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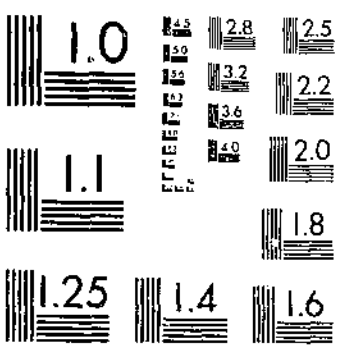

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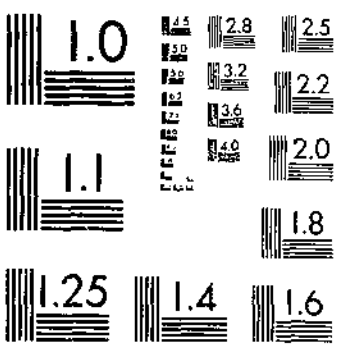

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Experiments With Oils and Lime-Sulfur for the Control of the San Jose Scale on Peach Trees in the South [1]

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INTRODUCTION

The San Jose scale (*Aspidiotus perniciosus* Comst.), a destructive pest of peach, apple, pear, plum, and other deciduous fruit trees is very abundant in the South, where reproduction may be continuous throughout the year. The insect takes its nourishment by sucking the sap from the tree, which at first merely checks growth, but as the infestation increases, limbs are killed and finally the tree dies. Infested peach trees are usually killed in a few seasons, or are so weakened as to be subject to attack by other pests. The preservation of trees for the production of fruit essential to a well-balanced diet, is vital to the war effort, and the effective control of the San Jose scale is an important requirement for that purpose.

Lime-sulfur came into general use for the control of this insect about 1900, and until 1922 it was the most popular spray for use against scale insects. Since 1922, however, the oil sprays have been considered more effective than lime-sulfur against scale insects and have largely supplanted it as an insecticide for the dormant spray. Experiments in the control of the San Jose scale on peach trees have been in progress at the peach insect laboratory of the Bureau of Entomology and Plant Quarantine at Fort Valley, Ga., since 1922.

[1] Submitted for publication Jan. 19, 1943.

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A bulletin [2] issued in 1931 gave the results of the work on this project to the spring of 1929. The present bulletin gives the results of experiments conducted at Fort Valley during the 13-year period from the fall of 1929 to the spring of 1942 and deals with additional phases of the San Jose scale problem.

EFFECTIVENESS OF BLENDED OILS AS COMPARED WITH STRAIGHT-RUN OILS FOR THE CONTROL OF THE SAN JOSE SCALE

Blended oils for spraying purposes have appeared on the market during recent years, and fruit growers are often able to buy these blends at a lower price than that asked for straight-run oils. To determine the comparative effectiveness of blended oils and straight-run oils for the control of the San Jose scale on peach trees, extensive spraying experiments with 14 oils at 2 strengths were conducted during the winters of 1935–36 and 1936–37. The blended oils were prepared in the laboratory by combining different oils in trial tests until mixtures of the desired characteristics were obtained. The methods and scale counts employed for these and all other experiments reported in this bulletin are the same as those used for the earlier experiments as described on pages 24 to 26 of Technical Bulletin 253, just referred to, except that when considerable rainy weather occurred during the first month after spraying, the interval between the time of application and the noting of results from oil sprays was longer than 1 month. A period of 1 month between the spraying and the counts of live and dead scales for results from oil sprays is not sufficient for accurate counts when rainy weather prevails during the first month after spraying. Under such conditions a period of from 45 to 52 days after the application of an oil spray is required for the dead scales to dry sufficiently for definite classification as dead.

The following formula was used for the computation of percentage control for these and all other experiments reported in this bulletin:

$$\text{Percentage control} = \frac{AX - Z}{AX} \times 100$$

where A = ratio of the percentage alive in checks at the close of the experiment to the percentage alive in checks at the beginning of the experiment.

X = percentage alive in sprayed plats before treatment.

Z = percentage alive in sprayed plats after treatment.

The standard error for each percentage control reported in this bulletin was determined by the following formula:

$$\frac{Z}{AX}\sqrt{\frac{S_z^2}{Z^2} + \frac{S_{ax}^2}{(AX)^2}}$$

where S_z^2 = standard error of Z.

S_{ax}^2 = standard error of AX.

Table 1 gives the results of the experiments to determine the comparative effectiveness of blended oils and straight-run oils.

[2] SWINGLE, H. S., and SNAPP, O. I. PETROLEUM OILS AND OIL EMULSIONS AS INSECTICIDES, AND THEIR USE AGAINST THE SAN JOSE SCALE ON PEACH TREES IN THE SOUTH. U. S. Dept. Agr. Tech. Bul. 253, 48 pp., illus. 1931.

TABLE 1.—*Results of experiments to determine the comparative effectiveness of blended oils and straight-run oils for the control of the San Jose scale, Fort Valley, Ga., 1935–37*

Test No.	Season	Kind of oil	Viscosity (Saybolt at 100° F.)	Volatility (loss during 4 hours at 110° C.)	Control of the San Jose scale with—	
					2-percent emulsion	3-percent emulsion
			Seconds	*Percent*	*Percent*	*Percent*
1	1935–36 [1]	Straight run	99	3.7	81.3±4.4	91.2±3.2
2	do	Blend	102	4.9	[2] 91.0±2.0	[3] 99.1± .9
3	do	Straight run	204	1.6	90.9±2.2	97.1±1.7
4	do	Blend	202	2.1	87.2±1.1	97.6±1.4
5	do	Straight run	140.2	2.0	89.6±3.0	[3] 89.5±1.5
6	do	Blend	139.4	1.2	90.5± .9	[3] 91.9±2.3
7	do	Straight run	141.9	1.3	76.2±2.8	94.3±1.3
8	do	Blend	142.4	1.5	79.6±5.8	95.1±3.0
9	do	Straight run	238	.9	90.1±3.2	93.2±2.8
10	do	Blend	238	1.6	80.5±2.9	92.9±1.0
11	1936–37	Straight run	142.2	2.1	85.3±3.0	98.6±1.5
12	do	Blend	142.8	1.2	94.4± .8	95.4±4.4
13	do	Straight run	238	.9	87.0±2.6	86.5±4.0
14	do	Blend	242	1.8	89.1±3.1	96.2±1.6

[1] Heavy, beating rains that fell during the night following the application of oils in tests 1 to 10 and on the day after these oils were applied may have lowered the control of the scale, especially from oils 9 and 10, which were applied late in the afternoon.

[2] A number of scales were killed by the twice-stabbed ladybeetle, *Chilocorus stigma* (Say). This was probably the reason for the high percentage of control shown for this blended oil of low viscosity.

[3] These 3-percent oils had been applied to damp trees, which probably accounts for the percentage control of the scale being practically no better than that from the 2-percent strength of the same oils.

In seven tests blended oils at 2- and 3-percent strengths gave just as good control of the San Jose scale on peach trees as the seven straight-run oils at the same strengths with which each was compared. Therefore, the results of these experiments warrant the conclusion that a blended oil is just as effective as a straight-run oil for the control of the San Jose scale.

RELATION OF VOLATILITY OF LUBRICATING OIL TO CONTROL OF THE SAN JOSE SCALE

Although considerable work has been done on the value of viscosity, unsulphonated residue, and certain other properties of lubricating oils as measures of toxicity to the San Jose scale, little is known about the relation of volatility of oils to the control of that insect. Experiments conducted previous to the fall of 1929 indicated that volatility up to 1.75 percent has little influence on toxicity when oils of sufficiently high viscosity are used. Extensive spraying experiments were conducted during the 6 dormant seasons of peach trees from the fall of 1932 to the spring of 1938 to determine whether the volatility of lubricating oil has a value as a measure of toxicity to the San Jose scale. The most significant results were obtained during the winters of 1935–36, 1936–37, and 1937–38, when 20 lubricating oils with volatilities ranging from 0.3 to 13 percent and with practically the same viscosity were used at two strengths.[3] Some of these oils were used as purchased in the open market whereas others were produced by blending different oils. The results of these experiments are given in table 2.

[3] Volatility as reported in this bulletin was determined according to the following method: Put 20 grams of oil in a 3½-inch crystalizing dish, and heat at 110° C. for 4 hours in an electric oven. Reweigh, and report loss in weight as percent volatility.

TABLE 2.—*Experiments on the relation of volatility of oils to control of the San Jose scale on peach trees at Fort Valley, Ga., 1935–38*

Test No.	Season	Volatility (loss during 4 hours at 110° C.)	Viscosity (Saybolt at 100° F.)	Control of the San Jose scale with—	
				2-percent emulsion	3-percent emulsion
		Percent	*Seconds*	*Percent*	*Percent*
1	1935-36	0.6	144.0	97.5±1.6	98.6±1.1
2	do	2.0	140.2	98.2± .8	100.0±0
3	do	5.4	144.4	98.2± .3	99.8±2.2
4	do	8.1	135.0	85.3±3.6	90.7± .6
5	do	10.8	144.0	91.4±3.4	94.2±1.9
6	do	13.0	136.0	76.0±3.2	83.5±2.5
7	1936-37	.3	147.0	98.9± .4	100.0±0
8	do	2.1	142.2	85.3±3.0	98.5±1.5
9	do	4.9	142.6	81.9±0.5	95.8±1.4
10	do	5.8	138.2	82.0±4.0	95.4±2.5
11	do	7.0	142.5	97.4±1.3	99.7± .2
12	do	8.0	141.2	76.1±4.6	92.9±3.0
13	do	9.7	145.0	70.6±4.8	79.9±3.0
14	1937-38	.3	142.2	96.1±1.3	100.0±0
15	do	2.1	143.0	90.3±1.5	97.0± .7
16	do	3.0	158.0	87.3±1.8	98.1±1.4
17	do	4.1	142.5	85.6±2.4	98.8± .8
18	do	4.9	160.0	75.5±3.5	90.7±2.7
19	do	6.3	141.6	66.7±1.7	87.4±1.9
20	do	6.9	145.5	64.4±4.9	87.9±2.2

According to these experiments, best results in the control of the San Jose scale are obtained from mineral oils with a volatility of not more than 1 percent. In general scale control was greatly reduced with oils having a volatility of from 5 to 13 percent.

RELATION OF VISCOSITY OF LUBRICATING OIL TO CONTROL OF THE SAN JOSE SCALE

Experiments conducted previous to the fall of 1929 showed that the viscosity of an oil is the most accurate measure of its toxicity when used as a dormant spray for the control of the San Jose scale, and that for best results the oil should have a viscosity (Saybolt at 100° F.) of at least 125 seconds. These results have been confirmed by further experiments conducted at Fort Valley on the relation of viscosity of an oil to control of the San Jose scale on peach trees, the most significant results of which were obtained during the season of 1931–32 and are given in table 3.

TABLE 3.—*Experiments on the relation of viscosity of oils to control of the San Jose scale on peach trees at Fort Valley, Ga., season of 1931–32*

Test No.	Viscosity (Saybolt at 100° F.)	Control of the San Jose scale with—		Test No.	Viscosity (Saybolt at 100° F.)	Control of the San Jose scale with—	
		2-percent emulsion	3-percent emulsion			2-percent emulsion	3-percent emulsion
	Seconds	*Percent*	*Percent*		*Seconds*	*Percent*	*Percent*
1	55	.....	86.9±11.0	5	145	.....	98.8±.6
2	85	.....	93.2 ±4.4	6	220	92.7±2.8	.....
3	110	.....	97.0 ±1.1	7	295	92.4±1.4	.....
4	120	.....	96.9 ±1.0	8	370	93.3±1.9	.....

There was a trend toward poorer results with oils having viscosities less than 100 seconds when these were used at the 3-percent strength. At the 2-percent strength, oils having viscosities of 295 and 370 seconds did not appear to be any more effective than an oil of 220 seconds' viscosity.

WOOD-TAR OIL EMULSION FOR SCALE CONTROL

Experiments were conducted during the seasons of 1932–33 and 1933–34 to determine the value of an emulsion of wood-tar oil for the control of the San Jose scale on peach trees. The material was used alone and with the addition of a 1-percent mineral-oil emulsion, since mineral oil is often added to coal-tar distillates for dormant spraying. The results are given in table 4.

TABLE 4.—*Experiments with an emulsion of wood-tar oil for the control of the San Jose scale, Fort Valley, Ga., seasons of 1932–33 and 1933–34*

Season	Material	Proportion of oil in emulsion	Control of the San Jose scale
		Percent	*Percent*
1932–33	Wood-tar oil (viscosity 29 sec., volatility 98.5 percent).	1	4.0±3.6
Do	do	2	1.8±3.0
Do	do	3	0
Do	do	6	0
1933–34	do	4	14.0±8.5
Do	do	8	42.8±4.2
Do	Wood-tar oil plus mineral oil (viscosity 265 sec., volatility 0.1 percent).	Wood-tar oil, 3 percent; mineral oil, 1 percent.	44.8±5.7

The results of these experiments show that wood-tar oil is not effective against the San Jose scale. During the season of 1932–33 the 3- and 6-percent emulsions of that material failed to reduce the number of live scales below that recorded before the spray was applied. Even at 8-percent strength, the use of which would be prohibitive on account of cost, only 42.8±4.2 percent control was obtained. The control with 3 percent of wood-tar oil emulsion added to 1 percent of mineral-oil emulsion was not so good as that usually obtained from 1 percent of mineral-oil emulsion when used alone. Wood-tar oil emulsion carrying as much as 12 percent of oil caused no injury to peach trees.

CASEIN AND AMMONIA FOR EMULSIFYING MINERAL OILS

Tests were conducted during the season of 1932–33 to determine the effectiveness in the control of the San Jose scale on peach trees of mineral, or lubricating, oil emulsified with casein and ammonia as compared with that emulsified with potash-fish-oil soap. The former was made according to the following formula:

Oil	100 gals.
Water	35 gals.
Casein	3 lbs.
Ammonia (28 percent)	2 pints.

This is a slight modification of that used in the Pacific Northwest.[4]

The stock emulsion may be prepared in an ordinary orchard sprayer. The water is put in the tank, after which the casein and ammonia are added with the agitator running. The casein will dissolve in a few minutes, and then the oil is added about as fast as it will run from a drum. The casein must be dissolved before the oil is added. As soon as all the oil has run in, the mixture is pumped through the spray rods at about 200 pounds' pressure with the agitator still running. A good emulsion will result from pumping the mixture from one to three times. The finished stock emulsion, which will contain approximately 75 percent of oil, should be put in a closed container where it will keep in the shade at least 6 weeks.

The cold-stirred method of emulsification was employed for preparing the stock emulsion made with potash-fish-oil soap for these experiments.

The oil used for these tests had a viscosity of 220 seconds and a volatility of 11.3 percent. It was expected that an oil having these characteristics would be less effective than one having a lower volatility The results of the experiments are given in table 5.

TABLE 5.—*Experiments with mineral oil emulsified with casein and ammonia and with potash-fish-oil soap for the control of the San Jose scale, Fort Valley, Ga., season of 1932–33*

Material used as emulsifier	Control of the San Jose scale with—	
	2-percent emulsion	3-percent emulsion
	Percent	*Percent*
Casein-ammonia	89.8±2.7	93.5±2.7
Potash-fish-oil soap (cold stirred)	85.4±5.0	94.6±2.7

The results of these experiments indicate that mineral oil emulsified with casein and ammonia is just as effective against the San Jose scale on peach trees in the South as mineral oil emulsified with potash-fish-oil soap. The emulsion made with casein is somewhat easier to prepare and a little cheaper than that made with potash-fish-oil soap. It will hold up longer than mineral oil emulsified with calcium caseinate by the cold-pumped method but not so long as that emulsified with potash-fish-oil soap by the hot-pumped method.

CONCENTRATION OF LUBRICATING OIL TOXIC TO PEACH TREES

Tests were conducted during each of 13 seasons, beginning in the fall of 1929, to determine the concentration of lubricating oil at which injury to peach trees begins, and the extent of injury by the stronger emulsions. Examinations for tree injury were made monthly for 6 to 8 months after the spraying. The results of these tests are given in table 6.

[4] NEWCOMER, E. J. ORCHARD INSECTS OF THE PACIFIC NORTHWEST AND THEIR CONTROL. U. S. Dept. Agr. Cir. 270, 77 pp., illus. 1933.

TABLE 6.—*Tests to determine the extent of injury to peach trees from different strengths of lubricating-oil emulsion, Fort Valley, Ga., 1929–41*

Season	Lubricating oil		Effect on peach trees from emulsions containing—							
	Viscosity (Saybolt at 100° F.)	Volatility (loss during 4 hours at 110° C.)	3 percent oil	6 percent oil	8 percent oil	10 percent oil	12 percent oil	15 percent oil	20 percent oil	25 percent oil
	Seconds	*Percent*								
1929-30	(Commercial)		None	None	None	Leaf growth delayed; a few twigs injured.	Leaf growth delayed; a few twigs injured.	Leaf growth delayed; some twig injury.		Leaf growth delayed; twig injury; a number of "blind" twigs.
1930-31	220	0.08	do	do	do	Blooming delayed; a few twigs injured.	Some buds dropped; some twig injury.	Many buds dropped; twig injury.		All buds failed to open; tree injured.
1931-32	130	5.20	do	do	Light injury to twigs.	Light injury to twigs and small limbs.	Considerable injury to twigs and small limbs.	Whole tree injured		Whole tree injured.
1932-33	210		do	Blooming slightly retarded, but no injury.	Blooming retarded, but no injury.	A few buds killed	Some leaf and fruit buds killed; some limbs injured.			
1933-34	220	1.70	do	None	None	A few twigs injured.	Severe injury to some limbs.			
1934-35	202	1.36	do	do	A few buds dropped.	do	A few twigs injured.	Several twigs killed, others injured.	Some dead twigs; one dead limb.	
1935-36	205	1.62	do	do	None	None	None	None	Blooming retarded; fruit buds reduced.	
1936-37	203	1.62	do	do	do	do	do	do	Many lateral shoots and some branches killed.	
1937-38	195	1.62	do	do	do	do	do	do	Some twigs killed; growth of tree retarded; inferior quality of fruit.	
1938-39	195	1.62	do	do	do	do	do	Area 8×2 inches on south side of trunk injured into heartwood.	Died Apr. 7, 1939	
1939-40	195	1.62	do	do	do	One limb died Apr. 20, 1940.	Died from winter injury.	One-third of tree died Apr 20, 1940.		
1940-41	195	1.62	do	do	do	A few twigs killed and foliage lighter.		A few twigs killed and foliage lighter.		
1941-42	195	1.62	do	do	do	Bark on old limbs rough and cracked; foliage little lighter.		Bark on old limbs rough and cracked; foliage little lighter.		

The results of these tests show that there is an ample margin of safety for the usual recommendation of 3-percent lubricating-oil emulsion for the control of the San Jose scale on peach trees. There were no signs of injury to the trees from the 3-percent emulsion during the 13 years of these tests. There was no injury from the 6-percent emulsion except that blooming was retarded in 1 year. The 8-percent emulsion caused no tree injury during 10 of the 13 years. That strength caused light injury 2 years and retarded blooming in 1 year. The 10- and 12-percent emulsions caused more or less tree injury, but in no case did these emulsions kill a tree. The 15-, 20-, and 25-percent emulsions caused some severe injury, especially during the season of 1931–32, when more injury occurred than during any of the other years of these tests because of delayed dormancy of the trees. The oil emulsions caused least injury during the season of 1935–36, the coldest in 31 years at Fort Valley. The 20-percent emulsion killed a tree during the season of 1938–39.

CUMULATIVE-INJURY STUDIES

A number of experiments were conducted during the period 1922 to 1942 to determine whether cumulative injury would result from the continued use of an annual application of lubricating oil emulsion during the dormant season. Table 7 gives the results of these experiments.

TABLE 7.—*Experiments to determine whether cumulative injury to peach trees would result from the continued use of lubricating-oil emulsion, Fort Valley, Ga., 1922–42*

Seasons	Oil content of spray	Total annual applications	Effect on peach trees
	Percent	*Number*	
1922–30	3	8	None.
1933–42	3	9	None.
1929–34	6	5	None, except blooming slightly retarded in the fourth season.
1936–42	6	6	None.
1931–42	8	8	None, except a few buds dropped in the first season.
1928–34	10	6	Leaf growth delayed in the second season. A few buds killed in the fifth season. A few twigs injured in the second, third, fourth, and sixth seasons. A few small limbs injured in the fourth season. No injury to large limbs.
1931–42	10	8	A few twigs injured in the first year. One limb died in the sixth year. A few twigs killed and foliage lighter in the seventh year. Bark on old limbs rough and cracked in the eighth year.
1931–40	12	6	Budwood injury in the first season. A few buds dropped off in the fourth season. Bud opening slightly retarded in the fifth season. Winter injury contributed to death of tree in the sixth season.
1934–42	15	8	Some budwood killed or injured in the first season. Trunk injury in the fifth season. One-third of tree dead in the sixth season. Further injury in the seventh and eighth seasons.

Apparently there is no danger of cumulative injury to peach trees from the continued use of 3-percent lubricating-oil emulsion when the applications are made approximately 1 year apart. Two applications of a 3-percent oil spray are sometimes necessary for the proper control of the San Jose scale on encrusted fruit trees, and these must be made within the dormant period of the trees, which is from 3 to 4 months in the South. The experiments show that a 6-percent oil emulsion can be used annually on peach trees without danger of cumulative injury other than the possibility of slightly retarding the blooming period. Therefore two applications of a 3-percent oil spray during the same dormant season of the trees appears to be a safe procedure in cases where the extent of the scale infestation demands a second treatment.

COMPARATIVE EFFECTIVENESS OF LIME-SULFUR AND LUBRICATING-OIL EMULSION FOR CONTROL OF THE SAN JOSE SCALE

Experiments were conducted during five seasons to determine the effectiveness of lime-sulfur as compared with lubricating-oil emulsion for the control of the San Jose scale on peach trees. The results of these experiments are given in table 8.

The data presented show that 3-percent lubricating-oil emulsion is somewhat more effective than lime-sulfur, 1–7, for the control of the San Jose scale on peach trees. The latter material proved to be a better insecticide for scale control, however, than it has been given credit for during recent years. It is apparent that 1 month after spraying is entirely too soon to determine the efficacy of lime-sulfur as an insecticide for the San Jose scale. The final count to determine the results from the use of lime-sulfur should not be made until 6 months after the insecticide is applied.

The increase in the average percentage of live scale between the sixth and eighth months after spraying with lime-sulfur is the result of the progeny of a few gravid females found on the trees 6 months after spraying, which may have come from a few individuals in cracks or protected places that escaped being hit by the insecticide. The somewhat lower final percentage of control of scale in the first test of lime-sulfur, 1–7, during the season of 1935–36, is believed to have been due to the effect of 1.05 inches of rain that fell during the first night after the material was applied.

In 1935–36 not a single live scale was found on the trees 8 months after they were sprayed with 3-percent lubricating-oil emulsion, whereas scales were building up during the period from 6 to 8 months after spraying with lime-sulfur. It is believed that oil emulsion, with better spreading quality than lime-sulfur, penetrates into cracks in the bark and other somewhat protected places, killing the scale where the insect probably would escape the effect of a lime-sulfur spray.

TABLE 8.—*Experiments to determine the comparative effectiveness of lime-sulfur and lubricating-oil emulsion for the control of the San Jose scale on peach trees at Fort Valley, Ga., 1931–36*

Season and material	Gravity of concentrate	Dilution	Viscosity	Volatility	Spray strength	Control of the San Jose scale at stated months after the spraying						
						1 month	2 months	3 months	4 months	5 months	6 months	8 months
1931–32	°*B*		*Seconds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Precent*	*Percent*
Lime-sulfur	32.6	1–6				2.9±3.3						
Do	32.6	1–7				14.9±3.4						
Do	32.6	1–8				9.2±5.7						
Do	32.0	1–6				8.3±2.6	12.8±3.5					
Do	32.0	1–7				4.8±2.8	0 ±2.8					
Do	32.0	1–8				4.8±5.4	0 ±5.4					
Do	32.0	1–7				10.5±3.2	24.3±1.2					
Do	32.0	1–7				28.7						
Do	32.0	1–7				35.5						
Mineral oil			145		3	98.8± .6						
1932–33												
Lime-sulfur	33.0	1–7				30.2±2.4						
Mineral oil			265	2.6	3	98.1± .6						
1933–34												
Lime-sulfur	33.4	1–6				29.5±3.5	42.3±5.8	74.4±6.8	80.2±8.9			
Do	33.4	1–7				32.3±6.1	56.3±3.2	59.2±4.2	87.9±3.7			
Do	33.4	1–8				36.6±5.7	50.6±5.4	87.4±6.5	94.8±3.1			
Mineral oil			265	0.1	3	98.4± .8						
1934–35												
Lime-sulfur	32.6	1–6				22.2±2.8		46.2±3.0	[1] 90.0	[1] 98.3		
Do	32.6	1–7				12.5±3.4		39.7±3.3	[1] 78.5	[1] 96.2		
Do	32.6	1–8				9.3±3.1		37.0±2.0	[1] 66.8	[1] 98.7		
Mineral oil			169.5	6.0	3	98.5± .4						
1935–36												
Lime-sulfur	32.5	1–7						69.3±3.0	87.8±1.1		98.7±0.9	89.5±3.2
Do	32.5	1–7						80.0±2.2	93.5±1.2		99.6± .1	96.5±1.2
Mineral oil			140.2	2.0	3		100.0±0					100.0±0
Do			144	0.6	3		98.6±1.1					

[1] Average percentage of dead scales on sprayed trees.

EXPERIMENTS TO DETERMINE WHETHER LIME-SULFUR CAUSES STERILITY OF FEMALE SCALES OR PREVENTS CRAWLERS FROM SETTLING

Several workers[5,6] have expressed the opinion that lime-sulfur causes sterility of females of the San Jose scale, and others have stated that the lime-sulfur residue probably prevents scale crawlers from settling. Experiments were conducted at Fort Valley during the seasons of 1933–34, 1934–35, and 1935–36 to determine whether these opinions are well founded. The most significant results were obtained during the last season of these experiments, and these will be discussed briefly.

The applications of lime-sulfur were made in January. Three months afterward 14 to 20 percent of the scales examined were alive, and practically all of them were large females. Four months after the spraying the proportion of living scales had dropped to about 12 percent, but there was still practically no production of crawlers. Most of the scales had died by the sixth month, at which time the production of young scales was still negligible. There were no live or dead crawlers under any of the old female scale covers, which is further evidence that the lime-sulfur may have caused sterility of the matured females. The first recently settled scales were found on the trees 4 months after the spraying with lime-sulfur, but very few young scales were present until the observations made 8 months after the spraying. This indicates that lime-sulfur will prevent scale crawlers from settling as long as there is sufficient residue on the trees. The residue begins to weather off within 3 to 4 months after the trees are sprayed, and it is practically all gone at the end of 8 months.

The few gravid females found 6 months after a spraying with lime-sulfur, and the scales of various sizes from just settled to gravid females found 8 months after the spraying may have resulted from a few individuals in cracks in the bark or in crevices which were not hit by the lime-sulfur and rendered sterile. This supposition is supported by the fact that no gravid females were found on the limbs examined 3 and 4 months after the spraying.

SUMMARY

This bulletin reports the continuation of the investigations on the control of the San Jose scale on peach trees which had been begun at Fort Valley, Ga., in 1922, and gives the results obtained from 1929 to the close of the 1941–42 season.

Blended oil is just as effective as a straight-run oil for the control of the San Jose scale.

Scale control is greatly reduced if the oils have a volatility of 5 percent or more. The reduction in control apparently starts with oils having a volatility above 1 percent, although the reduction is slight until the volatility reaches 5 percent.

Mineral oils having a viscosity of less than approximately 125 seconds, Saybolt, should not be used for the control of the San Jose scale in the South.

[5] NEWCOMER, E. J., and YOTHERS, M. A. STERILITY IN THE SAN JOSE SCALE. (Sci. Note) Jour. Econ. Ent. 22: 821-822. 1929.

[6] YOTHERS, M. A. FEMALES OF THE SAN JOSE SCALE RENDERED UNPRODUCTIVE BY LIME-SULFUR. Jour. Econ. Ent. 33: 890-892. 1940.

Emulsions of wood-tar oil are not effective against the San Jose scale.

Mineral oil emulsified with casein and ammonia is just as effective against the San Jose scale as mineral oil emulsified with potash-fish-oil soap. The emulsion made with casein is somewhat easier to prepare and a little cheaper than that made with potash-fish-oil soap.

The results of tests conducted during 13 seasons show that there is an ample margin of safety to peach trees in the usual recommendation of 3-percent lubricating-oil emulsion for the control of the San Jose scale, and furthermore there is no danger of cumulative injury to peach trees from the continued use of the 3-percent emulsion when the applications are made approximately 1 year apart. A 6-percent oil emulsion can be used annually on peach trees without danger of cumulative injury other than the possibility of a slight retarding of the blooming period. Therefore 2 applications of a 3-percent oil spray during the same dormant season appears to be a safe procedure in cases in which the extent of the infestation demands a second treatment.

Three-percent lubricating-oil emulsion is somewhat more effective than lime-sulfur, 1–7, for the control of the San Jose scale, but the latter material proved to be a better insecticide for scale control than it has been given credit for during recent years. The apparent control of the San Jose scale with lime-sulfur increases between the first and sixth months after the spraying, and 1 month after spraying is entirely too soon to determine its efficacy as an insecticide for the control of that insect. The final count to determine the results from lime-sulfur should not be made until 6 months after the insecticide is applied.

Liquid lime-sulfur apparently caused sterility of the matured female scales in the winter of 1935–36. The results of the experiments indicate that lime-sulfur prevents scale crawlers from settling as long as there is sufficient residue on the trees. The residue begins to weather off within 3 to 4 months after the spraying, and it is practically all gone by the end of 8 months.

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