

The Control of San Jose Scale in the Orchard.

Respectfully submitted to Professor Harvey L. Price for the degree
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The Control of San Jose Scale in the Orchard-A Brief Study.

Introduction.

"How can we kill the scale?" "Can the San Jose Scale be controlled?" "Will spraying kill the scale?" are the questions constantly asked of the horticulturist and entomologist of today. The question of the control of this famous pest is a much noted one, and one which in the last ten years has perhaps received more attention than any other query regarding one insect. A decade ago, when an orchardist discovered a few San Jose scale on one of his trees he grew faint, for in his mind's eye he could see the complete and speedy destruction of his entire orchard by this pernicious insect. At that time Aspidiotus perniciosus was considered wellnigh uncontrollable and the appearance of no insect was so dreaded in a fruit country as that of "the scale". Hundreds of orchards were cut out by as many intelligent fruitgrowers, following the advice of trained scientific and practical men, and everywhere the appearance of this little Coccid created consternation similar to that caused by the Gypsy Moth in Massachusetts or by the Boll Weevil in Texas and the adjoining states. It is impossible to estimate how many nurserymen and fruitgrowers went entirely out of business thru fear of the ravages of the scale, while, with the application of a few principles in vogue at present, they might still have been following their chosen vocations. Now all has changed. While the San Jose Scale is acknowledged by all scientists to be a permanent factor in our fruitgrowing, and

altho its spread in the last ten years has been almost incomprehensible, this insect is not so much to be feared today by the up to date fruitgrower, as many other insects with which he has been contending for years, such as the Codling Moth, Peach-tree Borer, or Plum Curculio. It is practically impossible to eradicate the scale, and, as regards eradication, it is impossible with any insect-but it can be easily controlled, and simply also, if handled with foresight and intelligence.

San Jose Scale Work in Illinois.

The writer spent the past fall and winter inspecting for San Jose Scale in Illinois, and was thus afforded an opportunity of studying the problem of the control of this insect in one of the states which is doing the best work along this line. Twelve inspectors were employed on this work, under the direction of the Assistant Entomologist. They were divided into three corps, each corps being placed in a district from which San Jose Scale had been reported. Their duty was in each case to "round up the scale", that is, to inspect every orchard or lot containing fruit trees, until they had an unbroken ring of at least two uninfested places entirely around the infested district, sending into the office a detailed report of each premise inspected. In some cases, where the outbreak was of comparatively recent origin, this was the work of only a few days or perhaps weeks, but in case of old centers of infestation, -the work of months or probably years, In one instance, fresh in the mind of the writer,

his corps followed scale infestation for nineteen miles from the supposed center of infestation, inspecting a strip six miles broad. This was in one direction only, and the complete inspection of this district will require probably two years of steady work. In another section, located principally in Union and Jackson counties, in the extreme southern portion of the state, about two hundred and sixty square miles have been thoroughly inspected during the past five months. Explicit directions for treatment, legally drawn up, are issued to each property owner and tenant, and every effort is made by the state officials to see that these directions are followed. In a year or so after the first inspection, the premises are reinspected, and if the owners have not treated and refuse to do so, one of the state outfits is sent to this section, and the trees of all such owners sprayed by a state spraying gang under the direction of a state spraying operator. The owners must bear one-half of the cost, and a lawyer is employed by the Entomologist by the year for the purpose of arranging these claims. Some of the orchardists prefer to pay out more money than they would if they conducted the remedial work themselves, and allow the state gang to spray, as they are all experienced men, and the work is therefore much more thoroughly done. A few statistics will serve to show the cost of the spraying operations to both owner and state. Below are given in detail, the resulting expenses from the spraying of nine average orchards.

Orch. no.	No. trees.	Size.	Total Cost.	Owners pt.	Cost per tree.	
					Total.	Owner.
1/	115.	Large.	\$54.25.	\$27.13	\$.47 1/5	\$.23 3/5.
2.	180.	102 lge. 78 med.	43.50.	21.75	.24 1/5	.12 1/10.
3.	194.	Medium.	40.47.	20.24	.20 4/5	.10 2/5.
4.	78.	"	21.02.	10.51	.26 9/10.	.13 1/2.
5.	69.	Sm. to med.	8.06.	4.03	.11 3/5	.05 4/5.
6.	8.	Large.	4.52	2.26	.56 1/2	.28 1/4.
7.	489.	Mostly lge.	86.49.	43.25	.17 7/10	.08 4/5.
8.	18.	Large.	6.98.	3.49	.38 4/5	.19 2/5.
9.	2.	"	1.93.	.97	.96 1/2	.48 1/4.

Average total cost per tree, -23 1/10 cts. Owner's portion, -11 3/5.

These bills cover all items of expense, wages, subsistence, travel, incidentals of operators, materials, repairs, etc., with a small amount for office work. Most of the trees were apple. The weather was especially unfavorable to spraying at the time that these applications were made, consequently there was a large amount of delay and a proportionate increase of expense per orchard and tree.

Treatment.

The wash most generally used against the San Jose Scale is compounded of lime, salt, and sulphur, mixed with water, or simply lime and sulphur with water. The use of salt in the wash is gradually being abandoned, as many careful experiments have shown that it

is of no benefit. For many years it was thought that salt added to the sticking qualities of the wash, but this ^{has been} almost positively proven to be a fallacy. In the writer's opinion, even if salt is slightly beneficial in this way, this benefit is checkmated by the additional corrosive action upon the pump. The wash is a development from a sheep-dip used in California. Various formulae are recommended by the different workers, the chief variation being in the amount of lime used. Those advising an excess of lime claim that this feature adds to the adhesive qualities of the wash. To illustrate the difference in opinion in this regard, the formulae recommended by ~~six~~ wellknown stations are given below.-

Mr. C. L. Marlatt, U. S. Dept. Agr., Bureau of Entomology,

20 lbs. lime,
15 lbs. sulphur,
50 gals. water.

Illinois and Virginia Agricultural Experiment Stations,-

15 lbs. lime,
15 lbs. sulphur,
50 gals. water.

Georgia State Board of Entomology,-

30 lbs. lime,
20 lbs. sulphur,
10 lbs. salt,
60 gals. water.

Ohio Agricultural Experiment Station

15 lbs. lime,
15 lbs. sulphur,
15 lbs. salt,
50 gals. water.

Preparing the Lime-sulphur Wash.

Too much care cannot be given to preparing the lime-sulphur wash properly, yet to prepare it properly is very simple. To prepare the wash in fifty gallon batches, place about five gallons of water in a kettle of from twenty to twenty-five gallons capacity, allow to become hot, and place the required amount of lime in it. When slaking becomes brisk, add the sulphur and agitate thoroughly, pouring in hot water as needed. When all slaking is over and the mixture is thoroughly worked, fill the kettle about half full with water, and boil for forty minutes. Hot water is used in diluting the mixture simply because it accelerates the cooking, not because the resulting wash would be any different. When cooked the proper time, strain into spray barrel, make up to fifty gallons, and apply at once to trees, keeping wash thoroughly agitated during the operation.

In preparing the wash in large quantities, essentially the same method is followed, and the mixture is generally boiled with steam.

This wash must be applied when the trees are dormant, as it is very caustic and will probably kill the trees if applied during the growing season. For the same reason, sprayers and horses should be as well protected from the spray as possible.

Other Preparations Used against San Jose Scale.

Many other mixtures have been tried against the San Jose scale, but none have as yet proven as generally satisfactory as the mix-

ture described above. Before the developement of the latter to its present state of efficiency various remedies were used, the principle ones being kerosene, kerosene emulsion, whale oil or resin soap, and crude petroleum. Of these, kerosene gave decidedly the best results as regards killing the insect, but it had one paramount fault, viz.- it had too much of a tendency to kill the trees also. Caustic soda, by itself and in conjunction with the lime-sulphur mixture, and the lime-sulphur wash unboiled, except from the heat of the slaking lime, are also advised by some, but experiments have, in most cases, failed to establish their value. Mr. C. P. Close, of Delaware, has recently recommended very strongly a kerosene-lime mixture, but its trial at other experiment stations has in no wise made "K-L" appear as a promising substitute for the old established "L-S". Numerous patent washes are also on the market, but the majority are almost absolutely useless when used at the strength recommended by the manufacturers, and when used in a more concentrated form, their price renders their comparison with lime-sulphur unfavorable. The miscible oils are showing up well in some cases, and if the manufacturers could be induced to sell a solution at a cheaper price, in order that it could be used in more concentrated form without extra expense, these oils would probably revolutionize the treatment of scale as it is at present practiced.

Summer Treatment .

No successful method of fighting San Jose scale successfully during

the growing season has been found, and spraying in the summer time is not usually advised, unless the attack of scale is an extremely severe one, and the owner of the trees simply desires to check the insects as much as possible until the winter, when more drastic treatment can be given.

Equipment.

The pumps which are probably most used are those made by the Morrill and Morley Company of Benton Harbor, Mich., altho the Gould Manufacturing Company, the Deming Company, and the Spraymotor Company also put out some good pumps. For small orchards, an ordinary barrel pump mounted on a wagon or cart, will suffice, but for extensive spraying operations, a power sprayer is much the more economical and efficient. The pump should be as much of brass as possible, and should have a good agitator. It should be fitted with bamboo extension rods at the ends of the lines of hose, the length of these rods being regulated by the kind and size of trees to be sprayed. In most cases, however, the extension rods should be at least ten feet long. Double Vermorel nozzles should be used in all cases. The lines of hose should be of good quality and about twenty feet long.

General Considerations.

One thorough application of the lime-sulphur wash each year is all that is necessary, and where the scale infestation is slight, it is not absolutely essential to apply it this often, altho much bet-

ter results will be secured if this plan is followed. Aside from the insecticidal value, the lime-sulphur wash is worth a great deal to an orchard. It is the best remedy known against Peach Leaf Curl, has a deterrent action on Brown Rot of Peach (Sclerotinia fructigena), and cleans up trees beautifully, removing quantities of lichens, rough bark, etc. With this cheap and efficient method of control at our command, it is simply a case of neglect if the American orchardist of today allows the San Jose scale to gain the upper hand.

With increases acreage in fruit trees has come a multiplication of insects and fruit diseases, and the time has forever gone by when the fruit grower could sit comfortably in his domicile, while the trees took care of themselves. Today eternal vigilance is the price of fruit, and without this prerequisite it becomes more and more difficult each year to obtain a satisfactory crop. Four processes are essential to the successful prosecution of fruitgrowing, viz.-pruning, spraying, fertilizing, and cultivating, and no horticulturist can hope to succeed who does not give each of these his attention.