SUMMARY OF FUMIGATION AND DIPPING EXPERIMENTS

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The desire to verify the results of the rather limited amount of work conducted by other investigators on the effect of various strengths of hydrocyanic acid gas with different exposures upon tender peach buds and at the same time to demonstrate to the nurserymen of the state the great importance of fumigating all propagating stock to prevent the introduction and dissemination of the San José scale prompted us to conduct a series of experiments with this gas during the past three years. The experiments in fumigating buds were conducted at two nurseries in the state under as normal conditions as possible. In addition a series of tests with salable nursery stock badly infested with San José scale was conducted to observe the effect of the gas upon the scale and trees. The trees were fumigated at the nursery and planted out on the Experiment Station Farm. I cheerfully acknowledge the assistance of Messrs. A. B. Gahan, Geo. P. Weldon and L. M. Peairs in conducting these experiments.

1. On September 7, 1906, 505 peach buds were fumigated with 0.40 and 0.50 grams cyanide per cubic foot and exposed to the gas for 30 minutes and 805 peach buds were fumigated with the same strengths of gas and exposed to the gas for one hour. There was a check of 750 buds. The buds were cut from the Early Crawford, Late Crawford, Reeves Favorite, Elberta and Beers Smock varieties of trees in the nursery. The check buds were taken from the same varieties of trees.

An examination of the buds in the experiment October 3, 1906, more than a month after fumigation, showed an average of 98.5 per cent of the buds to be alive, while an examination and count of the buds August 30, 1907, showed 62.6 per cent of those exposed to the gas one half hour and 53.2 per cent of those exposed one hour to be alive. Only 20.9 per cent of the buds in the check were alive at the final examination. The normal per cent to grow in this state is from 60 to 65 per cent.

2. A second experiment conducted at another nursery September 1, 1906, consisted of 2,647 peach buds, Elberta and Champion varieties about equally divided into different tests. They were fumigated with 0.15, 0.18, 0.20 and 0.25 grams of cyanide per cubic foot, with 30 and 60-minute exposures.

An examination of these buds October 9, 1906, showed only 41.2 per cent as an average of buds alive fumigated with the various strengths gas and exposed for 30 minutes, while 49.1 per cent was the average of

those alive that were exposed to the gas 60 minutes. This very poor stand, due to excessive wet weather in the experiment as well as throughout the field, caused the abandonment of further observations. It may be said that it so happened that in each test the 60-minute exposure gave a larger per cent of live buds than the 30-minute exposure at this examination.

3. On September 7, 1906, 270 peach buds cut from orchard trees were fumigated with 0.285, 0.35 and 0.40 grams of cyanide per cubic foot, with an exposure of 30 minutes. An equal number of Elberta and Heaths Freestone varieties were employed in each test and all buds were known to be infested with San José scale.

An examination of the buds on October 13, 1906, showed 100 per cent of the buds in all tests to be alive, while at the final examination, August 30, 1907, an average of 34.2 per cent of the buds were alive. At this examination no live scale could be found on any of the buds, showing that all the strengths killed the scale.

4. On August 27, 1907, 624 peach buds, Late Crawford variety, were fumigated with 0.18, 0.20 and 0.30 grams of cyanide per cubic foot, exposed 45 minutes. All buds in the test were known to be infested with the San José scale. At the final examination, September 10, 1908, an average of 52.7 per cent of the buds in the test and 52.2 per cent of those in the check, which were not fumigated, were alive. No live scale could be found on any of the buds fumigated.

5. On December 4, 1906, 500 nursery trees were fumigated in ten different lots of 20 peach and 30 apple with 0.15, 0.20, 0.30, 0.40 and 0.50 grams cyanide per cubic foot, for 30 and 60 minutes respectively. All trees were badly infested with the San José scale.

At the final examination of the trees, September, 1907, all were living and vigorous. Living scale was found on some of the trees in each test below those fumigated with 0.30 grams per cubic foot, with an exposure of 60 minutes.

A second experiment, consisting of 8 tests with 10 apple trees in each, badly infested with scale, fumigated with 0.15, 0.20, 0.28 and 0.50 grams cyanide per cubic foot and exposed 30 and 60 minutes respectively, was conducted November 2, 1906. This lot of trees were delayed *en route* to College Park and accordingly were not in good condition for planting upon arrival. For this reason no accurate conclusions can be drawn, but at the final examination an average of six trees in each test were living and no more trees were dead in the test with the highest strength of gas and the 60-minute exposure than in the test of the weakest gas, with shortest duration of exposure. Further

living scale was found on some of the trees in each test below 0.20 grams per cubic foot with the 60-minute exposure.

Conclusions

The experiments in fumigating buds demonstrate that a much higher strength of gas and longer exposure than is ordinarily recommended, viz., 0.16 to 0.20 grams per cubic foot, can be employed without endangering the vitality of the buds, and that the exposure to the gas, even at the normal recommended strength, should be at least 45 minutes. In fumigating nursery trees at the normal recommended strength, viz., 1 ounce of cyanide to 100 cubic feet, the duration of exposure should be one hour, and if less time is desired the strength of the gas may be increased with perfect safety to the trees, in order to insure as far as possible the killing of any scale that may be present.

Dipping Experiments

Numerous inquiries as to the effectiveness and practicability of dipping nursery trees in lime-sulfur or other spray mixtures as a preventive against the dissemination of San José scale, either for the purpose of substituting such treatment for fumigation with hydrocyanic acid gas at the nursery or giving such additional treatment by the orchardists before planting as a further means of killing any scale that may have escaped previous treatment, led us to conduct a series of experiments in dipping during the last three years. The tests were not as extended as was desired on account of various circumstances, but the results will add to the rather limited amount of work published on the subject.

1. During March, 1906, 240 dormant nursery trees were dipped instantaneously in the lime-sulfur and salt wash, which was boiled for one hour with steam.

a. 40 apple and 20 peach were dipped, roots and stems in the mixture at a temperature of about 170 degrees Fahrenheit, and a like number were dipped, stems only, in the same mixture.

At the final examination, September, 1906, all trees in the first lot were dead. Only two had started to grow, and all the trees in the second showed that their stems had been scalded. 23 apple and 16 peach in this test had started at or near the top of the ground and were growing.

b. 40 apple and 20 peach were dipped, roots and stems, in the mixture, at a temperature of 120 degrees Fahrenheit, and a like number were dipped, stems only, in the mixture at the same temperature.

Of the first lot, only 10 apple and 3 peach were alive, and of the second, 30 apple and 19 peach were alive and doing well.

2. 69 apple and peach trees were dipped instantaneously, tops only, in the lime-sulfur wash, at a temperature of 122 degrees Fahrenheit, April 27, 1907. In addition about 100 well-grown plants of California privet were dipped in the same solution. Both the trees and privet were infested with the San José scale.

Examination November 29, 1907, showed no injury apparent and no scale could be found on any of the plants.

3. On November 29, 1907, about 200 peach and apple trees, 100 of which were infested with San José scale, were dipped in five different solutions, viz., home-made lime-sulfur at 100 degrees Fahrenheit, Scalecide, Target brand emulsion, Soluble Oil and Kiloscale, the oils being diluted 1 to 15. Part of the trees were dipped roots and stems, and stems alone, in each solution, also scaly trees were dipped in each wash.

Examination of the trees during the past summer and finally October 16, 1908, showed no trees to have been injured in any way by any of the solutions and further no scale could be found on any of the trees.

4. The above experiment was duplicated as far as possible this past spring, the trees being dipped in the same solutions, except that San-U-Zay was substituted for Kiloscale, April 14 and 16, 1908.

Examination of these trees during the past summer and finally October 15, 1908, showed more or less injury by the various oil solutions, but this is no doubt due to the fact that all the trees used in the experiment were just beginning to leaf at the time of dipping. All the trees dipped in the lime-sulfur wash lived and seemed not to be hurt by the solution, while all the trees in two tests dipped in San-U-Zay died. All the trees in the check lived and were thrifty. Further, no scale could be found on any of the trees that were infested before dipping at the final examination.

Conclusions

The experiments of 1906 showed that dipping dormant nursery trees, either roots and stems, or stems alone, in the lime-sulfur wash, at a temperature from 122 degrees to 172 degrees Fahrenheit, may be expected to be attended by severe injury to the trees.

In the 1907 and 1908 experiments no difference could be detected from the appearance of the trees dipped, roots and stems, or stems only, in the lime-sulfur, at a temperature of 100 degrees Fahrenheit and in the various oil mixtures at the strength of 1 to 15. However,

we believe that the dipping of the roots of trees in any of the mixtures at any time to be a rather questionable procedure. They also show that only strictly dormant nursery stock should be dipped in any of the solutions used.

While no scale developed on any of the infested trees after the treatment in either experiment, in view of the published results of other experimenters and the limited number of infested trees included in these tests, we consider that these results may be inconclusive.

Finally these varying results go to show that further experimentation is necessary in order to establish what may be expected from such treatment, even if its adoption for general use should become desirable.

PRESIDENT FORBES: Any discussion on this paper?

A MEMBER: I would like to ask whether you would recommend dipping to the grower who wants to take every precaution to have his trees free from scale? I had that question from a correspondent the other day and would like information concerning it. We get scale right along on our trees when the certificate says they have been fumigated. With the average man fumigation is a little difficult. Is fumigation safe enough and satisfactory enough to warrant our advising growers to dip the nursery stock, omitting dipping the roots?

MR. PARROTT: We have made some experiments in dipping trees. If the farmer desires to dip, I would suggest that he use one of the miscible oils. I do not believe that the lime-sulfur wash has the penetrating qualities of the miscible oils, for in our comparative tests of these sprays we have had much better results with the latter. Moreover, I do not believe that the average farmer will fumigate, and if he desires to treat his trees before planting, I would suggest a miscible oil, but I think it would be better for him to plant his trees first and then to spray them with either the lime-sulfur wash or a miscible oil.

MR. SKINNER: Mr. President, I don't know that it has ever been tried in dipping, but I would like to have some one try solutions of potassium cyanide of varying strength. It ought to be very effective and very cleanly and inexpensive.

MR. J. B. SMITH: I would like to answer Doctor Skinner that it is extremely effective. It kills every plant dipped in it.

MR. SKINNER: I would like to ask Doctor Smith the strength?

MR. J. B. SMITH: I run it down to where it wouldn't hurt insects and it still killed every plant I tried it on.

MR. PARROTT: Since this question has come up, I would like to ask if any of the members have tried any of the concentrated tobacco pre-

parations for the woolly aphis. I have always thought there might be some field of usefulness for these preparations, as dips for this pest.

A MEMBER: Mr. President, last year part of our trees were dipped in a tobacco preparation for the woolly aphis and for the green aphis on the tops. We expect to dip about 20,000 this year. I hope that Mr. Parrott will try it. We are not certain how effective it is.

MR. HITCHINGS: Last week a gentleman came to me and asked if he would be allowed to bring scions from an infested district to Maine, as he wished to use them to graft his trees. He wanted to secure several thousand. Would it be safe to have these scions dipped or should they be fumigated?

A MEMBER: Fumigated every time, I should say.

[The remainder of the Proceedings will appear in the next issue.—ED.]

THE LIFE HISTORY OF THE ARGENTINE ANT

Iridomyrmex humilis Mayr

By WILMON NEWELL

A general account of this species and its habits appeared in the JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. I, p. 21 to 34 and accounts of twoinquilines occurring in its nests were given in the same volume, p. 262. On p. 289-293, Mr. E. Foster published an interesting account of the introduction of this ant into New Orleans.

The present paper is intended to deal only with the more salient features of this insect's life history which have been brought to light in the course of the author's studies during the past two years.

There are but three adult forms in the case of this ant, the queen, male and worker. Of the immature forms there are three, egg, larva and pupa, of each the queen, male and worker. There is hardly sufficient difference between the virgin queen and the dealated queen after fertilization to justify considering them as distinct forms. A possible fourth stage may be recognized in the "callow," which is the term used by some writers in referring to the worker which has completed its transformation from pupa to adult but which has not attained the normal worker color and activity. A complete colony may therefore consist of queen and workers only, of queens and workers or of queen (or queens), males and workers: with each of these combinations may be associated any one or all of the three immature stages corresponding to each of the three adult forms, or