Bulletin 170 November, 1910

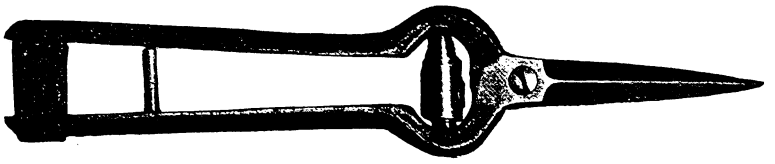
The Agricultural Experiment Station

OF THE

Colorado Agricultural College

# THINNING THE WINESAP

## Winter and Frost Injuries of Fruit Trees



BY

R. S. HERRICK

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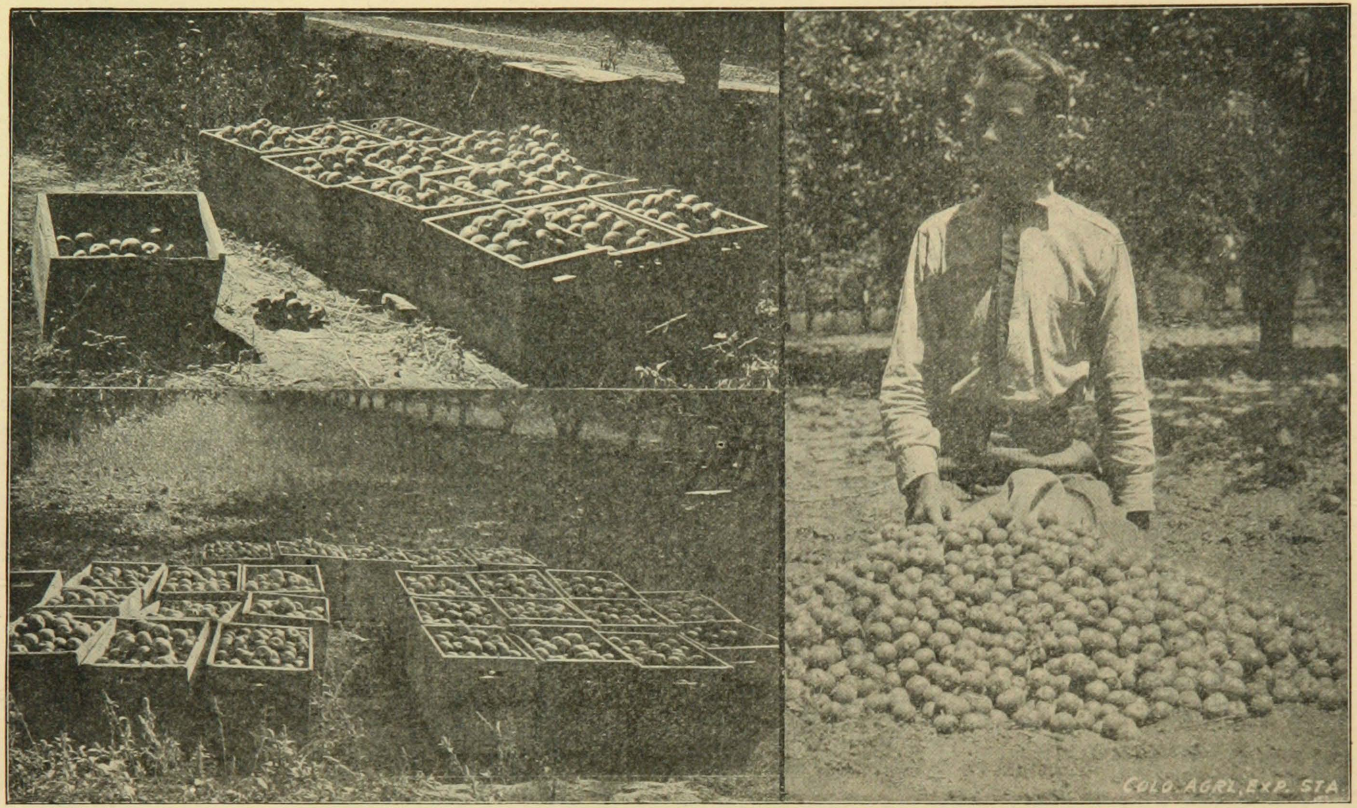


Fig. 1. (a) Apples from thinned tree No. 6. Note small pile of culls.
(b) Apples from unthinned tree No. 1. Five boxes of culls in rear.
(c) Apples thinned off tree No. 6.

# THINNING OF THE WINESAP

*By* R. S. HERRICK

The Winesap apple, as a rule, does not attain sufficient size to meet the requirements for packing in the higher grades. This is especially true of heavily loaded old trees. It is not a "shy" bearer, but has a tendency to bear a heavy crop every year.

At a meeting of the representatives of the leading fruit growers' associations of the State, held at Grand Junction in February, 1910, rules were made and adopted for the grading of apples, which were as follows: "That the grade names be designated as 'Extra Fancy,' 'Extra Choice,' and 'Standard.' That the Extra Fancy grade is to include perfect apples, free from all blemishes, not less than 2½ inches in diameter for all varieties and of normal color, and layered throughout the box. That the Extra Choice is to include apples of not less than 2¼ inches in diameter and containing no worm holes and layered throughout the box. That the Standard grade be left to the discretion of the respective shippers." The Standard grade as packed by one of the leading fruit growers' associations of the State is as follows: "Pack in this grade all apples lacking in color or shape and pack nothing less than 2¼ inches in any variety. One small worm hole in side or end is allowed, but no more. If a worm hole is surrounded by a large discoloration, cull the apple. Leaf-rubbed or limb-scarred fruit, or fruit having two or three worm-stings is admissible."

It will be seen from the above rules that great care must be taken in the handling of the standard varieties of our apples, and in tending the orchard, to maintain a high grade of fruit. Among other things, careful attention must be given to the pruning, thinning, spraying, fertilizing, cultivating and irrigating. All of these are important factors in the management of an orchard; and, particularly with the Winesap, thinning should rank high among the requirements for best results. While every orchardist wishes to get the best possible yield for the season, at the same time it is better to have an average yield every season than a heavy crop one season and nothing the next. It is not claimed that thinning alone will attain this end, but there is no doubt that it will play an important part in doing so. If a tree will show a marked gain in value received from only one year's thinning, then it is important that the operation be continued.

In this bulletin the thinning of the Winesap will be discussed more fully than that of any other variety. A block of Winesaps and Jonathans was secured for a thinning experiment, in Mr. A. L. Robert's orchard at Paonia, Colorado. The Winesaps were about thirteen years old, set in rows running north and south, with the

trees 16 by 32 feet apart. The Winesaps in the rows alternated with fillers mostly of Missouri Pippins and Wagners and a few Jonathan apple and Elberta peach trees. This orchard has a very good soil for fruit trees and the Winesaps are of good size for their age.

## TIME OF THINNING.

Ten trees were selected that had from a fair to a very heavy load of apples which were about three-quarters of an inch in diameter. Six of these trees were thinned on June 16th, 17th and 20th. This was done just as soon after the "June drop" as it was possible to tell what fruit would stick. The earlier in the season after the "June drop" that thinning of the Winesap can be done, the better it will be for the tree and remaining apples.

The mid-summer thinning was done on July 22nd. Only two trees were thinned, and although the per cent. of the better grades was as good as from the June thinned trees, it might not have held good if more trees had been thinned at that time. The extra amount of plant food that is utilized by the apples which remain on an early thinned tree, after part of them have been taken off, induces a growth that could not be made by the same number of apples left on a tree after thinning late in the season. This is one of the chief reasons why thinning of apples should be done just as early as possible. There have been various attempts to thin the bloom instead of the apples, after they have set, but at present no method has been devised whereby this can be successfully done. This would be hard to do, and undesirable, where killing spring frosts are liable to occur.

THINNING WINESAP—SEASON 1910.

| Tree No. | No. Apples Thinned Off | | Windfalls Before and At Picking Time | | | | Total No. Apples Picked Per Tree | | Total No. Borne Per Tree | Thinning Distance in Inches |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | No. | Date | Before | At Picking | No. Boxes | Boxes | Apples | Apples | |
| 1 | 6–16 | 3167 | 10–7 | 93 | 18 | .5 | 20.5 | 3391 | 6669 | About 10 except in top |
| 2 | 6—16 | 2550 | 10–7 | 76 | 47 | .5 | 21.5 | 3526 | 6199 | 6 to 8 |
| 3 | 6—17 | 2150 | 10–7 | 101 | 4 | .5 | 18 | 3134 | 5389 | 8 |
| 4 | 6—17 | 1000 | 10–8 | 48 | 12 | .3 | 10 | 1908 | 2968 | 10 to 12 |
| 5 | 6—17 | 1980 | 10—8 | 58 | 40 | .5 | 14 | 2155 | 4233 | About 8 |
| 6 | 5–20 | 3250 | 10—8 | 52 | 43 | .5 | 14 | 2036 | 5381 | 10 |
| 7 | 7–22 | 2033 | 10—8 | 40 | 15 | .25 | 12 | 1711 | 3799 | 8 to 10 |
| 8 | 7—22 | 3060 | 10—8 | 75 | 21 | .5 | 14 | 2371 | 5527 | 6 to 8 |
| Check 1 | ------ | ------ | 10—10 | 246 | 133 | 1.25 | 26 | 6293 | 6672 | Not Thinned |
| Check 2 | ------ | ----- | 10—10 | 312 | 71 | 1.25 | 16 | 3249 | 3632 | Not Thinned |

## RECORD IN PACKING HOUSE.

(NO WINDFALLS TAKEN TO PACKING HOUSE)

| Tree No. | No. Picking Boxes | PACKED OUT BOXES GRADED | | | | | | Total Boxes Culls with Windfalls |
|---|---|---|---|---|---|---|---|---|
| | | Ex. F. | Ex. C. | Standard | Three Grades Total | Culls | Four Grades Total | |
| 1 | 20.5 | 7.5 | 3 | 5 | 15.5 | .62 | 16.12 | 1.12 |
| 2 | 21.5 | 7.12 | 6.5 | 4.5 | 18.12 | .75 | 18.87 | 1.25 |
| 3 | 18 | 4 | 5.25 | 3.66 | 12.91 | 1.66 | 14.57 | 2.16 |
| 4 | 10 | 2 | 1.33 | 4 | 7.33 | .33 | 7.66 | .63 |
| 5 | 14 | 3 | 3.66 | 3 | 9.66 | .5 | 10.16 | 1 |
| 6 | 14 | 6.5 | 2 | 1.87 | 10.37 | .5 | 10.87 | 1 |
| 7 | 12 | 5.5 | 1 | 1 12 | 7.62 | .5 | 8.12 | .75 |
| 8 | 14 | 7.12 | 1.8 | 2.5 | 11.42 | .5 | 11.92 | 1 |
| Check 1 | 26 | 2 | 0 | 12 | 14 | 6 | 20 | 7.25 |
| Check 2 | 16 | 3 | 2 | 6 | 11 | 1.66 | 12.66 | 2.91 |

## THE PER CENT. PACKED OUT FOR EACH TREE FOR THE FOUR GRADES.

| Tree No. | In Packing House, Not Counting Windfalls | | | | | Grand Total No. Packed Out Boxes and Per Cent. for Each Tree, Counting all Windfalls | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Four Grades Total Boxes | Per Cent. Packed Out in Different Grades | | | | Windfalls—No. Boxes | Total Boxes | Per Cent. for Each Tree | | | |
| | | Ex. F % | Ex. C % | Stand. % | Culls % | | | Ex. F % | Ex. C % | Stand. % | Culls % |
| 1 | 16.12 | 46.21 | 18.61 | 31.01 | 3.84 | .5 | 16.62 | 45.12 | 18.05 | 30.08 | 6.75 |
| 2 | 18.87 | 37.73 | 34.44 | 23.84 | 3.97 | .5 | 19.37 | 36.77 | 33.55 | 23.23 | 6.45 |
| 3 | 14.57 | 27.45 | 36.03 | 25.12 | 11.39 | .5 | 15.07 | 26.54 | 34 84 | 24 29 | 14.33 |
| 4 | 7.66 | 26.1 | 17.36 | 52.21 | 4.3 | .3 | 7.96 | 25.12 | 16.71 | 50.25 | 7.91 |
| 5 | 10.16 | 29.43 | 36.02 | 29.43 | 4.92 | .5 | 10.66 | 28.07 | 34.35 | 28.07 | 9.40 |
| 6 | 10.87 | 59.79 | 18.39 | 17.2 | 4.59 | .5 | 11.37 | 57.17 | 17.59 | 16.44 | 8.80 |
| 7 | 8 12 | 67.73 | 12.31 | 13.79 | 6.15 | .25 | 8.37 | 65.71 | 11.94 | 13.38 | 8.96 |
| 8 | 11.92 | 59.73 | 15.1 | 20.97 | 4.19 | .5 | 12.42 | 57.33 | 14.50 | 20.13 | 8.05 |
| Check 1 | 20 | 10 | ..... | 60 | 30 | 1.25 | 21.25 | 9.41 | ..... | 56.47 | 34.12 |
| Check 2 | 12.66 | 26.69 | 15.79 | 47.39 | 13.11 | 1.25 | 13.91 | 21.56 | 14.38 | 43.13 | 20.83 |

## AVERAGES.

| | Average No. Picking Boxes to Tree | Average No. Packed Out Boxes to Tree | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ex. F | Ex. C | Stand. | Total 3 Grades | Total Culls | Total to Tree |
| Thinned | 15 08 eight trees | 5.34 | 3.07 | 3.20 | 11.61 | 1.11 | 12.72 |
| Unthinned | 22.25 two trees | 2.5 | 1 | 9 | 12.5 | 5.8 | 17.58 |

## OR IN PER CENT.

| | Average % of Packed Out Boxes to Tree in Different Grades | | | | | |
|---|---|---|---|---|---|---|
| | Ex. F % | Ex. C % | Stand. % | 3 Gr'd's % | Culls % | Boxes |
| Thinned | 41.98 | 24.14 | 25.15 | 91.27 | 8.72 | 12.72 |
| Unthinned | 14.22 | 5.69 | 51.19 | 71.10 | 28.89 | 17.58 |

DISCUSSION OF TABLES.

*Windfalls.*—In figuring the total per cent. of the different grades borne by each tree, the thinned off apples were not counted. The windfalls were all counted as culls, for it is a well known fact that when an apple falls to the ground, from any cause, it generally bruises so that it has to be thrown into the cull box.

It will be seen that the average number of windfalls per tree before picking, was 68 apples for the thinned and 279 apples for the unthinned trees. The average number of apples which fell to the ground while picking was 25 from the thinned, and 102 from the checks or unthinned trees. The total average number of apples which fell to the ground was 93 from the thinned trees and 381 from the unthinned, making about four times as many fallen apples per tree for the checks or unthinned, as for the thinned trees. The number of apples which fell while picking was 77 less per tree for the thinned trees than for the unthinned. When the apples are in clusters at picking time, it is impossible to keep from dropping some on the ground, and the more clusters there are the greater will be the number that fall. The figures show there were about four times as many apples dropped from the unthinned as from the thinned trees.

*Culls.*—Apples which come under this head were those less than 2¼ inches in diameter, those badly bruised or scarred, and those very wormy. In connection with this it might be well to state that the Winesaps in the experiment were from 5 to 7 per cent. wormy. This worminess had some effect on the per cent. of boxes packed in the different grades, and as the unthinned fruit was more wormy, because of the clusters affording favorable places for the young codling moth larvae to gain an entrance to the fruit, the number of culls due to codling moth, would be proportionately greater from the unthinned trees.

Many of the apples "culled" were those that were limb-bruised because of their rubbing against some limb. Those apples growing on the terminals of long, slender branches were often badly limb-bruised, caused by being knocked about in the wind. Proper pruning and thinning does away largely with these abrasions.

*Thinning Distance.*—To thin the fruit on a tree and leave the apples a definite distance apart is a difficult matter. A keen eye and experience are required for the best results. One may think that he is taking off too many apples, or whatever fruit he is thinning, and that he is ruining his crop, but at picking time he generally wishes that he had taken off more. A good motto to go by in thinning is: "Look up, not down." In other words, pay no attention to the apples on the ground, but be sure that every branch is thinned

to such an extent that it will not only be able to properly support a load of mature fruit, but will also be able to grow it to proper size and color. Because one side of a tree is light and the other side heavy with fruit is no reason why the heavy side should not be thinned. The physiology of a tree is such that the food supply for one side or part of it, is largely independent of the other parts. For example, one side or part of a tree may be dead because of the death of the roots which fed that part of the tree. This is perhaps more often true of old trees than of young ones.

It may be seen from the table that the apples of tree No. 1 were thinned to about 10 inches, except in the top, and it was due to this fact that the small apples were found in that portion of the tree. Because it was hard to tell exactly the distance that the fruit was thinned on each tree, the distances given are more or less estimated.

A study of the individual tree is necessary in order that one may be able to thin it in such a manner as to get the best results. Trees of the same variety and age, may vary in their productiveness in the same orchard, and for this reason it is a good plan to study each tree for several seasons to be able to ascertain its wants and requirements. In averaging the total number of apples borne by each tree, it will be seen that this average is about the same for the thinned as for the checks or unthinned trees. These average totals are 5,021 apples for the trees that were thinned, and 5,152 apples for the checks or unthinned trees. These averages per tree include all of the apples that were set at thinning time.

The average per tree for the number of apples at picking time, including all windfalls, was for the thinned 2,622, and for the unthinned or checks 5,152 apples. From these figures it may be seen that about one-half of the apples were removed from thinned trees. The average estimated distance apart of all apples on thinned trees was 8¾ inches. In examining the apples at picking time, it was found that as a rule, better apples, in regard to size and color, were found on limbs where they had been thinned to about 10 inches. It is believed that the very best results from thinning old, heavy bearing Winesap trees, would be obtained by thinning the apples uniformly to a distance of from 9 to 10 inches as soon as possible after the "June drop."

*Cost of Thinning.*—In this experiment an average of about 750 apples per hour were thinned from the trees. This would make 7,500 apples for a day of ten hours. Counting 2,400 apples to be thinned from a tree, one man would thin 3⅛ trees per day. The cost of thinning a tree, allowing two dollars a day for a man's wages, would be 64 cents. An expert thinner who could take off 1,000 apples an hour would cut this cost down to 48 cents per tree.

DOES THINNING PAY?

It often happens that the fruit grower does not like to do a thing unless he is sure that he will get quick returns for his labor. He so often does not look far enough into the future to regulate and manage certain factors over which he may have control that would insure future returns which would more than pay for any extra effort that he might put forth. From this standpoint it is necessary to consider other phases than that of the net returns of a single year, to tell whether or not thinning pays. These may be stated as follows:

1. Maintaining *the vigor of the trees. 2. Securing annual crops instead of alternate. 3. To be able to produce fruit of maximum size, color and quality.

*Maintaining the Vigor.*—This is a very important factor, for any fruit tree when injured or impaired in any manner, will not be able so successfully to resist insect, fungus and freezing effects.

Thinning annually and uniformly will have much to do in preserving this vitality. Whenever the question is asked an orchardist, "Why is it that this apparently healthy apple tree is not bearing this year?" the chances are that he will answer, either that the fruit or bloom was killed by frost, or that it overbore the year before. It is noticeable, in this connection, that a tree with a heavy bloom will go through the average spring frost with little damage to the crop.

There is no doubt that the orchardist is right when he claims that overbearing one year will cause "shy" blooming the next with some varieties of apples, such as the Jonathan for instance, and the writer has seen the Ben Davis affected in the same way. The Winesap, as a rule, is not a "shy" bloomer, and overbearing may weaken the vitality, causing the tree to grow small, inferior apples, some of which never properly ripen.

The breaking down of limbs is the result of overbearing and can only be avoided by either propping or pruning and thinning. We firmly believe that props have no place in an orchard and when used are only a sign of very poor orchard management. There is no doubt that pruning has a very important place in orchard management and should not, by any means, be neglected. Especially is this true for the young trees. If a tree is properly pruned every year from the time it is set out, the amount of pruning can be decreased somewhat in proportion to the size of the tree when it has become full-grown. The word full-grown is used more or less arbitrarily, but generally conveys the idea that the tree is capable of bearing a full crop. Some think that every apple tree can be thinned

*E. R. Bennett, Storrs, Conn. Experiment Station Report, 1903.

enough with the pruning shears in the winter time, thereby doing away with the necessity of thinning by hand in the summer. These people forget that the plant food that goes to make and mature the apple is manufactured by the leaves and not by the roots of the tree. Keep a tree defoliated in the summer for any length of time and you will kill it. It is not best to obtain all of the leaf surface possible, as would be the case with an unpruned tree, for this would mean wood growth at the expense of fruit, and a greater amount of hand thinning. There would also be too much shade for the fruit and a poor color would be the result. A well balanced and well cared for tree, bearing a good crop of uniform sized apples every year will retain its vigor, while a tree allowed to bear an enormous crop one year and none the next may suffer the consequences of over production.

*Securing Annual Crops Instead of Alternate.*—A tree will produce quantity at the expense of quality, and at the same time utilize plant food that should be used in making the fruit buds for the next year's bloom. The law of nature is to reproduce its kind and it tends to do it even at the expense of the welfare of the tree. Annual thinning tends to throw a tree into annual bearing. When a tree has been in the habit of bearing alternate crops, it may take some time to induce it to bear every year by thinning. It has been demonstrated in the orchard where this experiment was carried on that by annual thinning the Jonathan can be made to bloom well every year.

*Fruit of Maximum Size, Color and Quality.*—The total averages, as given in the table found in the different grades, illustrates the points of size and color, for apples have to be of a certain size and a certain color to be packed in the first two grades. The following table illustrates the comparative values of the different grades. The culls were selling at the cannery and evaporator at $7 per ton, or the equal of $0.175 per fifty-pound box.

| | Ex. F. Boxes at $1.75 | Ex. C. Boxes at $1.50 | Stand. Boxes at $0.85 | Cull Boxes at $0.175 | Cost of Thinning |
|---|---|---|---|---|---|
| Thinned ..... | 5.34=$9.35 | 3.07=$4.61 | 3.2 =$2.72 | 1.11=$0.19 | $0.64 |
| Unthinned .... | 2.5 =$4.38 | 1 =$1.50 | 9 =$7.65 | 5.08=$0.89 | ---- --------- |
| Thinned ..... | Gain=$4.97 | Gain=$3.11 | Loss=$4.93 | Loss=$0.70 | Loss=$0.64 |
| $8.08—$6.23=$1.85, total gain per tree. | | | | | |

When trees are set 16x32 feet, there are 85 to the acre. A gain of $1.85 per tree would make a total gain of $157.25 to the acre.

This seems strong evidence that thinning the Winesap gives large returns for time and labor expended. The above figures are conservative in at least two respects: 1st. Many of the windfalls which were counted as culls could never have been sold for any purpose; especially was this true of the early dropped windfalls. Also there is much doubt as to whether the amount received for the culls would have paid for the extra labor required in picking, hauling and sorting. 2nd. The extra amount of time that it took to grade the apples from the unthinned trees for packing was considerable. These two expenses would alone almost offset the cost of thinning.

Uniformity of size was very characteristic of the apples from the thinned trees, while the apples from the unthinned ones were of all sizes. (See Fig. 1.)

Better colored fruit was always found on the thinned trees than on the unthinned, due largely to the fact that the fruit on the unthinned trees was crowded and consequently more or less shaded.

The lessened percentage of wormy apples, due to picking and destroying the apples infested by the first brood of worms, would probably be a saving sufficient to largely bear the expense of thinning.

## HOW TO THIN.

Study each tree individually and thin so that at picking time the tree will hold up well under a load of uniform, good sized and well colored apples. It takes experience and study to get the very best results from thinning.

The experiment indicates that best results in thinning the Winesap can be attained when the apples are thinned to a distance of from nine to ten inches. It is well to commence at the top of the tree and work down. Perhaps, if there is any difference in distance to be made, it would be better to thin the apples on the lower limbs next to the trunk of the tree a little farther apart on account of there being more shade in this part of a tree. Although some shade is a good thing, as it prevents sun-scalded fruit, it is possible to have too much.

A very good type of thinning shears is shown on the front cover page. Thinning is much more easily done with this instrument than by hand. (Fig. 2 shows how a small branch with a heavy load should be thinned.)

Take off all terminal apples on long, slender branches and break all doubles. Take off all wormy apples and all those that are much smaller than the average. Take off all limb-bruised or badly frost marked apples, and also those that are liable to become limb-bruised as they grow in size. Leave the apples in singles and in

such a position that they can have the best chance to grow in size, color and uniformity, and be as free as possible from blemish.

There is another phase of thinning that would help, and that is the cutting out of every other tree in rows that have the trees so close together that they are crowding each other. Trees, when crowded, are bound to grow upward rather than outward, and if left alone will, in a little while, have most of their fruit bearing wood in the tops. This is truer of peaches, perhaps, than of apples, nevertheless apple trees when crowded cannot do as well as

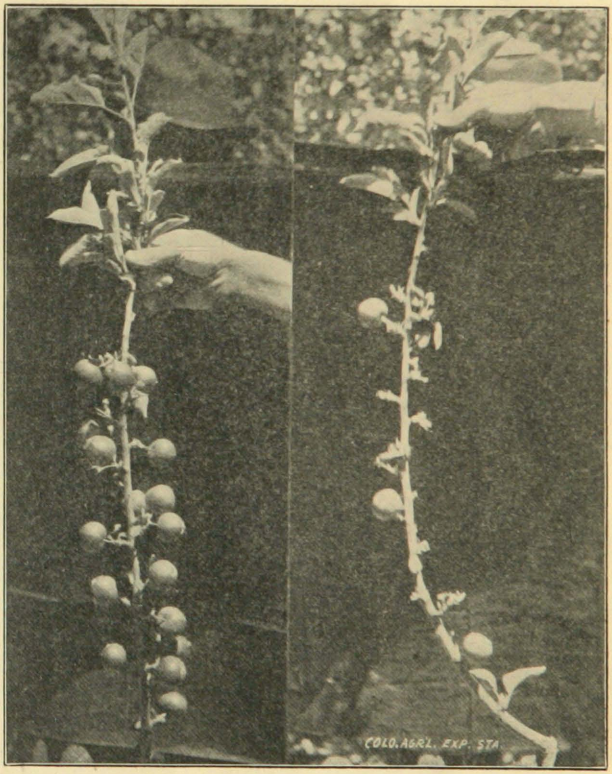


Figure 2. A three-foot branch before and after thinning.

when they have plenty of room. For this reason it is necessary to cut out every other tree in the row, or the alternates in every row, this depending on the way and the distance the trees are set.

## CONCLUSIONS.

1. That thinning of the mature Winesap tree pays in money returns the first year.

2. The more evenly distributed the fruit on the tree the more uniform will be the size and color of the pack.

3. That Winesaps respond to thinning by increased size and better color when thinned as late as July 20.

4. The earlier that thinning can be done, the better will be the returns from the fruit sold and the greater will be the vitality of the tree.

5. The best results are attained in thinning an old Winesap tree, by leaving the apples from 9 to 10 inches apart.

6. That proper pruning, and keeping the trees a proper distance from each other will facilitate thinning.

7. That systematic, annual, uniform thinning done from the time the trees come into bearing, should have much to do in securing an annual crop, thereby doing away with the so-called "off year" bearing of some of the apple varieties.

## WINTER AND FROST INJURIES OF FRUIT TREES

The object of the following discussion is to define as nearly as possible the different effects of freezing temperatures upon fruit trees and also to show that these effects often cause the death of fruit trees in Colorado. The subject divides itself into the following heads, namely: winter injury of young trees; winter injury of old trees; and spring frost injuries. In this bulletin, injury to peach and apple trees only will be discussed.

### WINTER INJURY OF YOUNG TREES.

This divides itself into two heads, injury done to young apple trees, and that done to young peach trees. Young apple trees are injured for the most part, by freezing at the ground line, and by sun scalding on the trunks. Injury to young apple trees at the ground line is often caused by very low temperatures, resulting in perpendicular cracks which extend on the trunk from the ground line, or just below, upwards to a distance of an inch, or sometimes more. There may be from one to five cracks depending upon the severity of the freeze. In some varieties, such as the Rome Beauty for instance, it is often found that the bark bridges up between these cracks, causing a complete girdling of the trees, which often kills the tree. In most varieties, such as Jonathan and Winesap, the tree generally has strength enough to heal these wounds over so that in a few years they are hardly noticeable. In those cases where there is danger of killing the tree, it would be a good thing to fill the cracks with wax, or it might be of value to heap damp earth around the base of such a tree. If very bad cracks (Fig. 1) were found and taken in time, it might be possible to save the tree by bridge grafting.

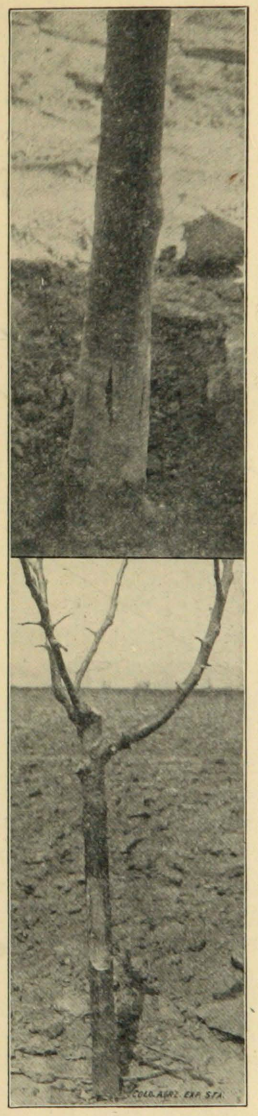

FIG. 1. Cracks at base of Rome Beauty caused by winter freezing.
FIG. 2. Winter injury by sun scald on southwest side of Winesap. The affected portion is cut out

In Fig. 2 there will be seen a case of sun scald. This sun scald generally takes place on the southwest side of the tree and, if severe enough, will work around, completely girdling the tree. On young apple trees sun scald is more frequent in winter than it is in summer. Especially is this true when the ground is covered with snow so that the sun's rays are reflected onto the trunks. It is very likely that sunny days and freezing temperatures at night have much to do with sun scald. The injury takes place, as a rule, from the snow line up to the scaffold limbs. In some cases it will be found to extend up on the scaffold limbs, but this latter condition is not so frequent. Prevention of sun scald is better than any remedy that could be prescribed for the trouble, although in severe cases it may be well to bridge graft. Whenever it is possible, it is better to use other methods than bridge grafting in Colorado, as our climate is so dry that it is very hard to keep the scions from drying out. Especially is this true when scions of any length have to be used. The fact that, as a rule, but little sun scald bark is found on the scaffold limbs, is one reason at least why low headed trees are practical. If by some method the ground could be left in such shape in the fall of the year as to prevent snow from lying in a level plane for any length of time, it might do much toward preventing sun scald of young trees. In localities where it is quite sure that the snow fall will be great enough to insure plenty of moisture, it might be well to leave the plowed ground in the fall in a rough state. This would do much to break the snow line. If a green shade crop were plowed under in the fall, this would help in the same way. In those places where the young orchards are bothered by rabbits, a wire netting extending from the ground line to

the scaffold limbs of the tree would not only keep rabbits from gnawing . but would also do much toward breaking the direct and reflected sun rays on the trunks. Wood veneering will answer the same purpose here as wire netting. Never use tar paper, as it not only concentrates the rays of the sun, but has an injurious effect upon the trunks, and in some cases the writer has seen death caused by its use.

It seems that the darker the bark the more liable it is to injuries from sun scald. Whitewashing the trunks of the trees is a very good practice and one that can be used on old trees as well as young. A very good whitewash is the California formula, which is as follows:

| | |
|---|---|
| Quicklime | 30 pounds |
| Tallow | 4 pounds |
| Salt | 5 pounds |
| Water | enough to make mixture flow well |

Prof. W. Paddock says that this makes a tenacious whitewash not easily washed off by rains or removed by other means.

If whitewash is to be applied to the trunks of old trees in the winter time, it is a good thing first to remove all the old, rough bark. In this way many of the injurious insects that are hibernating over winter under this bark will be killed. A rough rasp or file is a very good implement to use in removing the old bark.

In peach orchard districts, where the temperature sometimes falls from 15 to 24 degrees below zero, there is more or less danger of damage being done to peach trees. Especially is this true when the trees are young and the temperature remains low for any length of time. It is sometimes very hard to tell whether considerable damage has been done to trees or not, until late winter, or sometimes it is the first of May before one can be sure whether the trees have withstood the rigorous weather. Perhaps, for peaches, the most common injury is that of killing the fruit buds. But this is not to be dreaded as much as freezing at the crown or ground line, which causes the so-called "collar girdle." Another form of freezing is that beginning at the terminals on the one-year wood and freezing back onto the older wood. This latter form is perhaps more common on older trees than young ones.

For the reason that it is almost impossible to tell the extent of the damage done by freezing until early summer, it is often a good plan to delay pruning until about the first of May. It must be understood that this is when the trees have undergone a severe winter. In other cases perhaps it is better to prune when a tree is dormant, although this is disputed by some of our best orchardists. At

any rate, when severe freezing of the wood has taken place, it is well to wait until the buds have started so that one will know where to prune. Even then peach trees may be so injured as to live months, or in some cases a year or two before dying from the effects of freezing. The so-called "collar girdle" seems to be one that does not show until some time after the freezing has taken place. Trees injured by freezing very often need to be severely cut back. A peach tree will stand a heavier heading back than the apple and for this reason can be pruned very severely, so that it will have a chance to put forth a new growth which, when properly pruned, can take the place of the old head.

One of the very important things to watch in connection with both young apple and peach trees is that of irrigation. It is a very good plan to get all of the growth possible during the early part of the growing season, so that the trees may have a chance to harden off during late summer. In order to do this a young orchard should never be irrigated later than the first of August, and in many cases it would be better if the last summer irrigation took place not later than July 15th, the time varying somewhat with location, kind of soil, etc. Then, if no moisture comes in the latter part of October or first of November, it is a good thing to irrigate. If the trees are not properly ripened or hardened off there is much danger that they will be killed back more or less by the first fall freeze. The writer has seen cases of young peach trees where the terminals were killed back for several inches as early as the middle of October. This was in an orchard where the irrigation was kept up until some time in September. The orchardist's object was to mature a crop of corn that he was raising between the peach tree rows. By spring every peach tree in this orchard was killed to the ground. It often happens that a peach tree has enough vitality and plant food in the trunk and limbs to leaf out and may even bloom, and at the same time it may be so injured by freezing as to be girdled somewhere on the trunk so that in a little while the whole tree dies.

In the case of young apple trees, where the top is frozen back to the trunk, or where the trunk is injured by sun scald and freezing, it is sometimes possible to insert a scion by the cleft or kerf method and thus growing a new top. In top working of this kind be sure that the top is cut off below the injured portion *i. e.*, have the stock of good, sound wood. It is often possible to top work a young tree in this manner so that a single year's growth would almost equal that which was killed. In a case like this, where a tree has a well established root system, it does not take long to form a good top, but one must be careful about letting it grow too late in the season, as growth like this takes more time to harden off than when slower growth is made. In young trees which have under-

gone severe winters, it is often possible to find the sap wood discolored, generally due to freezing and in some cases traceable by the annual rings to the year of the injury.

### WINTER INJURY OF THE OLD TREES.

One form of freezing found on the old, and sometimes young apple trees, is due to "freezing dry." This is thought to result from perhaps two causes, one being lack of moisture in the soil, and the other a deeply frozen condition, stopping all root action.

Transpiration, or the loss of water from the limbs and twigs of the tree, goes on in winter as well as in summer. Whenever either or both of the conditions mentioned above exist for any length of time, the results are detrimental to the tree and, if severe enough, may cause death. For this reason it is necessary to irrigate in late fall or early winter. As a rule, the first of November is a desirable time to do this, as it very seldom happens that the soil around the roots freezes enough to do any damage unless the trees are shallow rooted. In this case root freezing might prove to be detrimental. The above statements will hold for the peach as well as for the apple.

There is another form of winter injury to old apple trees that is often found and which, in some cases, is hard to distinguish from injuries due to arsenical poisoning. The distinguishing features are that the injury for the most part is at the crown or ground line primarily and seldom runs down into the root system. The roots, of course, may be affected from this injury, but in such cases the injury would be secondary. The injury takes place in the form of a partial or complete girdling at the ground line. The bark peels off in rough pieces and generally in one spot only. It may extend up to the trunk of the tree for several inches. It depends upon the size of this affected spot whether the injury will prove fatal to the tree or not. In cases of arsenical poisoning the bark becomes corroded to a mealy mass in which the tissues are broken down and may be scraped off from the wood, while with winter injury the bark remains intact and separates at the cambium. The writer has seen cases where fifteen year old Ben Davis trees were killed by this crown line injury. Attempts were made to save the trees by bridge grafting, but as stated before, the scions that had to be used were too long, and dried out before adhesion could take place. These trees were in such a position that undoubtedly more or less ice and snow remained around the bases of them for long periods of time. Although in some cases it would appear that ice around the base of a tree had no detrimental effect, it is not well to allow this, as one can never tell when the conditions are just right for damage to be done. In the fall irrigation it is well to keep the

water in the irrigation furrows and not let it collect around the bases of the trees and freeze. Perhaps there is no harm in allowing it to freeze in the furrow.

The worst injury to old peach trees, other than that of killing them outright, is that of killing the fruit buds. For this reason it is a good plan to delay pruning until one is sure what buds are alive and what are dead. But if this is kept up for any number of years the chances are that the fruit bearing wood will be in the top of the tree and will eventually necessitate a severe heading in.

### SPRING FROST INJURIES.

Perhaps there is no injury due to freezing temperatures which gives such immediate results as that of killing frosts in the spring. This too, may have its effect throughout the growing season, but the primary effect is that of a total or partial killing of the bloom, and sometimes that of the set fruit, in the spring. It is not the object in this bulletin to discuss the protection of the orchard from frost, except in a general way.

*Some Effects of Frost on the Fruit and Leaves.*—Frost may be severe enough to cause only a partial failure of a crop, and when this is the case there is always more or less of the injury seen throughout the season. The most common of these are frost marks consisting of russety patches at both the stem and blossom ends, or in some cases russet bands around the fruit. These russet bands are often seen on the pear. One form of injury, thought to be due to freezing, not often seen, is that of small round russet spots on the surface, which may be in almost any position on the fruit. This has been seen on the Northwest Greening and was supposed at first to be due to spray injury, but upon investigation it was thought to be due to frost injury when the apples were small. It often happens that apples and pears are so injured as to have no seed. Another form of injury to the fruit is that of freezing a part or all of the calyx end, causing the fruit to be deformed. In this latter case the injury generally takes place after the fruit has been pollinated and has set.

The early leaves are often injured by frost and the effects are that they never grow much larger in size than they were at the time of freezing. They may turn yellow and drop during the early season, or they may still hang to the trees, but if they do, they become much thickened, somewhat shriveled, and turn yellow much quicker than the uninjured leaves. As a rule, if the frost is not too late, the damage done to the leaves is not enough to cause any alarm. In some severe cases where most of the leaves are out and all are injured to such an extent as to cause them to drop, there might be some detrimental effects. But, as a rule, the tree will soon throw

out new leaves which will take the place of the injured ones

*Prevention of Frost Injuries in General.*—As this is a subject that would require a bulletin to be satisfactorily handled, we will give only some of the most important features concerning orchard heating. The following conclusions were drawn after consulting over forty of the leading orchardists of the State who had used orchard heaters:

1. The fact that every orchardist, who had been interviewed upon this subject, claimed that the orchard heater is a good investment as an assurance in the fighting of frost, indicates that the orchard heater has come to stay.

2. The oil heater is usually preferred over the coal, when more than five acres are to be heated, because of its more economical maintenance.

3. On cold, windy nights orchards with low headed trees receive more benefit from the heaters than high headed ones.

4. Good thermometers well tested should be in the orchard as well as on the outside.

5. Careful study of the stage of growth of the fruit buds should be made to ascertain their hardihood against frost injuries.

In regard to the stage of growth of the fruit buds, bloom and set fruit of peaches and apples, as compared to their resistance to frost, the following opinions are given: Prof. W. L. Howard *states that in Missouri fully dormant peach buds can stand 8 or 9 degrees below zero. When appreciably swollen, zero is the danger point. When the buds are showing the pink, they can stand 15 degrees above zero. When the petals are off they stand 30 degrees above zero. For apples, when the petals begin to show, they can possibly stand a temperature of from 20 to 22 degrees above zero. From this stage on their resistance to cold becomes less and less as growth progresses.

Prof. P. J. O'Gara †states that, in the Pacific Northwest, peaches in bud are injured by a temperature of 29 degrees F.; in blossom by 30 degrees, and set fruit by 30 degree F. Apples in bud are injured by a temperature of 27 degrees; in blossom by 29, and set fruit by 30 degrees F.

Prof. O. B. Whipple ‡found that it is doubtful if, in Colorado, a temperature of 30 degrees F. will injure fruit or buds, in any stage of growth. That a temperature of 28 degrees, if of long enough duration to freeze the tissues solid, will kill peaches in

*Reprint from the Annual Report of the Missouri State Board of Horticulture, 1909.

†Farmers' Bulletin No. 401, U. S. Dept. Agr.

‡Fruit Growing in Arid Regions, by Paddock and Whipple. p. 353. The MacMillan Company.

bloom or after the peaches have set. That after the peaches have reached some size they will stand a lower temperature for a short period of time. Peach trees well loaded with buds which show slight traces of pink, have often escaped with a good crop with a minimum temperature of 22 degrees. Fruit buds of apple and pear open far enough to show the flower tips, are seriously injured by temperatures lower than 20 degrees. When they are far enough advanced to show the color at the tips, they are generally only slightly injured by temperatures as low as 25 degrees. When in bloom and after the fruit is set, they will seldom stand temperatures lower than 28 degrees. Cherries, apricots, and most of the plums, will require about the same protection as peaches. Native plums in bloom or with fruit set will often stand a temperature of 25 degrees.

It will be seen from the foregoing that the danger point in temperature varies for the different fruit sections and for the different kinds of fruit. It may also vary in the same locality for different years and several years' observations will be necessary in order to get full data on all the conditions that have to do with resistance of freezing temperatures.

Careful study of the weather conditions should be made when orchard heaters are used. Some money can be made in the saving of fuel by starting and putting out the fires at the proper time. Oil heaters when fired can be put out and relighted instantly, while coal is very hard to relight. A good plan is to commence lighting the heaters when a temperature of 30 degrees is reached. If the temperature can be kept at 29 degrees or above, as a rule, there will be little damage done to the bloom or set fruit. The writer has seen, with systematic handling of the heaters, a temperature of around 21 outside raised to 29 degrees in the orchard. It is thought there is no harm done to the trees in the spring from a small amount of oil spilled in the orchard, nor from the gases, soot, etc., which come from the coal and oil.