SPRAYING AND FUMIGATING FOR SAN JOSÉ SCALE.

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SPRAYING AND FUMIGATING FOR SAN JOSE SCALE.

F. H. HALL.

CRUDE PETROLEUM EXPERIMENTS.

Against scale insects, Paris green and other arsenites are valueless. At no time in their existence do these minute creatures eat the outer parts of fruit or leaf or stem so that such poisons can affect them.

The little larvae, however, can be killed quite easily by contact insecticides when they first begin life and move about, unprotected, upon the surface near the mother scales. These latter, and the young after they have settled down and covered their backs with the protective scales, can also be destroyed by the same contact insecticides, which, with a little more difficulty, will reach the living insects under their shelters.

By contact insecticides are meant those substances like kerosene, whale-oil soap, tobacco dust, pyrethrum, etc., which cover or touch the bodies of insects, fill up their breathing pores, and thus destroy them.

A new insecticide.

Among the latest on the list of such insecticides, and for some purposes the best of all yet tested, is crude petroleum. This heavy, oily, inflammable liquid is the untreated product of the oil wells, a complex mixture of paraffin, light, vola-

*This is a brief review of Bulletin No. 202 of this Station, on San José Scale Investigations: III, by V. H. Lowe and P. J. Parrott. Any one specially interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete bulletin. The names of those who so request will be placed on the Station mailing list to receive future bulletins, popular or complete as desired. Bulletins are issued at irregular intervals as investigations are completed, not monthly.
tile oils, heavy oils, tar-like substances, and a long list of chemical compounds of which many are of great value in art, medicine or manufactures. It is the heavy oils which give it special importance as an insecticide; as these remain upon the sprayed trees for a long time without evaporating, gradually spreading beneath the scales or soaking down to them from above and killing the concealed little pests which draw the life from the trees. Too large a proportion of these heavy oils, however, is dangerous to the trees themselves. All investigators who have tested crude petroleum warn orchardists against using any grade of it which contains enough of these heavy oils to bring its specific gravity below 43° on the Baumé oil test scale.

In applying the petroleum it is usually emulsified—that is thoroughly and intimately mixed—with water, so that it can be spread by the spray pump in a very thin coating over all parts of the tree. The undiluted substance is liable to be applied too freely in the effort to have all parts covered by it, which is wasteful; or portions of the tree are not covered, which may allow some scales to escape. The crude petroleum costs from about 8 to 14 cents a gallon according to quantity purchased and to locality.

Some recent tests. In experiments carried on in states south of New York, undiluted crude petroleum of the accepted specific gravity appeared not to injure ordinary orchard trees when sprayed upon them; while emulsions containing as little as 20 per cent of the petroleum seemed effective in destroying the scales. In tests made in Eastern New York by the State Entomologist, however, the undiluted crude petroleum seriously injured the trees.

Station tests. These results conflict seriously and indicate that something, possibly differences in methods or care in applying, but more probably climatic or local influences, render tests elsewhere unsafe guides for Western New York conditions.

To obtain additional data as to the effectiveness and the possible injurious effect of the new insecticide in this, the principal fruit-growing section of the State, the Station has, during the past year, carried on extensive series of tests.

The first series was planned to test only the effect of the petroleum on uninfested, healthy trees. The second and more extensive series, upon trees infested with scale, tested the power of the substance as an insecticide. Results in this series could also be considered in the first series, as the effects of the different percentages of petroleum upon the trees were noted as well as the effect upon the insects. In this latter series, though, trees might sometimes appear injured by the spraying which would not have
been harmed unless already weakened by the attacks of the scale. In both series undiluted petroleum was used upon some trees and upon others emulsions containing 25, 40 or 60 per ct. of the petroleum with 75, 60 or 40 per ct. of water. The emulsions were made by a pump which combined the two substances at the nozzle. This gave perfect and lasting emulsions which varied but a trifle from the percentages for which the pump was set.

In all, 321 trees were treated—apple, cherry, pear, peach and plum—in four different orchards. The trees were sprayed until they began to drip and great care was taken to cover all parts. All the treatments were upon dormant trees, some being sprayed in the late fall or winter, others in the spring, while a few received both applications. Of the plum, pear, and cherry trees in the first series, none were injured by the 25 per ct. emulsion. Plum trees were seriously injured by the 40 per ct., 60 per ct. and undiluted petroleum. Some old and enfeebled Reine Claude trees under test suffered severely, half of those treated with 40 per ct. emulsion being seriously damaged; while 5 out of 8 treated with 60 per ct. petroleum, and all of those sprayed with the undiluted were killed. The younger and more vigorous plum trees, though affected considerably by emulsions of 40 per ct. or stronger, were not hurt beyond recovery except by the undiluted petroleum.

In the second series peach trees were badly affected even by the 25 per ct. emulsion. Apple trees were affected in some instances by the 40 per ct. petroleum, but where the trees were vigorous and not weakened by heavy trimming they escaped injury at this percentage.

In all cases the fall and early winter treatments caused greater injury than spring spraying; and trees which received both applications suffered worse than those sprayed but once.

Contrary to most of the previous experience, the second series of tests, on infested trees, showed that the 25 per ct. emulsion could not be depended on to destroy the hibernating scales; but the 40 per ct. strength was effective in every instance.

From these tests it seems quite conclusively proven that, for Western New York, crude petroleum can be used with safety upon apple, cherry and pear trees at a strength sufficient to kill the scales, 40 per ct.; that it must be used with care upon plum trees; and that it is liable to kill peach trees at any strength that will kill the pests infesting them. The spraying should be done in the spring, but before the trees have begun to start into growth.
Taking care to omit peach trees and any old or feeble plum trees and to spray only in early spring, just before the buds start, orchardists may safely use the 40 per ct. emulsion of crude petroleum and may count on killing the scales on the sprayed trees.

**Fumigation with Hydrocyanic Acid Gas.**

The character, method of using and value of **Most sure** hydrocyanic acid gas have been thoroughly dis-scale-killer. cussed in previous bulletins* of the Station; so that these points need not be taken up here. It is undoubtedly the most efficient insecticide we have against scales and is gradually coming into use in combating many other insects such as the destroyers of stored grain, household pests and greenhouse insects. As with crude petroleum, however, the limits of its effectiveness and safe use have been differently fixed by different investigators. To find out which of the results are applicable to Western New York conditions the Station has just made extensive and careful tests.

Since it is often necessary to fumigate nursery stock, it is essential to know whether the gas will injure dormant buds, and, if so, what percentage is safe to use. In the Station tests, large numbers of buds of apple, cherry, pear, peach and plum were fumigated for one-half hour or one hour with gas of varying strength, produced by the use of from 0.18 gram to 0.30 gram of potassium cyanide to each cubic foot of space. Check buds were set at the proper time for each sort, but some of the treated buds were put in a little later and under slightly less favorable conditions. In spite of these disadvantages, the setting of the buds showed only a slight difference in favor of the checks and this difference was no greater, except in case of peach, where the strongest gas was used. The peach buds showed slight evidence of injury with the 0.30 gram charge. This shows that conditions of setting, rather than the fumigating, were responsible for the differences, and proves it safe, except for peaches, to use at least 0.30 gram of cyanide per cubic foot in treating bud sticks.

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* Nos. 174, 181 and 194.
Infested orchard trees were fumigated under box fumigators such as are described in Bulletin No. 181. In this style of fumigator it is possible to use gas of fixed strength, so that accuracy in results is secured. Infested pears, peaches and plums were fumigated, some trees being treated in the winter, others in the spring. There was no injury to trees except in the case of peach, and so few peach trees were treated that it is unsafe to draw conclusions from this one test. The plum and pear trees were uninjured, even when .30 gram of cyanide was used and the fumigation continued for an hour.

Spring fumigation was much more effective in killing the scales than winter treatment with gas of the same strength; for neither 0.18 gram nor 0.25 gram of cyanide produced gas strong enough to kill the hibernating scales when the fumigating was done in December. It required 0.30 gram per cubic foot to destroy the insects in this instance, but 0.18 gram was enough to kill every scale when the fumigation was delayed until early June.

From these tests and previous investigations the following suggestions are made: The greatest recommendations. possible care should be used to prevent infection with San Jose scale, buying only from inspected nurseries, or better, demanding fumigated stock. Constant watch should be kept for the scale as it may be spread to considerable distances by birds and insects. If a single tree is found to be badly infested it is best to cut it down, when the insects will soon die. On large trees, under some conditions, the insects may live long enough to produce young and perhaps spread the trouble; but if the tree is burned immediately the beneficial parasites are destroyed as well as the scales. Large orchard trees can not be fumigated easily, but may be treated with a wash or spray, of which crude petroleum is best, as noted in the first part of this bulletin; and small orchard trees can be fumigated with hydrocyanic acid gas. If fumigation is done in the winter, either in orchard or in nursery packing house, use 0.30 gram of cyanide per cubic foot. Spring fumigation in the orchard is most effective and only 0.18 gram of cyanide need be used.
Change in Station Fumigat or.

The box style of fumigator is much easier to handle than the tent form, is less liable to break off buds and branches and is always of the same size so that the amounts of chemicals to be used for a charge need to be computed but once.

The box described in Change. Bulletin No. 181 was not convenient in closing; as several buttons had to be driven around to hold the door securely. By a simple modification these buttons are done away with and the time required to handle the fumigator is greatly lessened. Four strips are attached securely across the door in a horizontal position. These have their ends beveled as shown in Fig. 1, a, and fit into blocks bolted to the door casing, as shown at b. The figure shows the position of block and end of strip when the door is tight. Raising the door frees it. When the next tree is reached and the box is in position, the door is raised so that the ends of the strips are above the blocks. Dropping the door secures it quite firmly and a few light taps force it so close that the box is made gas-tight. The strip at the top of the box against which the top of the door rests has to be made wider than is given in Bulletin No. 181 and the blocks must be so placed that the bottom of the door does not quite touch the little projecting irons at the foot of the casing.