

UNIVERSITY OF IDAHO  
AGRICULTURAL EXPERIMENT STATION  
DEPARTMENT OF HORTICULTURE

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Sprays for the Control  
OF  
San Jose Scale

BY  
W. C. EDMUNDSON

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# UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

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## SPRAYS FOR THE CONTROL OF SAN JOSE SCALE

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Inquiries coming to the Department from time to time, with reference to the efficiency of the various spray materials used in combatting San Jose scale, seemed to render it desirable to test these sprays in a thoro manner, so that reliable information could be imparted. An experiment was outlined and conducted for three years to determine the relative efficiency of the different brands of spray materials that were being used by the fruit growers of Idaho, in their endeavor to control this pest.

### LIFE HISTORY AND DISTRIBUTION

The first appearance of this scale in Idaho is not definitely known. Dr. J. M. Aldrich reported its appearance in Lewiston, in 1894. About the same year, Mr. S. S. Foote, of Middleton, reported that his orchard was badly infested with it. This scale is supposed to have come to us from Walla Walla, Washington, for a nursery at that place known to be infested, sold many trees in this State at an early date. At the present time, it is generally prevalent thruout the State with the exception of the extreme northern and eastern parts.

On trees slightly infested with it, this scale may be overlooked by most fruit growers on account of its small size and dark gray, dusty color. In large numbers on the trees, it can be readily recognized. The scale is nipple-shaped and when closely examined, shows a lemon-yellow apex. By scraping a twig with the thumb nail, the scale can be disclosed and then the flat oval bodies of the yellow insects become visible. When limbs and twigs become entirely encrusted with the scale, it may be found on the leaves also. When the scale settles on the fruit, it is generally found at the stem or calyx end. A discoloration is made on the fruit around each scale, this being more pronounced on yellow, and less on highly colored fruit.

The San Jose scale passes the winter in an immature condition on the trunk and branches. In early spring, the insects feed on the tree's sap and soon the small, two-winged, active males issue from their scales. After mating with the females,

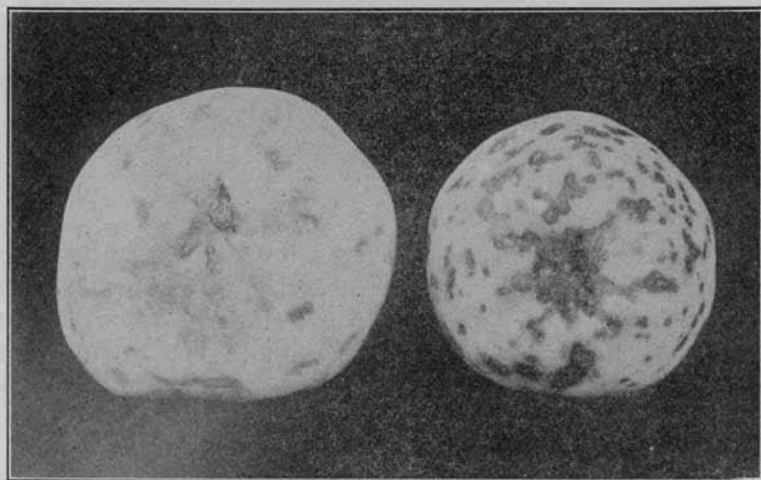


Fig. 1. San Jose Scale on Apple.

the males die. The females continue to grow and in about a month begin to produce living young.

The young insects are active for a few hours but they soon settle and push their slender beaks into the bark of the trees and then begin to suck the sap. About twenty-four to twenty-six days after birth the adult males emerge and fertilize the females, which produce young about thirty-three to forty-five days after birth. It is estimated by the best authorities that the progeny from one mother during the season may number

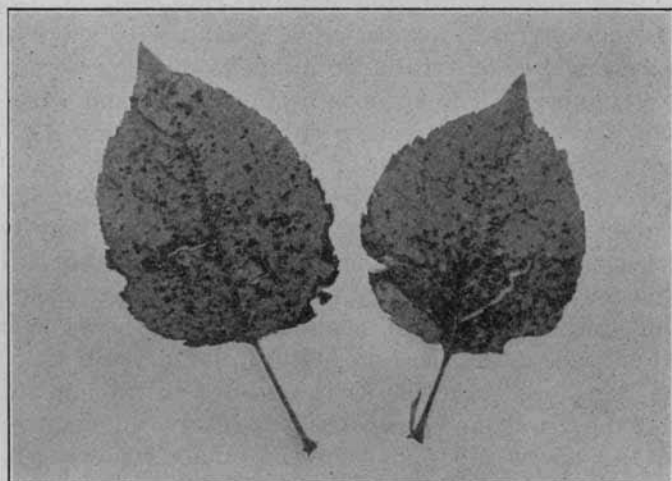


Fig. 2. San Jose Scale on Leaves.

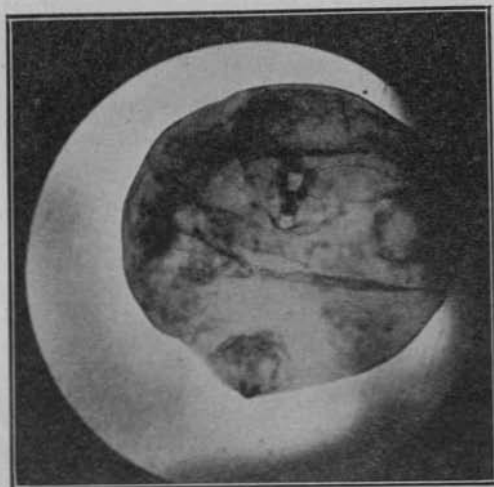


Fig. 3. Body of female scale greatly enlarged

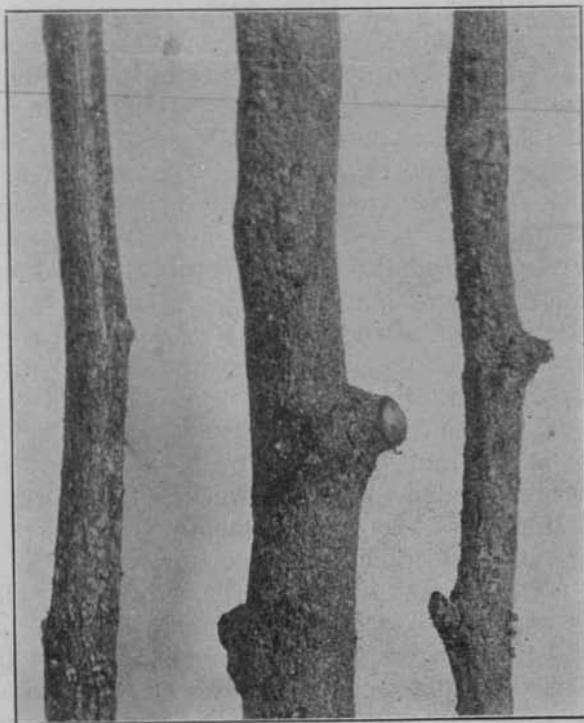


Fig. 4. San Jose Scale on twigs.

1,608,940,000. In the light of this information, it is very easy for us to understand why stringent measures are necessary in controlling this pest.

In many sections of this State, some kinds of the forest underbrush, as well as many species of trees and shrubs, along the streams and irrigation ditches, have become infested, making it very difficult to eradicate the source of infestation for our orchards.

#### PLAN OF EXPERIMENT

The sprays used in this experiment may be classed in one of two groups; the sulfur sprays, and the oil sprays. The sulfur sprays used were: Lime-sulfur, soluble sulfur, Spra Sulfur and dry lime-sulfur. The oil sprays were: Scalecide, crude oil emulsion from virgin crude oil, crude oil emulsion from oil testing 26 degrees Baume, and dormant soluble oil. All of these spray materials are highly recommended by the companies which manufacture them and are being used in this State for the control of the San Jose scale by the fruit growers.

The orchard in which these experiments were conducted is known as the Indian Cache Ranch, and is located one mile north of Lewiston. The orchard contains about 300 acres of apples. The varieties grown in the orchard are Jonathans, Rome Beauty, Delicious, Stayman Winesap, and Spitzenburg. At the time the experiment was begun, the trees were four and five years old. The orchard is laid off in five acre tracts, most of which contain 242 trees. These five-acre divisions of the orchard were used for the experimental plats. Four or five trees in different locations on each plat were selected from which to study the efficiency of the various spray materials. Definite infested areas on each tree were selected and outlined by cutting a small slit in the outer bark. The alive, dead and old scales on one-half the outlined area were removed and counted before spraying. The scales on the other half of the outlined area were counted about six weeks after spraying. The counting of the scales was done alone by the author, with the aid of a hand lens and each scale was turned over by a dissecting needle. The number and conditions of the various scale insects were recorded by a clerk.

Bean and Hardy pressure sprayers were used in the experiment, and 200 to 220 pounds pressure was maintained by the pumps. The Clipper nozzles were used in applying the material,

and thoro work was done at all times, although special attention was never given to trees on which results were recorded.

## LIME-SULFUR, 1915

Plat No. 52

Counts made before spraying March 15				Counts made after spraying April 3			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
14-H	117	10	6	14-H	5	134	9
20-J	176	16	9	20-J	10	130	11
5-A	330	48	65	5-A	11	394	65
10-G	192	18	28	10-G	12	149	18
Total	815	92	108	Total	38	807	103

95 per cent killed.

## LIME-SULFUR, 1916

Plat No. 31

Counts made before spraying March 14				Counts made after spraying April 28			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
3-B	72	26	18	3-B	6	82	20
21-C	228	64	32	21-C	8	105	22
Total	300	90	50	Total	14	187	42

## LIME-SULFUR

Plat No. 32

Counts made before spraying March 14				Counts made after spraying April 28			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
3-C	73	31	12	3-C	13	160	102
3-B	170	41	87	3-B	8	143	20
2-B	143	42	31	2-B	12	162	22
Total	386	114	90	Total	33	465	144

92 per cent killed

## LIME-SULFUR, 1917

Counts made before spraying March 7				Counts made after spraying May 15			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
7-J	218	40	28	7-J	10	206	24
11-C	84	27	12	11-C	4	96	12
11-F	252	50	42	11-F	8	208	22
15-F	354	66	27	15-F	12	368	16
Total	908	183	109	Total	32	878	74

95.8 per cent killed

The lime-sulfur used in 1915 was purchased from a company at Clarkston, Washington. It tested 30 degrees Baume. In 1916 and 1917 the lime-sulfur used was prepared at a plant on the Indian Cache Ranch designed for making this spray. The following formula was used: Lime 50 pounds, sulfur 100 pounds, water 50 gallons. The home spray tested about the same as the commercial product. All lime-sulfur sprays used in the experiment were tested before and after filling the tanks and always applied at 5 degrees Baume.

## SOLUBLE SULFUR, 1915

## Plat No. 34

Counts made before spraying March 9				Counts made after spraying April 14			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
15-E	235	42	31	15-E	98	206	36
11-F	141	10	21	11-F	60	104	32
11-C	240	13	25	11-C	50	136	28
11-J	200	17	42	11-J	67	137	35
Total	816	82	119	Total	275	583	131

64 per cent killed

## SOLUBLE SULFUR, 1916

## Plat No. 34

Counts made before spraying March 14				Counts made after spraying April 27			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
15-E	196	59	26	15-E	26	150	26
11-F	242	69	57	11-F	21	122	14
11-C	108	37	20	11-C	23	152	18
7-J	115	21	30	15-E	26	154	17
Total	661	186	135	Total	96	578	75

82 per cent killed.

## SOLUBLE SULFUR, 1917

## Plat No. 33

Counts made before spraying March 8				Counts made after spraying May 15			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
4-B	472	100	62	4-B	29	422	38
6-B	627	118	84	6-B	34	606	24
3-C	634	120	35	3-C	22	508	27
Total	1733	338	181	Total	85	1536	88

93.6 per cent killed.



The Soluble Sulfur used in 1915, 1916 and 1917 was purchased from C. H. Lilly Co., of Seattle, Washington. In 1915, twenty pounds of Soluble Sulfur were used to each 100 gallons of water. In 1916 and 1917 the strength of this spray was increased upon recommendation of the manufacturer to twenty-five pounds to each 100 gallons of water. The solution was prepared by washing the Soluble Sulfur thru the strainer while the tank was being filled with water.

## SPRA-SULFUR, 1915

## Plat No. 2

Counts made before spraying March 9				Counts made after spraying April 13			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
4-E	248	72	68	4-E	74	214	54
11-D	338	39	72	11-D	118	267	62
16-D	85	7	13	16-D	34	52	26
16-H	46	7	5	16-H	23	60	12
Total	717	125	158	Total	249	594	148

65 per cent killed

The Spra-Sulfur used in 1915 was secured from the Spokane Seed Company, Spokane, Washington. Twenty pounds of Spra-Sulfur were used to each 100 gallons of water, and the solution was prepared by washing the powder thru the strainer while the tank was being filled with water. This spray gave the same results as the Soluble Sulfur and as the two sprays seemed to be identical, the Spra-Sulfur was dropped from the experiment after 1915.

Dry lime-sulfur manufactured by the Sherwin-Williams Company was added to the experiment in 1917. It gave very encouraging results, but we are not prepared at this time to make any recommendations regarding this spray.

## SCALECIDE 1915

## Plat No. 5

Counts made before spraying March 10				Counts made after spraying April 13			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
16-K	305	54	70	16-K	2	398	50
14-I	145	15	21	14-I	1	191	22
16-G	110	8	12	16-G	2	244	20
18-J	125	12	7	18-J	2	199	17
Total	685	89	110	Total	7	952	112

99 per cent killed.

## SCALECIDE 1916

Plat No. 54

Counts made before spraying March 15				Counts made after spraying April 28			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
12-B	223	65	43	12-B	5	345	38
12-C	138	28	27	12-C	12	128	22
11-D	255	68	18	11-D	10	286	49
9-E	217	44	27	9-E	3	155	26
Total	833	205	115	Total	30	914	135

96 per cent killed.

## SCALECIDE 1917

Plat No. 54

Counts made before spraying March 7				Counts made after spraying May 14			
<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>	<i>Tree No.</i>	<i>Alive</i>	<i>Dead</i>	<i>Old</i>
13-C	326	74	29	13-C	8	382	22
11-D	428	89	58	11-D	5	452	42
7-E	316	72	37	7-D	6	375	33
Total	1072	235	124	Total	19	1209	107

98 per cent killed.

The Scalecide Oil is manufactured by B. G. Pratt Company of New York. It was secured from the Spokane Seed Co. Scalecide is said to be a petroleum oil, from which the heavy lubricating and light inflammable oils have been removed, combined with certain vegetable oils and chemically treated so as to mix with cold water, making a white, milky solution.

In 1915 and 1917, seven gallons of Scalecide were used to each 100 gallons of water. It was prepared by filling the tank nearly full of water, and then adding the Scalecide while the agitator was running. In 1916 the spray was prepared in the same manner but six gallons were used instead of seven. The formula used in 1915 and 1917 gave the best results.

The Scalecide Oil gave the best results thruout the experiment. But on account of its high cost, it may never become popular with the fruit growers.

## CRUDE OIL EMULSION, 1915

16 degree oil.

Plat No. 31

Counts made before spraying March 9				Counts made after spraying April 13			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
4-E	202	22	38	4-E	28	122	28
3-B	250	33	31	3-B	26	170	33
Total	452	55	69	Total	54	292	61

Plat No. 33

Counts made before spraying March 10.				Counts made after spraying April 14.			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
6-B	130	6	30	6-B	36	103	27
8-A	206	55	35	8-A	40	187	23
1-B	417	68	58	1-B	87	305	35
Total	753	119	123	Total	163	655	85

Plat No. 47

Counts made before spraying March 10				Counts made after spraying April 14			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
18-K	146	11	22	18-K	45	146	29
17-J	167	12	16	17-J	32	140	11
Total	313	22	38	Total	77	286	35

79 per cent killed.

## CRUDE OIL EMULSION 1916.

16 degree oil.

Plat No. 33

Counts made before spraying March 14				Counts made after spraying April 28			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
1-B	294	61	78	1-B	46	208	22
4-B	255	53	62	4-B	35	196	20
6-B	175	48	52	6-B	32	220	16
Total	724	162	192	Total	113	624	58

Plat No. 45

Counts made before spraying March 15				Counts made after spraying April 28			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
2-B	248	39	47	2-B	32	112	24

80 per cent killed.

The virgin crude oil used in this experiment was purchased from the Union Oil Company of Portland, and tested 16 degrees

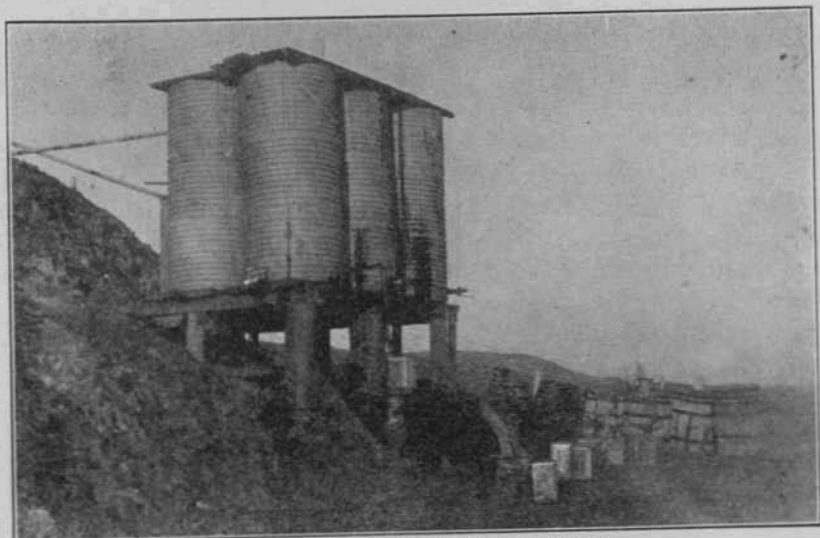


Fig. 5. Storage tanks for crude oil.

Baume. In 1915, the following formula was used: Liquid soap, 30 gallons, crude oil 20 gallons, water to make 200 gallons. In 1916, the amount of oil was increased from 20 to 25 gallons.

The liquid soap was prepared in a large iron kettle, like the one shown in Fig. 7. The liquid soap was made from the following formula: Water 40 gallons, fish oil soap 32 pounds, and caustic soda 6 pounds dissolved in 6 gallons of water. The water



Fig. 6. Spray machine and supply tank.

was brought to a boil, then the fish oil soap was added and stirred until all dissolved. After the soap was thoroly dissolved, the caustic soda was added. The liquid soap was stored in a tank similar to those used for storing the crude oil.

To prepare a 200 gallon tank of crude oil emulsion, thirty gallons of liquid soap were placed in the spray tank with the agitator running. Then 150 gallons of water were added. After the soap and water became thoroly mixed the crude oil was poured in.

## CRUDE OIL EMULSION 1915.

26 degrees oil.

Plat No. 47

Counts made before spraying March 10				Counts made after spraying April 14			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
17-E	182	19	20	17-E	62	117	18
19-H	104	5	18	19-H	58	124	15
18-E	100	7	15	18-E	51	107	11
Total	386	31	53	Total	171	348	44

64 per cent killed.

The crude oil of 26 degrees Baume was used in 1915, but it gave very poor results and was dropped from the experiment in 1916. The formula used to prepare this spray was: Liquid soap 30 gallons, oil 20 gallons, water to make 200 gallons of spray material.

## DORMANT SOLUBLE OIL, 1916.

Plat No. 47.

Counts made before spraying March 15				Counts made after spraying April 27			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
18-K	341	57	44	18-K	11	369	39
16-K	290	48	37	16-K	29	343	41
13-J	255	48	33	13-J	22	328	39
Total	886	153	114	Total	62	1040	119

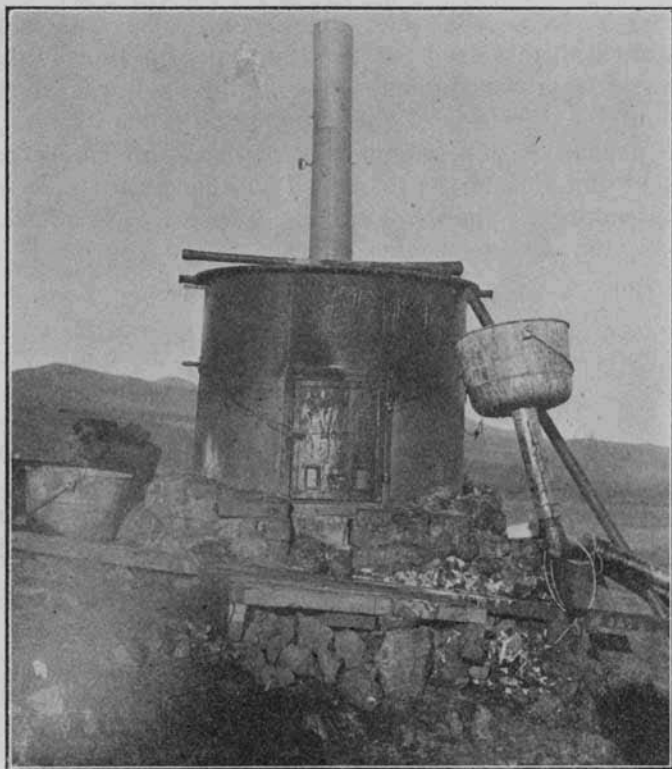
94 per cent killed.

## DORMANT SOLUBLE OIL, 1917.

Plat No. 53

Counts made before spraying March 8				Counts made after spraying May 15			
Tree No.	Alive	Dead	Old	Tree No.	Alive	Dead	Old
19-I	454	132	20	19-I	18	362	16
10-K	512	114	89	10-K	14	334	12
18-K	468	126	48	18-K	.....	.....	.....
Total	1434	372	157	Total	32	696	28

95.55 per cent killed.



**Fig. 7.** Stove and kettle used for making liquid soap.

The Dormant Soluble Oil was secured from the General Chemical Company of San Francisco, California. It resembles very closely the Scalecide Oil used in the experiment and gave very satisfactory results. It was used in 1916 and 1917 at the rate of seven gallons to each 100 gallons of water. In preparing it for use the oil was thoroly stirred in the barrel, then the desired quantity of oil was poured in the buckets. Small quantities of water were added and stirred vigorously until the oil turned to a white creamy emulsion, after which it was put in the spray tank while the tank was being filled with water with the agitator running.

## SUMMARY.

<i>Material Used</i>	<i>Year</i>	<i>Formula</i>	<i>Per ct. killed</i>
Lime-Sulfur .....	1915	5° Baume .....	95
Lime-Sulfur .....	1916	5° Baume .....	92
Lime-Sulfur .....	1917	5° Baume .....	95.8
Soluble Sulfur .....	1915	20 lbs. to 100 gals. water ....	64
Soluble Sulfur .....	1916	25 lbs. to 100 gals. water ....	82
Soluble Sulfur .....	1917	25 lbs. to 100 gals. water ....	93
Spra-Sulfur .....	1915	10 lbs. to 100 gals. water ....	65
Scalecide .....	1915	7 gals to 100 gals. water ..	99
Scalecide .....	1916	6 gals to 100 gals. water ....	96
Scalecide .....	1917	7 gals. to 100 gals. water ..	98
Crude Oil 16° .....	1915	Liquid Soap 30 gals. Crude Oil 20 gals. Water to make 200 gals. ....	79
Crude Oil 16° .....	1916	Liquid Soap 30 gals. Crude Oil 25 gals. Water to make 200 gals ....	80
Crude Oil 26° .....	1916	Liquid Soap 30 gals. Crude Oil 20 gals. Water to make 200 gals. ....	64
Dormant Soluble Oil ....	1915	7 gals. to 100 gals. water ..	94
Dormant Soluble Oil ....	1916	7 gals. to 100 gals. water ..	95

1. The results secured from the lime-sulfur were very gratifying and we feel safe in recommending it for the control of San Jose scale.

2. The Soluble Sulfur gave fairly good results in 1917, but we cannot recommend its use over lime-sulfur.

3. The Scalecide gave the best results of all the sprays tested. We believe that it will clean up a badly infested orchard, but we do not recommend oil sprays for continual use in the orchard. The cost of Scalecide is almost prohibitive.

4. The results obtained from the use of crude oil were very discouraging, and we do not recommend its use in Idaho.

5. The results obtained from the use of Dormant Soluble Oil were very satisfactory, and we feel that it is a very effective spray for the control of San Jose scale.

## ACKNOWLEDGEMENTS.

The writer wishes to acknowledge the valuable aid and kindly co-operation of Mr. H. G. Darwin, Manager of the Indian Cache Ranch, who furnished spray material, men, horses and machinery necessary for carrying on the experiment.

The following publications may be obtained without cost, by addressing the Agricultural Experiment Station, Moscow, Idaho

#### BULLETINS.

65. Alaska Wheat Investigations.
72. A Report on the Milling Properties of Idaho Wheat.
73. A Study of Idaho Butter with Suggestions for Improvement.
75. Composition of Irrigated and Non-Irrigated Fruits.
76. Tomato Culture in Idaho.
81. Soils of the Cut and Burned Over Areas of North Idaho.
85. The Use of Lime-Sulfur as a Summer Spray for Apple Scab.
86. Some Poisonous Plants of Idaho.
87. Insect Pests of the Orchards and Gardens of Idaho, and Their Control.
88. The Milling Values of Dry-Farmed and Irrigated Wheat.
89. Sheep and Lamb Feeding Experiments.
90. Creamery Records.
91. Methods of Clearing Logged-off Lands.
92. The Annual Report of the Experiment Station for the Year Ending June 30, 1916.
93. Experiments with Small Grains Under Irrigation.
94. Experiments with Legume Crops Under Irrigation.
95. The Management of Irrigated Grass Pastures.
96. The Management of Farm Flocks in Idaho.
97. Commercial Onion Culture in Idaho.
98. Winter Versus Summer Pruning of Apple Trees.
99. Experiments in the Irrigation of Apple Orchards.
100. The Production of Clover Seed Under Irrigation in Southern Idaho.
101. The Production of Alfalfa Seed in Southern Idaho.
102. The Management of Dairy Herds.
103. Performance Records of Some Eastern Wheats in Idaho.
104. Annual Report of the Experiment Station for 1917.
105. Trees: What, Where, When and How to Plant.
106. The Home Garden in Idaho.
107. Soil Survey of Latah County.

Measurement of Irrigation Waters  
Hog Cholera in Idaho.

The Alfalfa Weevil.

Directory of Idaho Pure-bred Breeders.

Farmers' Bulletin 769, Growing Grain On Southern Idaho Dry Farms.

\*Ground Squirrel Control.

\*Oats in Washington.

\*The Home Drying of Fruits and Vegetables.

\* Purchased of Washington State Experiment Station for distribution in Idaho.

#### CIRCULARS.

2. Field Peas.
3. Feeding for Egg Production.
5. Tested Forest Trees for Planting in Idaho.
6. The Spray Calendar.
7. Accumulators and Consumers of Nitrogen and Conditions Affecting Legume Inoculation.