spot or scab.

The sentiment of these two men, and we trust others also, is voiced by Mr. Lockwood, who declares that he will get down upon his knees and walk in that position around and beneath his trees and spend ten minutes upon each tree before he will slight his work in this part of the spraying. The results justify the extra work.

It is to be feared that the sole use of the "spray spar" in certain sections of the Lake fruit belt is somewhat inclined to favor carelessness in spraying. The fact that the spar introduces the practice of driving up on one side of the row and down on the other, without pausing for care in spraying certain vital parts of the trees, is to be regretted. The trees treated in this way in many places show the need of something that they evidently have not received.

#### STATION EXPERIMENTS.

In the autumn of 1903, in order to determine the degree of protection from freezing of the ground afforded by a natural covering of sod, or an artificial covering in the form of a light mulch of straw, the following plan was pursued: A plot of peaches was selected which was in a very exposed situation, and in which the trees were uniform in size and vigor, and of the same varieties. A strip of sod some ten or twelve feet wide was removed from a row which we shall designate as row No. 1, leaving the bare surface of the soil fully exposed to the cold, while the soil of row No. 2, with which the comparison was made, remained covered with a natural growth of mixed grasses and weeds which had been clipped and allowed to lie upon the ground. Where the sod had been removed, in row No. 1, leaving no surface protection whatever, the ground froze to the depth of eighteen inches. In row No. 2, beneath the thin sod-covering of grasses and weeds, the ground froze to the depth of but eight inches. The trees in row No. 1 were very slow in starting into growth the following spring of 1904. All of the trees in this row, were seriously injured by the cold, many large branches dying, while in one case the entire tree was so badly injured that but few leaves appeared throughout the season and these upon shoots so feeble and slender that the tree might well be considered dead. Later in the season, however, some of the trees rallied slightly, though all showed a serious lack of vitality. The trees in the sod, or row No. 2, did not suffer in the least degree—all making a healthy, uniform growth during the season of 1904.

Similar results were obtained in the Station orchard where a *clean culture* plot of peach trees was compared with an adjoining plot of the same variety in which the method of culture consisted of the addition of a *light mulch* of straw or other coarse, light ma-

terial over a *thin sod of mixed grasses and weeds* which had been kept clipped and allowed to lie upon the ground. The result is clearly shown in the two photographs, Figs. 8 and 9. In the clean culture plot, where the surface of the soil is unprotected, considerable injury was done by the extreme cold, while in the lightly mulched plot, not a trace of injury could be observed—the trees presenting the highest type of vigor and health throughout the season.

#### SUMMARY.

General cause of the "*finish*" of vast areas of peach orchards in the Lake Erie fruit belt: the severe and prolonged cold of the winter of 1903-4.

General cause of *unusual susceptibility* to cold, of the orchards of said district: prevailing low vitality of the trees.

Specific causes of *low vitality* of the trees: San Jose scale, leaf curl, lack of nourishing plant food, imperfect drainage.

*Exceptional causes of susceptibility* to cold in rare cases of apparently healthy, vigorous trees: low, moist, rich black soil which favored an extreme growth of soft, poorly ripened or matured wood; or high culture upon soil rich in plant food which brought about similar results.

The unusually deep, hard freezing of the earth's crust was due, directly, to the continued, steady cold, but was intensified, in many instances, by a lack of humus or vegetable matter in the soil, which constitutes nature's insulation of the surface of the earth from cold and heat.

Providing that the orchards had been kept free from fungus disease and the San Jose scale, by timely and thorough spraying, no injury of trees was found where stable or barnyard manure had been used upon the ground within the last year or two previous to the winter of 1903-4; rarely was an injured tree found standing in sod; no injury was done where the surface of the soil, beneath the trees, had been covered with even a very light mulch; little injury was done where the trees stood in fairly well drained soil containing a moderate amount of fertility and humus; no injury was found where the trees were under the grass mulch method of culture, as were quite a number at Mr. Bert Lockwood's; no injury was observed in any case where the stems of the trees had been slightly banked or mounded with a few shovelfuls or forkfuls of soil, peat or manure.

Very few trees which, within the past few years, had been affected with leaf curl or infested with San Jose scale or borers, remained alive or uninjured; and very few trees existing upon infertile or exhausted soil, depleted of humus escaped uninjured.



FIG. 8. Winter injury in clean plot. Station orchard.



FIG. 9. Trees in the mulched plot. Station orchard.