New York Agricultural Experiment Station.

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RINGING FRUIT TREES.

G. H. HOWE.

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RINGING FRUIT TREES.

G. H. HOWE.

SUMMARY.

1. The object of ringing fruit trees is to induce unproductive trees to set fruit.

2. Briefly stated, the theory of the operation is: That the removal of a band of bark through the cortex and bast of a plant, at the period of most vigorous growth, does not hinder the upward passage from the roots to the leaves, through the outer layer of woody cells, of unassimilated sap; but does prevent the distribution, through vessels in the cortex and inner bark below the wound, of assimilated food. The effect of this action is to cause an extra amount of reserve material to be stored in the upper parts of the plant for the production of fruit buds.

3. Ringing seems to favor certain organs for a time but devitalizes others.

4. The removal of narrow strips of bark is less injurious to plant growth than taking out wide rings.

5. Under certain conditions, ringing may induce and possibly increase fruitfulness of apples, but it rarely has these favorable effects on other fruits.

6. Only young and very vigorous apple trees, possibly now and then pear and cherry trees, can survive ringing, and even with these fruits the compensating gains seldom offset the injury to the trees.

7. The practice of ringing stone fruits should never be followed. The experiments indicate almost 100 per ct. loss in the life of the trees.

8. Regular and successive increases in productiveness did not result from the ringing of several varieties of our tree fruits.

9. Ringing had no apparent influence upon the size, color or maturity of apples.

10. The general effect of ringing on the roots of the trees was to decrease their size and number and to lessen their vigor.

INTRODUCTION.

Ringing plants consists in the removal of a band of bark through the cortex and bast of the trunk. The term girdling is frequently used
to designate this operation, but since this name is usually associated with wounds made more or less deeply in the wood, which result in ultimate death, as when a tree is girdled by mice or girdled for the purpose of killing, it is unfortunately chosen. French writers use the phrase, "décortication annulaire" (annular decortication) which is more exact than either ringing or girdling.

The object of ringing is to induce and increase fruitfulness. In the growth of plants, unassimilated sap rises from the roots through the outer woody cylinder of the main stem to the leaves. There it is changed into a suitable form for utilization in plant growth. This sap is then distributed, through cells in the cortex and inner bark, to the various plant organs. When plants are ringed the upward flow of sap is not materially impeded, but returning juices are prevented from passing below the wound. This causes an unusual accumulation above, thus supplying the upper portion of the plant with an extra amount of food at the expense of the parts below the ring.

The practice of ringing is by no means of recent origin but is known to have been in use at least a century ago for the purpose of increasing productiveness of woody plants. Thus, according to Prince,\textsuperscript{1} writing in 1832, Lindley, in his Guide to the Orchard and Kitchen Garden, advocated its use to bring fruit trees into bearing. Sorauer\textsuperscript{2} discussed at length the principle involved and the practicability of the operation. Goodman\textsuperscript{3} considered ringing just as important in the scheme of orchard management as pruning and cultivation. According to his experiments with a large number of trees the crop was increased five fold. Van Deman\textsuperscript{4} recommends the ringing of apple and pear trees only when all other means of inducing them to bear have failed. He discourages the practice of the operation with stone fruits. Paddock\textsuperscript{5} found that with certain varieties of grapes ringing produced an increased size of cluster and earliness of ripening but the operation was too devitalizing to be recommended as a common practice. Daniel\textsuperscript{6} found that the annual ringing of tomatoes and egg-plants produced a marked increase in the size of the fruits borne. Sablon\textsuperscript{7} ringed various

\textsuperscript{1} Prince, William. Pomological Manual. 2: X–XI. 1832.
\textsuperscript{2} Sorauer, Paul. Physiology of Plants, pp. 159-164. 1895.
\textsuperscript{4} Van Deman, H. E. Rural N. Y. 73: 1181. 1914.
\textsuperscript{5} Paddock, W. N. Y. Sta. Bul. 151: 1898.
woody plants in order to determine the distribution of the reserve plant juices contained therein. Hedrick, Taylor and Wellington, in a bulletin from this Station, found that ringing herbaceous plants was so deleterious to their growth that it could not be advocated for general practice. The loss to the plants was great and there proved to be little or no compensating gain.

The object of the experiments herein reported was to determine, if possible, the extent to which fruit trees can be ringed without permanent injury and in what degree, if at all, the operation induces and stimulates fruitfulness. Apples, pears, plums and cherries were the species used in these experiments. The work was started in 1910 and was carried on during the three succeeding years.

Ringing should be performed early in June or July, at which time the bark peels readily from the wood leaving the cambium in a succulent condition. The success of the operation hinges upon the fact that at this season of the year occurs the greatest cambial activity which readily facilitates the rapid formation of new bark and at the same time prevents exhaustive evaporation of plant juices. Any attempt to practice ringing when plant growth is sluggish or dormant always results in the death of the tree, since the cambium, being then firm, is torn from the woody cylinder during the operation. A common pruning knife or a sharp pocket knife is a suitable instrument for performing the operation. The rings were made of varying widths and were cut either at the base of the trunk or upon branches close to their union with the trunk. In one case narrow rings were made around the trunks at different distances from the surface of the ground.

RINGING APPLES.

In 1910 there were growing upon the Station grounds 122 seedling trees five years from planting, which up to this time had borne little or no fruit. Early in June, 1910, a band of bark one inch in width was removed from the trunk of each of these trees, just above the surface of the ground. These were normal, vigorous young trees, free from insect pests and diseases, and all were making a strong, thrifty growth. All received similar treatment as to cultivation and pruning. New bark began to form within a few days after the ringing and at the end of the growing season all of the wounds were entirely covered with new, healthy bark. As far as could be noticed, none of the trees

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had received any setback in the season's growth. All were vigorous and had made considerable new growth. Table I shows the number of bearing trees and the percentage of a crop per tree for the years 1910 and 1911.

**Table I.—Effect of Ringing on Fruit Production of Apple Trees.**

<table>
<thead>
<tr>
<th></th>
<th>1910</th>
<th></th>
<th>1911</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>122</td>
<td>54</td>
<td>44</td>
<td>7</td>
<td>107</td>
</tr>
</tbody>
</table>

These figures would seem to indicate that ringing, according to theory, exerted a very potent influence in bringing the trees into bearing and upon the fruitfulness of the trees. Manifestly, without ringing and with the same climatic conditions a larger number of trees would have fruited in 1911 than in the previous year, because of increasing maturity; and the crop per tree would likewise have been increased. Nevertheless, it is doubtful if such a marked increase in the number of bearing trees and in productiveness would have occurred, had not the setting of fruit-buds been stimulated owing to an interruption of physiological functions. It may be well to state at this point that since 1911 these trees have never yielded as large a crop even with subsequent ringing.

In the early part of June, 1911, 27 of the seedling trees which had been ringed the previous year were again subjected to the removal of a strip of bark one inch in width directly above the former rings. The bark peeled off from the wood this year with as great ease as it had before. Within a few days new bark was seen to be forming from the hardened cambium over the entire surface of every wound. At the end of the growing season an entire, new coating of bark was joined to the old upon either side of the ring. Apparently the trees had suffered no ill effects from the ringing. All seemed to be in a vigorous, thrifty condition and upon comparison with unringed trees no difference could be found in the amount of growth.

The 27 trees ringed produced in 1911 an average of 93 per ct. of a crop per tree and in 1912, 43 per ct. From these figures the fact
Fresh ring, one inch wide.  
New bark on one-inch ring.  
Three-inch ring with new bark.

Plate I.—Appearance of Rings on Apple Trees.
stands out clearly that the heavy crop in 1911 resulted in an off-year and a light yield in 1912, as is so often the case with many standard varieties of apples. The second ringing apparently had no influence in increasing the yield. The health and vigor of the trees seemed not to be decreased. All except two showed, at the close of the season, complete new bark formation. The two trees in question had failed to cover the entire ring and were not as vigorous as the others. It is possible that these trees lacked vigor from the time of planting.

In the early part of June, 1912, additional ringing was performed upon these same trees. This time rings 3, 6, 9, 12, 15, 18 and 21 inches in width were made, four trees being used for each of the various widths. These wounds were made around the trunks just above the former rings, all of the bark, whether in three-inch strips or twenty-one inch strips, being removed with equal ease. This ringing had no effect upon stimulating fruit production, for the crop borne in 1913 was about the same as that of 1912—so similar that further averages need not be given. Table II explains the effect of the ringing upon the vigor of the trees.

<table>
<thead>
<tr>
<th>No. of trees with various sized rings.</th>
<th>No. of trees fully healed.</th>
<th>No. of trees partially healed.</th>
<th>No. of trees failing to heal.</th>
<th>No. of vigorous thrifty trees.</th>
<th>No. weakened in vigor.</th>
<th>No. of trees entirely dead.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 trees ringed 3 in. wide...</td>
<td>3</td>
<td>......</td>
<td>1</td>
<td>3</td>
<td>......</td>
<td>1</td>
</tr>
<tr>
<td>4 trees ringed 6 in. wide...</td>
<td>3</td>
<td>......</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4 trees ringed 9 in. wide...</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4 trees ringed 12 in. wide...</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4 trees ringed 15 in. wide...</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4 trees ringed 18 in. wide...</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4 trees ringed 21 in. wide...</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

From the foregoing data it would appear that ringing tends to have injurious effects upon apple trees and that the wider the bands the more serious will be the injury. It may be stated again at this point that the trees used in this experiment were exceptionally strong and uniform in vigor and were therefore possibly in a better condition to withstand wounding than average orchard trees. All of the trees making a weak growth showed smaller foliage and less wood produc-
tion. The foliage, likewise, lost its color and fell from the branches four to six weeks earlier than that of normal trees. Sprouts two to six in number sprang up at the lower edge of the wound on nearly every tree. This would indicate that nature was endeavoring to provide assimilated food for the roots since passage of such food from the upper portion of the trees had been cut off. As has already been stated no gain in productiveness resulted from this ringing. The few fruits which were produced showed no differences in size or color from the normal. Clearly, ringing these trees seriously injured their health without increasing fruitfulness. Orchard space necessitated the discarding of these trees in 1914. Examination, at this time, of the root systems showed that, as a rule, the ringed trees had smaller, shorter roots (nearly approaching hairy roots) than the unringed trees. Trees low in vitality had extremely small root systems.

Early in June, 1911, 50 Baldwin trees three years from setting were ringed, bands 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20 inches wide, respectively, being removed from groups of five trees each. At the same time 35 trees of the same variety and age in another block were ringed, groups of five trees each being ringed with one-inch-wide rings at the surface of the ground and 4, 8, 12, 16, 20 and 24 inches, respectively, above the ground. In most cases new bark started to form, but at the end of the season not a single tree had made a perfect formation of new covering. Several trees in each lot were dead and all others lacked vigor. All foliage dropped about five weeks earlier than from adjoining unringed trees of the same age. The spring following the ringing, but 10 per ct. of the trees of both lots started growth, and this so weak that death resulted before mid-summer. While these two lots of trees were less vigorous than the seedlings of the previous experiments, they were representative of average trees of the commercial orchard.

About the middle of June, 1912, out of a block of 24 Baldwin trees four years from planting, 12 were ringed one inch wide at the base of the trunks and the remaining 12 were left as checks. These were average Baldwin trees, vigorous and thrifty. None had fruited up to the time of ringing. At the close of the growing season not a single tree showed an entire coating of new bark. All had partially recovered, but lacked vigor and tone. As compared with the checks, the ringed trees had made less growth. The foliage was smaller and dropped earlier. In the spring of 1913, one tree failed to start. All
of the others began growth at the same time as the checks but failed to advance as rapidly. No additional bark was formed and on each ringed tree portions of the new bark died during the summer. At the end of the season the check trees had made one-third more growth than those ringed. The wounded trees were then so weak, one having died, that they were all discarded. All of the living trees, both the ringed and the checks, bore a few apples in 1913 which dropped before the time of harvesting. The root systems of the ringed trees all proved to be much smaller and less developed than those of the checks.

From these experiments it is clear that the first ringing of the seedlings influenced fruitfulness and caused them to set a large crop of fruit. The experiments with the Baldwins, however, showed entirely different results. These trees, lacking the vigor and hardiness of the seedlings, failed to survive a single operation.

In some of the western states orchardists frequently resort to the ringing of their young trees to induce them to bear fruit, with very good results. Under most favorable conditions young, vigorous, thrifty trees ought to withstand and respond to one operation, but subsequent ringing is devitalizing and exerts practically no beneficial influence. From the experiments at this Station, the practice of ringing apple trees for the purpose of inducing and increasing productiveness seems too drastic a practice for the good of the trees. Even if a slight increase in fruitfulness is brought about it seldom offsets the injury to the tree.

RINGING Pears.

Early in June, 1912, 12 Bartlett pear trees four years from setting were ringed at the base of their trunks with bands one inch in width. Twelve adjoining trees of this variety were left as checks. As with apples, the pear-tree bark peeled from the wood at this season with ease. Succulent cambium covered the exposed woody cells. Soon after ringing, this cambium hardened and began forming bark over the entire wound and no injurious effects were evident. After a time, however, new bark continued to grow only in streaks, leaving patches of dying tissues. Wood growth became sluggish and the foliage failed to retain its usual dark green pigment. In the fall, 2 trees were dead, having formed but 5 per ct. of new bark. None of the others were thrifty. New bark was poorly formed. The foliage was small
and discolored and dropped several weeks earlier than that from the check trees.

In the spring of 1913 the 10 living trees started growth at about the same time as the checks. Growth was slow and as the season advanced more dead bark appeared where the ringing had been done. Towards the end of the summer 4 more trees died. The remaining 6 made such a poor growth that they were discarded at the end of the season. Very marked difference existed in the size of the ringed and unringed trees, the latter being one-third larger and making a rapid, vigorous growth. The roots of the ringed trees were poorly developed. At the beginning of the test the trees were all of equal size and similar to trees of the same age in the best commercial plantations. All received the same treatment. No fruit had been borne previous to the time of ringing. In 1913, however, both lots of trees bloomed in about equal proportions but no fruit set upon any of them, due, possibly, to the self-sterility of this variety.

RINGING PLUMS AND CHERRIES.

Almost no work seems to have been done upon the ringing of stone fruits. In general, drupes come into bearing earlier; are not as hardy; are less resistant to external injuries; and are shorter lived than pomes. The primary object of ringing these stone fruits was to determine in what degree they could withstand the injury, as it was hardly to be supposed that there would be a favorable effect in inducing or stimulating fruit-bearing.

Early in June, 1912, 12 Montmorency cherry and 12 Bradshaw plum trees, four years from planting, were ringed one inch wide at the base of their trunks. No difficulty was experienced in the removal of the bark and, like the pomes, the woody cells were covered with succulent cambium. Twelve trees of each variety in the same block were left as checks. At the same date 20 standard varieties of plums 15 years from setting were ringed. These trees were in an orchard of about 40 varieties all of the same age and receiving the same attention. Rings one inch in width were taken out. Four trees were ringed upon their trunks just above the ground. On the remaining 16 trees the largest branches were ringed close to their union with the trunks. All of the trees were strong and vigorous and free from insects and diseases. During the first few weeks after the ringing the cambium
seemed to be hardening into bark over all the wounds. By mid-
summer, however, growth had stopped and little or no new bark was
evident either on the cherries or plums. The cut edges from many
wounds showed growth in the nature of a callus and from these oc-
casionally would extend at right angles short strips of new bark almost
meeting at the center of the rings. But the wounds never entirely
closed. As the season advanced much of the newly formed bark died.
Tree growth became stunted. The foliage began losing color and the
general vigor of all the trees seemed impaired. The 15-year-old plum
trees set a small crop of fruit in 1912. At the time of harvesting no
difference could be found in size and color of the fruit from ringed and
from unringed trees. The flavor of fruit from ringed trees, however,
seemed not to be so good and the flesh was less juicy. No fruit was
borne on the Montmorency cherries or the Bradshaw plums in 1912.
At the close of the growing season 80 per ct. of all the trees were with-
out living bark covering the wounds. Usually the woody cells were
bare and often they were black and spotted indicating fungus diseases.
One cherry tree showed a considerable portion of the wound to be per-
fectedly healed, but this tree lacked the vigor of the unringed trees.
Both the cherry and plum foliage fell from the ringed trees from four
to five weeks earlier than from the checks. In case the trees were
ringed on the trunks the whole tree was in a weakened condition, but
where branches only were ringed, these and not the whole tree were
low in vitality. Out of all the trees ringed but one, a Montmorency
cherry, made any material growth the following season. All of the
other cherries and all of the plums which were not entirely dead failed
to make more than a start; before summer, all were dead. The Mont-
morency cherry mentioned, while making fair growth, was by no
means as vigorous as unringed trees. An examination of the root sys-
tems of the ringed trees showed that they were smaller, shorter and
less dense than those of check trees. This was particularly true of
the younger trees. With the older plum trees but little difference
could be found.

CONCLUSIONS.

The results obtained from these experiments are not favorable to
ringing fruit trees as a general practice. Under some conditions, for
a limited time, a more favorable outcome might be expected. Hardy,
vigorous, young apple trees may readily undergo a single ringing and
be benefited thereby, but subsequent operations are injurious. Trees lacking vigor are often seriously injured by the practice. The deleterious effects of the treatment have generally been so marked upon various plant organs as to render the operation exceedingly hazardous. There seems to be no regular or systematic increase in fruit production. The gains do not offset the losses.