

In brief the treatment consists of tarring the seed as is often done to keep crows from feeding upon it. The seed was then placed in a bucket containing fine dust and Paris green mixed in such proportions that the corn, after being shaken up in the bucket, showed a greenish color. The corn thus treated fed properly through the seeder and in every case came up satisfactorily, while check rows were badly injured. Examination of some of the corn thus treated, after about a week, showed that the wireworms were present close by the seed but that they did not molest the seed itself, apparently being repelled rather than destroyed by the treatment. It was evident that the germination of the seed was not affected, and it is probable that the Paris green was present in sufficient quantity to prove a fatal dose for crows which might attack it.

Soaking the seed in strychnine and other poisons gave far less satisfactory results than the one just given.

Further experiments may perhaps develop defects in this method, but none have as yet appeared, and it seems desirable to test it on a large scale in different parts of the country.

FUMIGATION, DOSAGE AND TIME OF EXPOSURE

By J. L. PHILLIPS, *Blacksburg, Va.*

The fumigation of nursery stock was begun in this state under the direction of Mr. W. B. Alwood in the fall of 1896, and soon came into general use in the Virginia nurseries. The fear of San Jose scale was felt very strongly during the first years of this work, and if nurserymen noticed injury from the use of this gas, our attention was not called to it. In fact, a number of nurserymen left their nursery stock exposed to the gas from 8 to 10 hours without noticing any ill effect.

A number of lots of nursery stock, infested with San Jose scale, were fumigated during these early years and examined the following summer without finding any living San Jose scale, and nurserymen and entomologists alike appear to have settled down to the conclusion that fumigation is effective, and that no injury need be expected if dormant nursery stock is fumigated according to directions usually given.

Of course every one recognizes the fact that for fumigation to be effective it must be conducted under the supervision of careful, intelligent men, who will carry out the directions in detail. Human

nature is very much the same the world over, and it requires some determination for the nurseryman in the height of the shipping season to demand that his workmen leave the fumigation house closed from 40 minutes to 1 hour, when he needs the stock to fill a number of orders, or to go through the fumigation process twice when he is quite sure the full amount of stock he has on hand can be crammed into the house at one time.

It is not surprising then that instances have come to our attention where stock that had been fumigated and set in orchards, remote from known cases of infestation with San Jose scale, develop this trouble. The fact that a large amount of adulterated potassium cyanide was on the market at that time also added to the difficulties.

Reports also began to reach us during 1903 and 1904 in regard to injury from fumigation. While we were sure, in the light of our experience in fumigation work, that some other agency was responsible for the trouble, careful tests were made during the fall of 1904, from which the conclusion was reached that nursery stock should not be injured by fumigation, as ordinarily recommended. In fact, no permanent injury to dormant trees treated with from 3 to 4 times the normal strength of gas was observed. Injury was noted in case of stone fruits, especially cherry, fumigated with the regular charge late in the spring after growth had started up. Messrs. Symons of Maryland and Burgess of Ohio carried out similar experiments about the same time with similar results.

The writer also had a large number of samples of cyanide on the market in the state during 1904 and 1905 analyzed, and found much of it to be impure. The close packing of nursery stock in the fumigation house, however, appeared to be one of the main sources of trouble. The writer's experiments on this phase of the question indicated that one could not expect fumigation to be effective against the San Jose scale on plants in the far corner of the fumigation house with an exposure of 40 minutes to this gas, even with ordinary 2 year apple stock if it is packed tightly. It also seemed impractical either to increase the charge or length of exposure to the gas sufficiently to fully compensate for the error of packing stock too tightly in the house.

Mr. Symons¹ found in his recent experiments: "That .30 grams with 30 minutes' exposure is hardly sufficient for fumigating trees known to be infested with San Jose scale (a little greater than ordinarily recommended) and that with this strength a 45 minute ex-

¹See bulletin 131, Md. Agr. Exp. Sta., College Park, Md.

posure should be made in order that the gas may be considered a fairly sure preventive." He also reached the conclusion:

"In fumigating nursery trees at the normal recommended strength, viz, 1 ounce of cyanide to 100 cu. ft., the duration of exposure should be 1 hour, and if less time is desired the strength of the gas may be increased with perfect safety to the trees, and insure as far as possible the killing of any scale that may be present."

While we had concluded from our various experiments and observations that a 60 minute exposure is preferable to a shorter length of time in ordinary nursery work, it was decided to call attention to these facts in a circular letter to state nursery inspectors, and request from them an opinion in regard to the length of exposure. Replies were received from 29 inspectors, practically all of whom expressed the opinion that a 45 minute exposure to the ordinary strength of gas is sufficient to kill the San Jose scale under best conditions of exposure, etc. All appeared to agree also on the point that no injury need be expected to dormant nursery stock even though exposed to the gas for a much greater period.

Mr. J. A. West of Illinois called attention to injury from fumigating cherry stock both in the fall and spring. Mr. Berger states that 45 minutes' exposure to a dose of 1 ounce is injurious to citrous nursery trees, but that the trees will stand this strength of gas if the roots are covered, so as to protect them from the gas.

Of the 29 entomologists replying to the above circular, one is recommending a 30 minute exposure, twelve a 40 minute exposure, four a 45 minute exposure, two a 50 minute exposure, and five a 60 minute exposure. Several did not express themselves in letter of reply, while nine who are recommending a less exposure, stated they had about decided to recommend a 60 minute exposure, or inclined strongly towards this recommendation.

At a meeting of the American Association of Horticultural Inspectors, held in Washington, D. C. November, 1903, the 1-2-4 formula was adopted and has now come into use generally. There appears, however, to have been a lack of any very definite experiments as to the chemical combination of the materials used in generating this gas, upon which to base this recommendation.

Recent work by Mr. R. S. Woglum, of the Bureau of Entomology,* in conjunction with the Bureau of Chemistry, appears to throw some light on the subject. From these experiments, it seems that 2 parts of water to 1 part each of acid and cyanide produces the maximum

*See bulletin No. 79, Bureau of Entomology, U. S. Dept. Agr.

amount of gas, but in this case the residue in the jar frequently congeals within 1 hour. It is stated however, that by using 3 parts of water the residue in the jar seldom congeals. It was found also that the greater the proportion of water used, (in addition to the maximum mentioned above) the smaller the quantity of gas evolved, until with 8 parts of water to one each of acid and cyanide less than 50 per cent. of the hydrocyanic acid passed off as gas.

As there now seems to be some definite experimental data to support the 1-1-3 formula, there appears to be no valid reason for not adopting it generally, and thus making the recommendation uniform. We prefer to state the formula in the order in which the chemicals are added, hence the change in position in the following:

Water.....3 fluid oz.
Commercial sulphuric acid (high grade 66 Beaume or 1.83 Sp. Gr.)...1 fluid oz.
Fused potassium cyanide, 98%.....1 oz.

To each 100 cubic feet of air space in the fumigating room.

The charge should remain in the room for one hour.

NURSERY INSPECTION IN LOUISIANA

By ARTHUR H. ROSENFELD, *Assistant Entomologist, State Crop Pest Commission of Louisiana, Baton Rouge*

Nursery conditions in the Pelican State might be described as both temperate and semi-tropical in character. The nurseries in the northern portion of the state grow such stock as apple, peach, plum, hardy hedge and ornamental plants, etc., while the majority of the nurseries in southern Louisiana grow such plants as orange, lemon, kumquat, *Ficus*, cape jasmine, pecan, etc. The insects attacking these two classes of nursery plants are quite distinct, but, as it is presumed that this discussion was intended to bring out a comparison of the methods in vogue in the various states, the writer will confine his description of inspection methods to those nurseries in which deciduous stock is grown.

Our inspections in these nurseries are made for the usual insects and plant diseases, with San José scale, of course, the principal *bête noire*. On account of our long, hot summer, nursery inspection is not begun until after July 1, as we have found that nurseries inspected earlier than this and found apparently free of infestation may, by September or October, show a comparatively heavy infestation.

The regulations of the State Crop Pest Commission require the inspection, at least once each season, of all nurseries doing business in