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EFFECT OF VARIOUS DRESSINGS ON PRUNING WOUNDS OF FRUIT TREES.

G. H. HOWE.

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BULLETIN No. 396.

EFFECT OF VARIOUS DRESSINGS ON PRUNING WOUNDS OF FRUIT TREES.

G. H. HOWE.

SUMMARY.

1. Fruit growers have long used paints, tars, waxes and other substances as coverings for wounds of trees. This bulletin is a report of the effects of these various substances on wounds made on the apple and on the peach.

2. The substances used as coverings were white lead, white zinc, yellow ochre, coal tar, shellac and avenarius carbolineum. The dressings of these materials were applied when the pruning was done at different seasons of the year and upon wounds of various ages.

3. In all cases undressed pruning wounds have healed more rapidly than those whose surfaces have been protected.

4. Shellac seemed, the first season, to exert a stimulating influence upon the wounds but the second season this effect disappeared. Of all the materials used shellac was least injurious. On the other hand it adheres to the wounded surfaces least well of all.

5. Avenarius carbolineum and yellow ochre caused so much injury that neither substance should ever be used.

6. Coal tar not only caused injury but quickly disappeared either through absorption or evaporation.

7. White lead and white zinc caused some injury at the time of application but the wounded tissues recovered rather quickly and at the close of the first season the injury was not very marked; at the close of the second season it had nearly disappeared. These two paints are the best of the protective substances used and of the two white lead is the better.

8. Nothing is to be gained in the treatment of wounds in waiting several weeks before applying any of the various dressings used in these experiments.

9. The treatment of peach tree wounds with any of the substances under experiment caused so much injury that it may be said that
the wounds of the peach should never be treated with any of them and it may be inferred that this is true of wounds on trees of all stone fruits.

10. There is nothing to show in this experiment that it is worth while to treat wounds, large or small, of tree fruits with any of the substances in common use. Had there been a longer period of observation, it might have developed that the wood exposed in the larger wounds would have been somewhat saved from the decay which often sets in on exposed wood of fruit trees. It may prove to be worth while, therefore, to cover large wounds; in which case white lead is undoubtedly the best dressing to use.

INTRODUCTION.

Fruit growers have long used paints, tars, waxes and other substances as coverings for wounds of trees. Curiously enough, comparative tests of the many compositions in use seem not to have been made to ascertain the value of these dressings. Tree pruners seem to have taken it for granted that some covering was necessary, for large wounds at least, and have applied the most suitable material at hand. Two theories suggest treatment of wounds. One is that cut surfaces of trees would heal more quickly if some substance be applied to act in the nature of a salve to a sore; the other, that a covering to the wound prevents the entrance of fungi and insects. A moment's reflection shows that if these purposes are served by any of the numerous substances used, some must be better than others. To determine whether any covering at all is needed and, if so, which is best, experiments were begun at this Station in 1911 and carried on for four years.

The trees used in these experiments were apples and peaches. The apple was taken as a representative of the pome fruits, it being assumed that the pear and quince would behave in much the same manner. The peach was taken as a representative of the stone fruits, although fruit growers seldom think it necessary to cover wounds of these fruits since the cuts made are usually smaller and heal more quickly, as a rule, than those made on trees of the pomes. It was thought, however, that the knowledge as to the effects of the various substances on wounds of the peach would be interesting and perhaps profitable.
The substances used as coverings in the experiments were those most commonly recommended for orchard work; namely, white lead, white zinc, yellow ochre, coal tar,\(^1\) shellac and avenarius carbolineum.\(^2\) The lead and zinc were standard brands and were mixed with raw linseed oil. The dressings were applied at different periods and upon wounds of various ages. Thus, certain trees were pruned in winter and treated at once, while others were left six weeks before being covered; other trees were pruned in the spring and immediately covered. The experiments divide themselves, therefore, into the four following heads under which they will be discussed:

I. The immediate treatment of winter-pruning wounds of apple trees.

II. The delayed treatment of pruning wounds of apple trees.

III. The immediate treatment of spring-pruning wounds of apple trees.

IV. The immediate treatment of winter-pruning wounds of peach trees.

I. IMMEDIATE TREATMENT OF WINTER-PRUNING WOUNDS OF APPLE TREES.

About the first of March, 1911, a number of standard varieties of apple trees grown upon dwarf stock and eight years from setting were pruned and the wounds treated at once. None of the wounds were over two inches in diameter. Groups of seven trees each were treated with white lead, white zinc, yellow ochre, coal tar and shellac. From two to three wounds were protected on each tree with an equal number left untreated to serve as checks. All of the trees were hardy and healthy and were making a strong, vigorous growth. The pruning was done as generally practiced in commercial orchards. Thick coatings of the materials used were applied to the wounds and the cut surfaces were all thoroughly covered,

\(^1\) Coal tar or gas tar, as it is frequently called, is the residual tar obtained from the distillation of bituminous coal used in gas making. There are so-called "coal tar" preparations which are produced by dissolving certain asphaltum compounds in gasoline or naphtha but such preparations were not used in these experiments.

\(^2\) Carbolineum, derived from the Latin words carbo, coal, and oleum, oil, to make a fancy name for a new commodity, is a distillation from coal tar or bituminous shale, containing phenoloid hydrocarbons of a highly preservative nature. The material used in these experiments is sold under the trade name avenarius carbolineum, from the fact that Richard Avenarius, a German, first recommended carbolineum as a wood preservative.
but care was taken to prevent the dressings from trickling down the trunks or branches.

At the end of the growing season of 1911, all of the wounds had healed more or less. Some of the smaller cuts showed a considerable amount of newly formed bark. In all cases the wounds which had been treated with the several substances, except shellac, showed that some of the cambium tissues at the lower edge of the cut surfaces had been injured, thereby increasing the size of the wounds. No such injury was apparent upon the untreated wounds or those coated with shellac. The exposed surfaces of the untreated wounds were all more or less cracked and checked due to drying out caused by the action of sunlight and atmospheric factors. No appreciable difference could be noted in the amount of healing of the smaller wounds, whether treated or untreated. With those of greater diameter, however, there was a slightly increased bark growth on the untreated wounds and those dressed with shellac.

At the close of the growing season of 1912, practically two years after the experiment was started, the majority of the wounds were nearly or completely healed. In some few cases cankers had started, either at the point of the wound or on the trunk or an adjoining branch. Cankers were as often found on the treated as on the untreated wounds. For the most part, however, the trees remained healthy, and normal growth had ensued. It was found that owing to the enlargement of the wounds treated with ochre, lead and zinc, much of the surface of the larger wounds still remained bare. The sides and top of the cut showed the greatest amount of new bark with less growth at the base where the material had collected. Coal tar caused a slight injury in several cases. There was no such injury where shellac had been used. The lead and zinc still remained intact over the surfaces of the unhealed wounds, leaving no cracks or crevices. Much of the shellac, however, had crumbled away leaving the wounds so treated somewhat dried out. Even the ochre and tar had been considerably affected by the weathering. As a whole the results were better upon the untreated wounds than upon those covered with the various preparations other than shellac.

Early in March, 1912, a number of seedling apple trees seven years from planting were treated with the same preparations used in the first experiment. Here again wounds up to two inches in diameter were made. Groups of four trees, each with three or four
wounds, were used for the different substances; while eight adjoin-
ing trees were pruned and the wounds left untreated to serve as
checks. The wounds made were for the most part upon the trunk
or at the base of some of the larger branches. At the close of the
growing season of 1912, newly formed bark was formed on the
majority of the wounds, whether treated or not. Injury was again
very apparent on all wounds treated with ochre, lead, zinc and coal
tar. No injury was found where shellac had been applied. On
the contrary this substance had seemingly stimulated growth,
there being, apparently, a greater amount of callus formation on
these wounds than on those which had not been treated. All of
the untreated wounds showed a cracked and checked surface due
to drying out. Some of the smaller ones were already nearly covered
over and on none was there any indication of fungi.

At the end of the next season, 1913, final observations revealed
a condition not unlike that found the second year in case of the
preceding experiment. The wounds upon which shellac had been
used and those which had received no treatment showed the greatest
amount of new growth. Fully half of the total number of such
wounds were practically closed in. There seemed to be no per-
ceptible difference between the amount of healing of those treated
with shellac and those left as checks. The first year, shellac seemed
to stimulate growth slightly but this was not apparent the following
season. At the time of examination most of the shellac had scaled
off leaving the unhealed wounds somewhat cracked and dried out.
The wounds treated with ochre, lead, zinc and tar all showed evi-
dences of injury caused at the time of application. While practically
all wounds were forming some new bark, the basal portion was
in every instance relatively poorly healed. The substances used
still remained intact, except that the tar had partly disappeared
owing to absorption and evaporation. Much of the ochre had also
disappeared. This material seemed to cause the most pronounced
injury, lead and zinc being somewhat less harmful but each of the
two to practically the same degree.

These experiments were further supplemented by another of similar
nature in 1913. Early in March, wounds made upon a number
of standard varieties of apple trees averaging 30 years old were
treated with yellow ochre, white lead, white zinc, coal tar, shellac,
and avenarius carbolineum. Wounds were dressed with the various
materials on groups of four trees, each with from two to three wounds, while an equal number of wounds were left untreated to serve as checks. Since it had already been proved that small wounds heal more readily without any treatment, in this experiment wounds 3½ to 5 inches in diameter were made. It is, of course, obvious that the larger the wound the longer will be the time required for its healing and the greater will be the danger of the entrance of fungi and insects.

At the end of the season it was found that of all the preparations used on the large wounds, shellac was the only one which caused no injury, and even this, in case of one wound heavily coated with it, caused a slight killing of the cambium tissues. On the other hand, shellac usually stimulated growth and, as a rule, the wounds so treated the first year seemed to have healed somewhat better than the checks. The untreated wounds, however, were all in good condition and, although more or less cracked and dried out, were free from any fungus. These wounds had made a greater progress in the formation of a new woody covering than any of those treated with preparations other than shellac. Of all the substances detrimental to the formation of a covering, avenarius carbolineum stood at the head. In fact, this substance was so injurious to the tissues, not only at the base but entirely around the wound, that there had been little or no healing. Even the woody tissues appeared dead owing to the absorption of the material. Carbolineum may be an excellent preservative but as a dressing for pruning wounds it is most injurious. All of the other wounds treated with ochre, lead, zinc and coal tar showed some injury but many had started new bark formation. Of these others, those treated with tar presented the smallest amount of injury while those upon which ochre was used exhibited the greatest amount. The lead and zinc caused a considerable killing of cells around the entire cut surface although this was most pronounced at the base. In fact the bark immediately surrounding the base where the paint had collected was frequently dead. Some new bark, however, was found around most of the wounds so treated.

At the close of the season of 1914 final observations were made upon these trees. In every case the untreated wounds had made a better formation of new bark than those covered with the various materials other than shellac. Practically no difference could be
determined between the amount of new bark formed upon wounds of these two classes. While the shellac had in the majority of instances nearly all flaked off leaving the unhealed surfaces of the wounds somewhat cracked, this cracking was not as apparent as on those receiving no treatment. Although only the smaller wounds were considerably healed, in no instance were any of the untreated wounds failing to make some growth. Occasionally here and there a wound rather poorly made, or upon a branch lacking vigor, was failing to heal rapidly but there were no evidences of any fungus attacking or entering such wounds. It should be remembered that these trees were relatively old and the healing process was naturally much slower than on younger trees. Moreover the wounds were of considerable size and therefore would require several years before closing in completely.

Of the protective coverings used, avenarius carbolineum again caused the most serious injury. Where it had been applied, practically no new bark had been formed. The injury to the entire wound at the time of application had so enlarged the surface and had so weakened the surrounding tissues that there is doubt as to whether complete healing could ever occur. Only traces of a new callus showed here and there. In several cases a considerable strip of bark directly beneath the wound was killed. The untreated wounds on the trees where carbolineum had been applied were all making considerable growth. Wounds upon or nearest the trunk, especially those carefully made, were making the greatest growth. All of the unhealed surfaces, however, showed a cracking and checking due to drying out but upon none was there any indication of the entrance of a fungus.

All of the other materials heretofore mentioned caused greater or less injury. Yellow ochre, while not as injurious as carbolineum, caused considerable injury. Furthermore, the substance adhered poorly, leaving the surface of the wounds dried out, thus affording as easy an access for diseases as those not treated. Lead and zinc adhered well but caused considerable injury although the wounds were overcoming this set-back and closing in. The unhealed surfaces at this time were fully protected by a good coating of the paint. The coal tar was considerably absorbed but the wound surfaces were in good condition aside from the injury caused by the use of it. Manifestly, all of the coverings used except shellac had
at first exerted a deleterious influence upon the formation of bark growth. Only two of the preparations, lead and zinc, adhered to the surfaces at all well. The others besides being injurious proved to be valueless as permanent dressings for pruning wounds. Lead or zinc, notwithstanding the initial injury caused, was the most valuable of all the materials for use on large wounds.

II. DELAYED TREATMENT OF PRUNING WOUNDS OF APPLE TREES.

Early in February, 1911, a number of dwarf apple trees eight years from setting were pruned. The last of March, after the cut wood had thoroughly dried out and the surface of the wood had become seasoned, dressings of yellow ochre, white lead and zinc, coal tar and shellac, were applied. Groups of six trees each were treated with the various dressings, two wounds on each tree being protected while two others were left untreated to serve as checks. None of the wounds exceeded two inches in diameter. Thick coatings of the materials were applied yet care was taken that the cut surfaces only should be covered. Observations at the end of the growing season of 1911 revealed a certain amount of new bark formation on all of the wounds. This new growth was greatest upon those treated with shellac and upon the check wounds. No difference was noticed in the amounts of new bark formed on the wounds of these two classes. Possibly the shellac had stimulated healing — certainly it had not been a retarding factor — but the differences in growth were so slight as to be negligible. Less growth was made on the wounds treated with the other materials. Many of the wounds had been enlarged at the base and but little new growth was made at this point. Those upon which ochre had been applied appeared to have suffered the most serious injury.

At the end of the next season, 1912, just before the trees were discarded, a final examination showed that many of the wounds were nearly closed in. The untreated wounds and those upon which shellac had been applied exhibited the greatest growth. Most of the shellac had crumbled away which resulted in the drying out of the unhealed surfaces. The injurious effects caused by the application of the other materials were overcome to a large extent by the formation of new bark, yet the healing on all of these was less advanced
than on those which had received no treatment. Both the yellow ochre and coal tar were considerably impaired by weather conditions. The lead and zinc, however, remained intact.

It is a common supposition that dry wounds hold protective preparations more effectively than those freshly pruned but this fact was not substantiated. No differences could be found regarding the adhesive properties of the dressings whether applied to dry wounds or to those freshly cut. Nor did there appear to be any difference in the degree of injury or in the amount of new growth formed, between the wounds treated at once and those which were first allowed to dry out. There was no indication of fungus diseases attacking either the wounds treated or those left untreated. To be sure, all of the wounds were small and the length of time required for healing would be relatively short thereby lessening the chance of fungus attacks.

In this experiment it was plainly to be observed that the wounds upon the trunk and lower branches closed in more rapidly than those farther removed. Likewise the closer the wound was made to the axis of the stem, the more readily it healed. This was true in a lesser degree for the treated wounds than for those left bare.

Yellow ochre again proved to be the most injurious material used, with lead, zinc and coal tar closely following. It must not be thought that there was any vast difference in the amount of injury caused by these various substances. Such differences were slight — in fact often hardly to be estimated.

III. IMMEDIATE TREATMENT OF SPRING-PRUNING WOUNDS OF APPLE TREES.

The last of April, 1911, groups of five to eight dwarf apple trees each with from two to three wounds not exceeding two inches in diameter were treated with the same substances as in the last experiment. These dressings were applied immediately after the pruning, before the wounds were allowed to become dry. Other wounds upon each tree were left untreated to serve as checks. The effect of the treatment at this season of the year seemed to be not unlike that of similar dressings applied when tree growth was dormant. At the end of the growing season, 1911, all of the wounds showed some new callus growth. Nevertheless, all of the materials,
except shellac, caused the same injuries noted in the other experiments. Most of the wounds had been enlarged and new bark had but slowly started. The untreated wounds presented more new growth than any of the others. Those treated with shellac were next in this respect. This material still remained intact over the wound surfaces.

The results noted at the end of the second year following the pruning were very similar to those obtained in previous trials. They can be summed up by saying that the untreated wounds presented the greatest amount of new growth, although closely followed by those upon which shellac had been applied. Yellow ochre had caused more injury to the tissues than the other materials, yet each of these in turn had produced some injury. No differences were noted between the adhesive qualities of the dressings applied in late spring and those used during the dormant season, nor were there differences in the relative amounts of new growth formed. Not in a single instance was there any indication of disease. As a whole the final outcome of this experiment was so nearly like that of the one last mentioned that further elaboration is unnecessary.

IV. IMMEDIATE TREATMENT OF WINTER-PRUNING WOUNDS OF PEACH TREES.

The first of March, 1912, a number of varieties of standard peach trees, five years from planting, were treated with materials identical with those used in the last two experiments, namely, yellow ochre, white lead, white zinc, shellac and coal tar. Groups of five trees, each with from three to four wounds, were treated with the various substances. Ten adjoining trees in the same orchard were also pruned and the wounds left untreated to serve as checks. None of the wounds made exceeded one and one-half inches in diameter and most of them were somewhat smaller. All of the trees were vigorous and thrifty and making a strong growth.

Observations showed, as the summer of 1912 advanced, that all of the materials except shellac were causing considerable injury. But little new callus was being made and a thick deposit of gum was becoming apparent over all of the wounds. This was less noticeable upon those wounds treated with shellac and rarely apparent on the untreated wounds. Such a result would clearly be indicative of
severe injury to the cambium tissues due to the penetration of the various preparations. After the dormant period of the trees was reached, similar conditions existed—possibly more pronounced. Scarcely any new bark was observed on the treated wounds except on those covered with shellac, yet here there seemed to be increased gumming. The wounds protected by shellac had for the most part made considerable new growth but not as much as had those left untreated. The unhealed surfaces of these wounds were considerably seasoned yet they remained clear and free from any disease.

At the end of the following year, 1913, the untreated wounds and most of those upon which shellac had been applied had healed well. The majority of the untreated wounds were practically entirely closed in, especially those located upon the trunks and lower branches. A few still remained partially healed but none of these showed any indications of fungi. As a whole, however, these wounds and those treated with shellac showed very satisfactory results. An entirely different outcome was evident with the trees the wounds of which had been treated with ochre, lead, zinc and coal tar. Large amounts of gum covered nearly every wound. Little or no growth had taken place. The wounds had been enlarged and in a few instances there was doubt as to their ultimate ability to heal. All of the substances applied, excepting shellac, appeared to have equally injurious effects.

The inability of the peach trees to withstand and overcome such serious injury to their growing tissues as was caused by the several dressings was very evident. The increased gumming, a common occurrence on the wounds of this species of trees, was a manifestation of this injury. Inasmuch as the pruning wounds of peach trees, like those of all trees of this class, are relatively small and readily healed, the time spent in applying protective coverings is worse than wasted as it often results in injury.

CONCLUSIONS.

When one comes to deal with practices going back several hundred years, as does the covering of pruning wounds with protective dressings, care must be exercised in drawing conclusions. But from the results of this experiment several deductions seem quite warranted. First, the dressings commonly applied to pruning wounds
retard rather than accelerate the healing of the wounds. Second, the effects are the same whether the dressings are applied when the wounds are made or some weeks later when the cut surface has dried out. Third, the effects of the dressings used are so injurious to peach wood that wounds on peach trees should never be covered. Probably this statement holds true for other stone fruits as well. Fourth, these experiments suggest that the popular notion that wounds need to be covered with some dressing to prevent the entrance of fungi, in sprayed orchards at least, is usually exaggerated. It is doubtful if it is necessary to attempt to prevent decay by applications of dressings of the kinds under discussion in wounds under four or five inches in diameter. It remains to be proved whether they have any real value in covering large wounds. It may be suspected that the injury caused by the dressings when applied to the wounds, largely, if not wholly, offsets, or even overbalances, the protection offered, if there be such, against decay.