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For the Control of Curculio, Brown Rot, and Scab

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EXPERIMENTS IN DUSTING AND SPRAYING PEACHES FOR THE CONTROL OF CURCULIO, BROWN ROT, AND SCAB*.

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INTRODUCTION.

Curculio, brown rot, and scab are responsible for the greatest part of the yearly damage to the peach crop in the South. During the past two seasons climatic conditions in Mississippi have been quite favorable for the germination of brown rot spores, and this disease alone has caused considerable losses in unsprayed orchards, while the curculio or common peach "worm" yearly causes thousands of dollars worth of damage to the Mississippi peach crop. During the past season fifty to sixty per cent of the peaches produced in unsprayed Mississippi orchards were "wormy."

Many advantages of the dry spraying or dusting over the liquid spraying for the control of the principal pests of peaches have been put forth by those who advocate the dusting method. The aim of this publication is to give a report of the results obtained in Mississippi during the 1920 season in testing the efficiency of various dust schedules as compared with the liquid schedule which has been used on peaches in the South for years.

OBJECTS.

The chief objects of these investigations were to study the following points in the control of curculio, brown rot, and scab:—(1) Actual count of fruit from certain trees in each plat to determine the percentage of perfect fruit and fruit damaged by curculio, brown rot and scab. Each peach from these count trees was cut open so that the curculio damage could be accurately ascertained. (2) The total yield of fruit from plats receiving various dust treatments as compared with the liquid treatment. (3) Comparative cost per tree of the various treatments.

LOCATION AND DESCRIPTION OF ORCHARD.

The experiments were conducted in the W. G. Bias orchard, located five miles south of New Albany, Union County, Mississippi. The orchard consisted of some sixty-nine acres of nine year old Belle of Georgia and Carmen peach trees. The orchard has been sprayed from year to year, yet it has suffered in previous years from the pests heretofore mentioned. Excellent hibernating quarters for adult curculios were quite numerous near the orchard, and many brown rot mummies of the previous season were found before the experiment was started. Most of the trees had made fair growth, although the new growth of the several past seasons was quite short on account of the lack of cultivation and fertilization. The soil was a sandy loam of the Orangeburg series.

*These experiments were conducted under the direction of Dr. A. L. Quaintance and Dr. J. W. Roberts of the U. S. Dept. of Agriculture, in cooperation with the Mississippi State Plant Board and Holly Springs branch of the Mississippi Agricultural Experiment Station.

Seven hundred and sixteen trees were utilized in the experiment and they were divided into seven plats of as near equal size as practical so that the various schedules would have an equal chance to prove their effectiveness. A much more extensive experiment was planned; however, the cyclone which swept this section on the morning of April 20th completely destroyed the trees in Plats 1, 2, 3, 11, 12, 13, 14, and 15 so that the schedules which were to be used on these plats had to be cut out entirely. The plats contained the following number of trees:

Plat 4— 97 trees
Plat 5—101 trees
Plat 6—109 trees
Plat 7—104 trees
Plat 8—101 trees
Plat 9—104 trees
Plat 10—100 trees

In the center of each plat ten trees were selected and tagged as count trees from which each peach was cut, examined, and an actual count made during harvest in order to ascertain the exact percentage of fruit injured by curculio, brown rot, and scab.

APPARATUS AND PREPARATION OF MATERIALS.

All of the dust applications were made with a large model D1 Niagara duster driven by a 3½ H. P. engine. The liquid sprays were applied with a barrel hand outfit developing about 175 pounds pressure per square inch.

One of the chief points to consider in dusting is fineness of materials, properly and thoroughly mixed. The only way that this can be accomplished is with a mechanical sifter and mixer built especially for the purpose. Superfine sulphur guaranteed 95% to pass a 200 mesh sieve and an exceedingly light diplumbic arsenate of lead was used in all dust mixtures. Fineness of material seems to have a great deal to do with the ability of the mixture to stick. The fine hairs which cover the fruit serve as lodging places for the finest particles and they are here somewhat protected from climatic conditions which would otherwise tend to wash or blow them off.

In preparing the self-boiled lime-sulphur for the liquid applications special attention was given to fineness of sulphur and to see that it was thoroughly wet before adding to the lime. This is one of the most important points to keep in mind when preparing this material. If any small lumps of sulphur are left when it is added to the boiling lime it will usually not break; therefore it will remain in the container throughout cooking operations without combining. The best grade unslacked lime should be used, care being exercised not to drown it with too much water before cooking starts. If the sulphur has been made thoroughly wet before adding there is no necessity of adding more water to the lime than enough to cover the lumps.

METHODS OF RECORDING RESULTS.

As before stated there were ten count or record trees in the center of each plat. The fruit from each of these trees was harvested separately, cut open, and an actual count made of the perfect fruit and that injured by curculio,

brown rot, and scab. The fruit from the remainder of the plat was then harvested separately, graded and packed by experienced packers, and a record made of the production per plat in terms of six basket crates of number ones and culls, these being the only grades used at this orchard.

The following outline gives the schedules used on the various plats:

Plat No.	1st Application	2nd Application	3rd Application
4	Dust-Arsenate lead powd. 10%; lime 10%; sulphur 80%.	Arsenate-lead powd. 10%; lime 10%; sulphur 80%.	Arsenate-lead powd. 10%; lime 10%; sulphur 80%.
5	Dust-Arsenate lead powd. 10%; lime 90%.	Arsenate-lead powd. 10%; lime 10%; sulphur 80%.	Sulphur 80% Lime 20%
6	Dust-Arsenate lead powd. 5%; lime 95%.	Arsenate lead powd. 5%; lime 15%; Sulphur 80%.	Sulphur 80% Lime 20%
7	Dust-Lime 70%; sulphur 30%.	Lime 70%; sulphur 30%	Lime 70%; sulphur 30%
8	Check-Untreated		
9	Spray—Arsenate lead powd. 1 lb.; water 50 gal.; stone lime 3 lbs.	Self-boiled lime-sulphur 8-8-50; arsenate lead powd. 1 lb.	Self-boiled lime-sulphur 8-8-50.
10	Dust-Arsenate lead powd. 15%; lime 85%.	Arsenate-lead powd. 15%; sulphur 50%; lime 35%.	Sulphur 50% Lime 50%

The first application was made on April 22nd as the shucks were being forced off of the little peaches. This application was delayed about three days on account of the cyclone damage which occurred on April 20th. The second applications were applied on May 11th and the third and last on June 12th about four and one half weeks before the fruit was harvested.

RESULTS.

The following summary of results brings together in terms of percentage the data obtained in making counts of the fruit from the record trees and the total commercial production from the plats. The two columns on the right are commercial results of fruit harvested from each plat except that taken from the count or record trees.

TABLE 1. SUMMARY OF RESULTS

Plat No.	Total No. Fruit	PER CENT TOTAL FRUIT										Per cent Brown Rot infection at curculio puncture	Per cent Sound Fruit	PER CENT TOTAL FRUIT (Commercial results measured in terms of 6 basket peach crates	
								Curculio wormy							
		Curculio wormy	Brown rot	Scab	Curculio wormy only	Brown Rot only	Scab only	Brown Rot Scab	Brown Rot	Scab	Brown Rot Scab			No. 1 Fruit	Cull Fruit
4	3057	19.83	.78	.36	19.50	.55	.26	0	.13	.10	0	.10	79.36	74.87	25.13
5	2831	31.29	1.59	.99	29.74	.85	.18	0	.25	.81	0	.49	67.68	84.01	15.99
6	2575	34.25	1.86	.94	32.81	.81	.47	0	.27	.43	.04	.74	64.43	84.69	15.31
7	2417	45.80	8.60	9.55	37.24	4.18	3.43	.58	1.03	4.84	.70	2.11	45.89	72.28	27.72
8	3104	47.48	8.96	40.4	23.74	2.62	17.27	2.77	1.16	18.88	1.48	.93	31.15	64.21	35.79
9	3000	29.03	2.10	.40	27.93	1.30	.07	.03	.24	.30	0	.53	69.60	88.08	11.92
10	2924	31.94	3.14	.14	30.51	1.85	0	0	.44	.14	0	.85	66.21	79.49	20.51

Quite severe foliage injury occurred on Plat 4 where 10% arsenate of lead dust was used in all three applications. Some of the trees in this plat were 80% defoliated by harvest time. The last application about four and one half weeks before the fruit ripened seemed to be largely responsible for most of the defoliation. The fruit on this plat matured unevenly and much of it was hard, lacked sugar and was insipid. These trees, however, were on thin soil which had received no fertilizer and very little cultivation for several years. The trees themselves were not vigorous and healthy as those on some other plats. It was quite evident that three applications of arsenate of lead were too many for trees in this orchard. Quite pronounced foliage injury was also noted on plat 10 where 15% arsenate of lead was used in the dust mixture. Some of the trees in this plat were entirely defoliated two months earlier than normal. Fifteen percent arsenate of lead cannot be used safely on peach foliage.

By referring to the above table it will be found that Plat 4 shows the lowest percentage of curculio wormy fruit 19.83%. Plat 9, the liquid sprayed plat, came next with 29.03% curculio wormy fruit. The low percentage of curculio wormy fruit on plat 4 as compared with the other plats is without doubt due to the three applications of arsenate of lead; however, as noted before, trees on thin soil will not stand three arsenical applications on account of foilage injury which will affect the ripening and size of the fruit.

The percentage of cull fruit in the commercial results ran high in plats 4 and 10 on account of the heavy defoliation before harvest which caused a quantity of the fruit to be small and grade culls which were not affected by a disease or worm.

Five percent arsenate of lead dust in the first two applications gave almost as efficient curculio control as 10% or 15%. The 5% yielded 34.25 percent curculio wormy fruit, while the 10% had 31.29%, and the 15% 31.94 per cent. As noted before, 15% arsenate of lead is too much for peach foliage on account

of severe burning. Apparently, therefore, no great advantage is obtained by increasing the amount of arsenate of lead in a dust mixture above 5 or 8%.

Plat 7 evidently did not contain enough sulphur to properly control brown rot and scab. Plat 7 received 30% sulphur in all three applications. This plat gave 8.6% brown rot while the check plat yielded 8.9% of the fruit damaged by brown rot at harvest. This plat also gave 9.5% scabby fruit while the scab percentage was negligible on all other plats except the check. 30% sulphur, however, reduced the scab infection as the check gave 40.4%. On account of the lack of an arsenical in the dust schedule used on Plat 7 the total percentage of curculio wormy fruit was almost as high as the check, there being 45.8% wormy fruit on Plat 7 as compared with 47.4% wormy fruit on the check plat.

The quality of the fruit produced on Plat 9, the liquid sprayed plat, was possibly the best in the orchard. It ripened evenly, colored well, and the packers could easily tell the difference when fruit from this plat was placed on the tables. Furthermore, it gave a higher percentage of number one fruit in the commercial results than any other plat, and the lowest percentage of curculio wormy fruit with the exception of the past schedule in which three applications of arsenate of lead were used. Dust schedules 4, 5, 6, and 10, however, held up very well as compared with the liquid schedule in controlling brown rot and scab.

There was very little sound fruit on the check plat. The results show 31%; however, even this was of poor quality. By referring to the commercial results in the table it will be found that the check plat yielded 35.8% cull fruit. Plat 7 also gave 27.7% cull fruit but the schedule used on this plat contained no arsenate of lead and only 30% sulphur, not enough to properly take care of the diseases.

With the proper amount of sulphur the dust schedules will probably control the diseases a little better than the liquid, but the liquid apparently gives the best curculio control. The general quality of the fruit from the liquid sprayed plat was better than that from the dusted plats; however, the dust in some cases seemed to assist somewhat in coloring the fruit.

Some hydrated lime is needed in a dust schedule to make it fluid which facilitates the carrying of it to the trees. Ninety percent sulphur is too heavy and a quantity is usually lost by immediately falling to the ground from the exit pipe before it reaches the tree. Eighty percent apparently is the greatest amount that can be satisfactorily carried to the trees.

COMPARATIVE COST OF THE DUST AND LIQUID SPRAYS.

In calculating the cost per tree for the entire three applications only the time actually spent in making the applications was used as a basis for man, horse, and machine hour calculation. Time spent on account of engine trouble, to refill hopper or spray tank, etc., was not taken into consideration.

Horse hours were calculated at 20 cents per hour, man hours at 30 cents per hour and machine hours at 20 cents per hour. The arsenate of lead cost was used at 40 cents per pound, sulphur at 4½ cents per pound, and hydrated and stone lime at 1½ cents per pound.

The following is the total cost for the three applications on the various plats:

The dust schedule used on Plat 4 cost 8 cents per tree.
The dust schedule used on Plat 5 cost 5.3 cents per tree.
The dust schedule used on Plat 6 cost 4 cents per tree.
The dust schedule used on Plat 7 cost 2.4 cents per tree.
The liquid schedule used on Plat 9 cost 4.7 cents per tree.
The dust schedule used on Plat 10 cost 4.5 cents per tree.

The initial cost of the dust material was very much more than that used in the liquid schedule; however, on account of the rapidity with which the dust can be applied, this difference was offset when the total cost per tree for the three applications was calculated taking into consideration horse, man, and machine hours used in making the applications. One hundred trees could easily be dusted in fifteen minutes whereas with one lead of hose one hour was required to properly apply the liquid spray to the same number of trees. This rapidity of applying dust has another value in that it is possible to get over the orchard quickly at critical times when weather conditions have been favorable for brown rot, or scab, etc.

The cost of eight cents per tree for the three applications used on plat 4 was the result of arsenate of lead in all the applications. The low cost of the schedule used on Plat 7 was due to the absence of arsenate of lead in this schedule. There was very little difference between the cost of the liquid schedule used on Plat 9 and the dust schedules used on Plats 5, 6, and 10. From these calculations it is evident that after the cost of applying the materials is taken into consideration there is little difference between the total cost of dust and liquid spraying.

RECOMMENDATIONS.

As a result of these experiments the following conclusions may be made as to the schedules recommended for future use in the state:

The quite heavy percentage of curculio wormy fruit on all plats in the experiment in spite of the applications of arsenate of lead show that an additional application of arsenate of lead might be advisable on the heavier soils where the trees are quite healthy and are making vigorous growth. The lowest percentage of curculio wormy fruit on any plat in the experiment was 19.8%. This percentage ran as high as 34.2% on one plat receiving arsenate of lead in two applications. This damage from curculio could be reduced by applying an early application of arsenate of lead, about the time most of the petals have fallen, as our data shows that the beetles are appearing on peach trees in numbers about this time during a normal season.

In using the liquid spray the following four applications are recommended

for use on healthy trees on fertile soil. The first application should be omitted on the poorer soils and where trees are stunted or unhealthy.

First application:—Immediately after the blossoms have fallen use arsenate of lead powder, one pound to fifty gallons of water plus five pounds of unslacked lime. Slack lime in a small container of water before adding to the spray tank.

Second application:—Ten days later or when the small peaches are bursting through the shucks use the same spray as recommended for first application.

Third application:—About two weeks after second application use self-boiled lime-sulphur 8-8-50 plus one pound of arsenate of lead powder.

Fourth application:—About four weeks before the fruit is due to ripen use self-boiled lime-sulphur 8-8-50 alone.

In using dust, four applications would be advisable on healthy, vigorous trees on strong soil. The four application schedule recommended is as follows:

First application:—Immediately after blossoms fall dust with 5% arsenate of lead and 95% hydrated lime.

Second application:—Ten days later, using same dust mixture as for first application.

Third application:—Two weeks after second application use 5% arsenate of lead; 70% sulphur;and 25% hydrated lime.

Fourth application:—About four weeks before fruit ripens use 70% sulphur and 30% hydrated lime.

On the poorer soils where trees have not made good growth the three application dust schedule is recommended as follows:—

First application:—About ten days after blossoms fall or when calyces are shedding use 10% arsenate of lead and 90% hydrated lime.

Second application:—Two weeks later use 10% arsenate of lead; 70% sulphur; and 20% hydrated lime.

Third application:—About four weeks before the fruit is due to ripen use 70% sulphur and 30% hydrated lime.