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Results of Dusting Versus Spraying in Connecticut Apple and Peach Orchards in 1922

By M. P. Zappe and E. M. Stoddard.

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Results of Dusting Versus Spraying in Connecticut Apple and Peach Orchards in 1922.

By M. P. Zappe and E. M. Stoddard.

This series of experiments with dust in comparison with liquid sprays for controlling the common insect and fungous pests of apple orchards in Connecticut was begun in 1920. The results of that year's work were printed in the Station Report for 1920, pages 168-177. In 1921 the project was enlarged to include peaches. Four apple and two peach orchards were used and the results of the work published in Bulletin 235 of the Station, and in Crop Protection Digest No. 2, page 7. In 1922 the same orchards were used as in preceding years.

APPLE ORCHARDS.

Orchard No. I.	Young orchard, Station Farm, Mount Carmel	96 trees
Orchard No. II.	Orchard of W. F. Platt, Orange	62 trees
Orchard No. III.	Orchard of F. N. Platt, Milford	285 trees
Orchard No. IV.	Old orchard, Station Farm, Mount Carmel	40 trees
		483 trees

A portion of the dusting materials was furnished gratis to Dr. W. E. Britton, Entomologist of this Station, on behalf of the Crop Protection Institute by the Dosch Chemical Company of Louisville, Kentucky, and we hereby express our appreciation and thanks for this favor.

We also desire to express our appreciation and thanks to Messrs. W. F. Platt and F. N. Platt for the use of their orchards and spray outfits, also for their co-operation in this work. We also wish to thank Dr. B. A. Porter, in charge of the Wallingford Field Station of the Bureau of Entomology, for the use of the dusting machine and for his assistance in scoring the fruit. Mr. G. E. Graham of the Botanical Department of this Station assisted in applying the treatments and scoring fruit. Messrs. W. E. Britton, B. H. Walden and P. Garman of the Entomological Department, and Messrs. F. D. Luddington and J. L. Rogers, temporary employees, assisted in gathering and scoring the fruit. The owners of the or-

chards furnished spray outfits with team and driver for each of the spray applications in orchards II and III.

MATERIALS USED.

SPRAYS.

The liquid spray for all treatments in all orchards was as follows:

Commercial Lime-Sulphur	3 gallons
Lead Arsenate (Dry)	3 pounds
Nicotine Sulphate	¾ pint
Water	100 gallons

DUSTS.

Sanders or Copper Dust.

Dehydrated Lime	79 per cent.
Dehydrated Copper Sulphate	13 per cent.
Calcium Arsenate	8 per cent.

Sulphur-Nicotine-Arsenate Dust.

Superfine Dusting Sulphur	65 per cent.
Lead Arsenate	10 per cent.
Nicotine Sulphate	5 per cent.
Carrier	20 per cent.

90-10 Sulphur-Arsenate Dust.

Dusting Sulphur	90 per cent.
Lead Arsenate	10 per cent.

APPARATUS USED.

The dusting machine used in all the orchards was a Niagara duster owned by the Bureau of Entomology and used at its Field Station at Wallingford, Connecticut. The machine was designed to be drawn by a team of horses, but this method was too slow when moving the outfit from orchard to orchard, so the machine was mounted on a Ford ton truck, thus saving considerable time on the road and in the orchards. The Ford truck had no trouble in carrying this outfit through the orchards. When the machine was not in use it could easily be unloaded from the truck and stored in a shed. In orchard No. I, an Arlington X. L. power sprayer with a 100 gallon tank was used. Two lines of hose were used with a nozzle at each rod. In orchards No. II and III, Friend power sprayers with 200 gallon tanks were used. In orchard No. II, spray rods were used, one man spraying from the tower and the other from the ground. The pressure was about 200 pounds. In orchard No. III, a single line of hose with a "spray gun" carrying 175 pounds pressure was used, spraying from the ground.

METHOD OF RECORDING DATA.

Certain trees promising a crop situated inside the border of each plot and representing the chief varieties upon which the tests

were made in each orchard were selected and marked as count trees. As a rule the count trees were selected near the center of each plot and not adjacent to a plot having a different treatment on account of the danger of spray or dust getting on the trees that were not intended to be so treated. With the liquid spray there is less danger of this, but the dust is quite apt to drift or be blown upon adjoining trees.

The green dropped fruit from each of the count trees was gathered, counted and examined for insect and fungous injuries and the data recorded for each tree twice before the ripe fruit was picked. At harvest time the picked fruit was scored in the same manner. Each individual apple was carefully examined and a record made of each insect and fungous injury. Apples that were called "good" were absolutely free from any signs of insects or fungous diseases and might better be called "perfect", for they were free from pests and were perfect except possibly as to size. An apple showing the work of more than one pest would be checked as many times as there were kinds of insect injury or fungous diseases. This very often gave a greater number of injuries than there were apples, and in order to get the true amount of any kind of injury all the apples had to be counted, and this number used to compute the percentage of injury or the percentage of good fruit. This scoring of the fruit involved examining separately 181,036 individual apples, equivalent to about 402 barrels.

The figures given in the tables of results from the various plots are percentages of perfect fruit or of injuries even if very slight, and cannot be compared with any commercial grading. For instance, an apple that had been bitten by a curculio might only have one or two small blemishes and would be counted as a "curculio" apple, but in a commercial grading of the fruit would easily go as a No. 1 apple. The same is true of other injuries, especially small spots of scab, sooty blotch or fruit speck. After scoring the apples by the above method, all the fruit on the count trees was graded as it would be for market. The results obtained by the commercial grading method are of the greatest importance to the fruit grower, and tell at a glance which treatment gives the highest per cent. of No. 1 fruit. The other method of scoring is of value in showing just where certain treatments fail.

ORCHARD NO. I.

Orchard No. I was the eleven year old Experiment Station orchard located at Mount Carmel. This orchard is just begining to bear, and consists of 96 trees on a side hill sloping to the west. All trees bearing fruit were used as count trees to check up results. The varieties were Baldwin, Rhode Island Greening, Roxbury Russet, McIntosh, Gravenstein, Duchess of Oldenburg, Fall Pip-

pin, Northern Spy, Sutton Beauty, King, Wealthy, Hurlbut and Stark.

This orchard was divided into three plots. The north plot was treated with liquid spray and the south plot with the 90-10 sulphur dust. The remaining plot in the center of the orchard was used as a check.

The green dropped fruit was gathered, counted and scored twice during the summer. At harvest time all the picked fruit was scored. All trees that bore fruit were used as count trees in this orchard.

NUMBER AND DATES OF APPLICATIONS.

The first application of spray and dust was given this orchard on April 29, when the blossom buds began to show pink. The second application was the calyx spray, made on May 22, just after all the petals had fallen. The next treatment was given on June 14. To test the value of later applications of spray and dust, the plots were each divided into two equal parts. One half of each original plot received two more applications of spray and dust while the other half had no further treatment. The two later applications were made on June 30 and July 20. The spray and dust were always applied on the same day. The dust was put on first, very early in the morning before the wind began to blow and often while the trees were still wet with dew. Later in the day, or as soon as the dusting operations were finished, the liquid spray was applied. As there were no sucking insects present, nicotine sulphate was omitted from the last two sprayings.

TABLE No. I.

RESULTS OF TREATMENT. ALL VARIETIES.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications ...	15.2	18.85	0	1.1	71.9	1.9	14.59	2.8
Sul.-Nic.-Ars. Dust 5 applications ...	15.2	12.49	.054	2.8	80.4	2.9	2.06	5.3
Check	1.49	17.7	.199	20.4	95.	6.5	8.9	55.1
Spray, 3 applications	17.7	11.3	9	2.6	70.5	2.9	10.1	5.4
Sul.-Nic.-Ars. Dust, 3 applications ...	11.05	17.6	.047	4.3	81.7	3.3	5.68	10.3

DISCUSSION OF RESULTS.

In this orchard there were many varieties, some of which were represented by only a few trees, so that each variety could not be

included in each plot. For instance, the McIntosh variety was included only in the sprayed plots; none in the dust plots. There were no varieties that scab badly in either of the dust plots; therefore the percentage of scab in the sprayed plot is naturally higher than in the dusted plots. The percentage of good fruit in this orchard was very low on account of the great abundance of curculio injury. In nearly every case the liquid spray was a little better than the dust treatment. The plot receiving the dust treatment was much better than the check or untreated plot. In the column called "other insects" are included chewing insects which are normally controlled by arsenate of lead. The "other fungi" column includes sooty blotch, fruit speck, bitter rot and cedar rust. The injury from red bugs in this orchard was negligible.

FIVE TREATMENTS VERSUS THREE TREATMENTS.

In most cases the spray or dust plots having five applications gave a lower percentage of insect and fungous injury than the plots having but three applications, exceptions being the case of curculio injury in the spray plots, the good fruit in the sprayed plots, the scab results in both spray and dust plots, and aphis results in both sprayed and dusted plots. In the case of scab results the difference is easily explained. The scab susceptible varieties were not equally represented in the various plots, there being more varieties that scab easily in the sprayed than in the dusted plots. The spray plot having the extra treatments was on the northern edge of the orchard and it is a common occurrence for the trees along the border of an orchard to show greater curculio injury than trees further back from the margin. The curculio injury is caused early in the season, soon after the young fruit has set, so that the later treatments would have no effect on this insect. The extra treatments showed a little better codling moth control, evidently on the second brood worms. The "other insects" being later feeders on the surface of fruit, would naturally be better controlled by later treatments of spray or dust. The same is true of the fungi which make their appearance later in the season, with the exception of scab.

ORCHARD NO. II.

This orchard is owned by Mr. W. F. Platt, located in the town of Orange, near the Milford line. It is twenty-eight years old and has been kept in very good condition. There were three experimental plots in this orchard; the spray plot, consisting of 33 trees; the dust plot of 25 trees, and the check plot of four trees.

The varieties in the experimental plots in this orchard were Fall Pippin, McIntosh and Greening. Each variety was represented in the spray, dust and check plots, except that there were

no Fall Pippins in the check plot. Count trees were selected soon after blooming and trees that gave promise of having a good crop were selected. Two trees of each variety were selected in each plot, one receiving the five treatments and the other the three treatments.

The number and dates of application were the same as those in orchard No. 1. The owner of the orchard put on the regular delayed dormant spray over all the plots, also the pre-pink spray on all Fall Pippin and McIntosh trees. The regular spraying and dusting operations began with the pink treatment on April 28, followed by the calyx application on May 19. The first treatment after the calyx was applied on June 13. After this treatment the spray and dust plots were divided into two parts, one part of which received two further applications of spray and dust, while the other had no further treatment.

In this orchard the liquid spray was put on with a Friend power sprayer, using two lines of hose with two nozzles at each rod. One man sprayed the tops of the trees from a tower on the spray outfit while the other sprayed the lower part of the tree from the ground. The regular lime-sulphur arsenate of lead spray with the addition of Black Leaf 40 was used.

The dust was applied with the same duster used in the other orchard. Only one kind of dust was used in this orchard, namely, the sulphur-nicotine dust. About three or four pounds of dust were used per tree.

TABLE NO. II.

RESULTS OF TREATMENT. GREENING.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	51.2	13.7	1.7	.14	15.1	1.76	28.1	6.45
Sul.-Nic.-Ars. Dust, 5 applications ...	7.8	7.77	.34	.42	7.5	2.36	46.2	97.
Checks	0	26.7	16.4	21.2	76.	6.62	89.5	113.
Spray, 3 applications	60.5	9.02	.05	.48	6.2	.97	16.5	12.9
Sul.-Nic.-Ars. Dust, 3 applications ...	6.4	11.04	.68	.76	15.	6.5	54.2	108.4

DISCUSSION OF RESULTS.

From Table II it is very evident that the liquid spray both in five and three applications gave a much higher percentage of good fruit than the dust treatment. The difference in control of apple scab and other fungous diseases is marked. In the control of in-

sect pests, the difference is not as great, although still a little in favor of the liquid spray. The value of five over three applications in both dust and liquid spray is again shown, especially in the case of other insects and other fungi, which appear later in the summer and are controlled with later applications.

TABLE No. III.

RESULTS OF TREATMENT. McINTOSH.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	40.	5.27	.44	.34	2.8	.54	54.5	4.38
Sul.-Nic.-Ars. Dust, 5 applications	6.39	9.54	.09	.18	3.56	.647	86.4	.55
Checks	.121	2.9	.78	4.4	35.3	3.14	98.4	9.11
Spray, 3 applications ...	44.4	.026	.227	.06	2.26	1.74	54.7	.166
Sul.-Nic.-Ars. Dust, 3 applications	5.06	3.58	.117	.311	4.66	1.55	96.	3.62

DISCUSSION OF RESULTS.

Here the liquid spray is again better than the dust treatments, particularly in the control of scab. The percentage of good fruit is very much greater in the sprayed plots both for the three and five treatments than in dusted plots. In control of other pests, the difference is not so marked. The difference noted in control of fungi on Greenings is more evident than in the case of McIntosh, probably because the McIntosh does not seem to be so susceptible to these diseases, as the check plot shows only nine per cent. of injury in this column.

TABLE No. IV.

RESULTS OF TREATMENT. FALL PIPPIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	24.9	14.1	.31	.387	2.56	1.35	64.4	6.
Sul.-Nic.-Ars. Dust, 5 applications	2.61	6.28	.23	.326	5.62	1.44	94.5	23.
Spray, 3 applications	19.09	12.9	.6	.247	3.99	.846	79.5	6.6
Sul.-Nic.-Ars. Dust, 3 applications	.95	11.	.08	.52	6.4	1.95	94.9	48.6
No checks.								

DISCUSSION OF RESULTS.

The results in the Fall Pippin plot are similar to those obtained in the other plots, the liquid spray again giving a higher percentage of good fruit and a very much lower percentage of scabby fruit also a much lower percentage of fruit showing the injury of sooty blotch and fruit speck. The differences in control of insect pests are not so evident as in the case of fungous diseases. There were no check trees left in the Fall Pippin plots, but in preceding years the fruit was absolutely worthless, showing nearly 100 per cent. of scab.

ORCHARD NO. III.

This orchard is located two miles north of the village of Milford and is bounded on the east side by a highway running north and south. The trees are 18 years old, and are located on a fairly level piece of land with woods on the west and open fields on north and south sides. The trees had dense crowns, making it rather difficult to reach the centers with spray or dust.

The varieties used in the experimental work in this orchard were Baldwin, Greening, Gravenstein and McIntosh. This orchard was divided into four plots, one for liquid spray, two for dust and one for check. Two kinds of dust were used, Sanders or copper dust, and sulphur-nicotine-arsenate dust. Count trees were selected soon after blossoming, and the green dropped fruit from them gathered, counted and scored twice during the summer. At harvest time the fruit remaining on these trees was gathered and scored.

The applications of spray and dust were put on at approximately the same dates as those of Orchard No. II. This orchard had no delayed dormant treatment nor any pre-pink spray, the first being applied when the blossom clusters had separated and were showing pink. As in the other two orchards the spray and dust plots were divided after the third application, one-half of each receiving two more treatments, while the other had no further applications.

The spray outfit used here was also a Friend machine, but a spray gun was used instead of spray rod as in orchard No. II. The same duster was used here as in the other orchards. The dusting was always done on the same day and usually before the spray was applied. One day the wind was too strong for dusting, so that it had to be put off until the evening of that day.

TABLE NO. V.

RESULTS OF TREATMENT. BALDWIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	39.2	28.2	1.53	.338	20.77	1.6	.73	9.96
Sul.-Nic.-Ars. Dust, 5 applications	11.5	8.1	.675	.725	24.87	3.	.948	117.2
Sanders Dust, 5 applications	21.5	11.6	2.55	1.03	40.64	6.73	.222	52.2
Checks	0	51.72	7.16	24.88	93.6	24.8	.127	177.5
Spray, 3 applications	25.8	15.1	4.1	1.15	36.22	3.73	.823	58.68
Sul.-Nic.-Ars. Dust, 3 applications	2.48	10.7	1.8	1.11	47.65	4.71	1.07	146.5
Sanders Dust, 3 applications	5.9	19.95	1.39	.856	51.55	6.66	.45	149.8

DISCUSSION OF RESULTS.

In each case the liquid spray produced a higher percentage of good fruit; Sanders dust came next and sulphur-nicotine-arsenate dust last, with the exception of the check plot, which had no good fruit at all. In the case of fungi, spray was best, Sanders dust averaged second best, while sulphur-nicotine-arsenate dust was third. In control of aphis and red bug, either of the dusts were better than the liquid spray and the sulphur-nicotine-arsenate dust was better than the Sanders dust.

In controlling curculio, codling moth and other chewing insects, liquid spray was a little better than either dust. There was little difference between the two dusts for the control of other insects.

TABLE NO. VI.

RESULTS OF TREATMENT. GREENING.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	39.6	38.2	2.14	.279	14.02	1.02	12.31	10.38
Sul.-Nic.-Ars. Dust, 5 applications	11.85	22.	.44	2.2	27.2	1.97	39.1	86.5
Sanders Dust, 5 applications	16.8	14.5	3.89	6.73	45.22	8.42	33.35	36.1
Checks	0	16.85	50.5	22.79	99.	28.75	45.6	184.
Spray, 3 applications	18.3	29.8	1.9	1.737	25.34	2.56	30.95	63.1
Sul.-Nic.-Ars. Dust, 3 applications	1.35	17.9	.579	1.35	39.55	4.81	39.1	140.7
Sanders Dust, 3 applications	.586	25.7	14.35	6.23	53.8	9.75	30.65	180.87

DISCUSSION OF RESULTS.

In the Greening plots the liquid spray is again better than either of the dusts. The three treatments of spray gave a higher percentage of good fruit than five applications of either dust. For some reason the three treatment Sanders dust plot made the poorest showing both in the percentage of good fruit and percentage of other fungi. The sulphur-nicotine-arsenate dust appeared to be more effective in controlling aphis and red bug than either spray or Sanders dust.

TABLE NO. VII.

RESULTS OF TREATMENT. GRAVENSTEIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	46.4	25.3	1.82	.032	10.73	1.4	17.98	6.65
Sul.-Nic.-Ars. Dust, 5 applications	8.4	18.2	1.51	.331	32.43	2.97	56.6	51.55
Sanders Dust, 5 applications	14.1	28.7	3.55	.935	39.59	5.32	42.35	10.8
Checks	.04	27.9	6.55	.63	56.25	3.95	28.34	54.2
Spray, 3 applications	31.2	34.	2.69	.018	10.32	1.95	25.77	19.64
Sul.-Nic.-Ars. Dust, 3 applications	6.77	12.9	.415	.192	30.79	3.7	64.6	135.5
Sanders Dust, 3 applications	10.9	19.1	1.28	.39	43.94	5.03	42.8	29.4

DISCUSSION OF RESULTS.

It will be seen from Table VII that the liquid spray gave better control of scab and other fungous diseases than did either of the dusts. The Sanders or copper dust gave a higher percentage of good fruit and a lower percentage of scab and other fungi than the sulphur-nicotine-arsenate dust. As might be expected, the nicotine dust gave better control of sucking insects such as aphids and red bugs than the Sanders dust. It was also a little better in controlling curculio and other chewing insects.

TABLE No. VIII.

RESULTS OF TREATMENT. McINTOSH.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	28.2	2.56	1.94	.085	14.21	1.44	66.2	1.46
Sul.-Nic.-Ars. Dust, 5 applications	1.85	9.71	3.62	.362	9.2	1.49	97.2	5.
Sanders Dust, 5 applications	.238	11.2	18.3	.315	27.45	3.42	96.3	3.74
Checks	.601	10.75	13.4	1.35	9.34	.975	98.9	2.29
Spray, 3 applications	4.73	9.1	5.61	.391	11.53	1.07	93.4	5.48
Sul.-Nic.-Ars. Dust. 3 applications	.11	13.3	5.71	.33	13.52	1.65	99.8	5.27
Sanders Dust, 3 applications	.364	8.65	13.	.5	25.34	3.28	99.1	8.7

DISCUSSION OF RESULTS.

The results of the treatments are similar to those obtained in the other varieties, the liquid spray again giving the best results and the Sanders dust being a little better for control of fungous diseases than the sulphur-nicotine-arsenate dust. The check tree of this variety was located in the spray plot and was partly sprayed twice. This probably accounts for the low percentage of injury when compared with the other treatments.

TABLE No. IX.

RESULTS OF TREATMENT. COMMERCIAL GRADING.

Treatment	Grade No. I Per Cent.	Grade No. II Per Cent.	Culls Per Cent.
BALDWIN.			
Spray	41.05	40.95	18.
Sulphur-nicotine-arsenate dust	37.1	45.25	17.65
Sanders dust	34.65	46.4	18.95
Check	0	0	100.
GREENING.			
Spray	59.45	20.8	19.75
Sulphur-nicotine-arsenate dust	48.1	38.1	13.8
Sanders dust	34.45	35.	30.55
Check	0	0	100.
GRAVENSTEIN.			
Spray	85.1	10.9	4.
Sulphur-nicotine-arsenate dust	67.6	26.8	5.6
Sanders dust	78.	19.95	2.05
Check	0	57.	43.

McIntosh.

Spray	63.75	27.50	8.75
Sulphur-nicotine-arsenate dust		Not graded.	
Sanders dust	19.	42.	39.
Check		Not graded.	

DISCUSSION OF RESULTS OF COMMERCIAL GRADING.

This method of obtaining data shows that the liquid spray is superior to either of the dusts used in orchard No. III. This is true of each of the four varieties in the experimental plots, in each case producing a higher percentage of No. I fruit. In the Baldwin and Greening plots the sulphur-nicotine-arsenate dust produced a greater percentage of No. I apples than the Sanders dust, though in the case of Gravensteins, the Sanders dust showed up the best. Due to an oversight the fruit from the McIntosh sulphur-nicotine-arsenate dust plot was not graded, so that no comparisons can be made.

ORCHARD NO. IV.

This is the old orchard on the Experiment Station Farm at Mount Carmel. This orchard is 46 years old and consists of about 40 Baldwin and Greening trees planted rather closely together. This orchard was divided into halves. The east half was used for the sulphur-nicotine-arsenate dust plot and the west half for Sanders dust. One row along the north end of the orchard was left for a check. Count trees in each plot were selected early in the season, but in this orchard the early dropped fruit was not gathered and scored. No scoring was done until harvest time, then all the fruit from two trees in each plot was picked, scored and then graded commercially into three grades, No. I, No. II and culls.

No liquid summer spray was used in this orchard and only two kinds of dust, namely: sulphur-nicotine-arsenate and Sanders or copper dust. The entire orchard was sprayed with the regular delayed dormant spray of commercial lime-sulphur, one part to nine of water. This was applied on April 11 and 12.

The first application was made on April 29, when the blossom buds began to show pink. The next treatment was the calyx application on May 22. This orchard received only one more application of dust and that was on June 14.

The dust at each treatment was applied early in the morning before the dew was off the leaves. There was very little fruit on the check trees at the time of harvest and none was scored or graded. The work in this orchard was simply a comparison of the two dusts used.

TABLE NO. X.

RESULTS OF TREATMENT. BALDWIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Sul.-Nic.-Ars. Dust.	30.2	20.5	0	1.03	29.54	4.09	.148	51.7
Sanders dust	31.8	18.1	.087	2.53	23.14	5.03	0	46.7

DISCUSSION OF RESULTS.

In this orchard there was very little difference between the two kinds of dust. The percentage of good fruit was very nearly the same, while in the control of fungi the Sanders dust gave slightly better results. The other differences are so slight that they are hardly worth mentioning.

TABLE NO. XI.

RESULTS OF TREATMENT. GREENING.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Sul.-Nic.-Ars. Dust.	18.05	20.	.056	3.77	45.2	3.71	2.08	85.72
Sanders dust	22.5	35.8	0	7.37	44.04	4.1	.504	48.27

DISCUSSION OF RESULTS.

The Sanders dust again gave better control of fungous diseases and consequently produced a higher percentage of good fruit. The sulphur-nicotine-arsenate dust gave better control of aphis and slightly better control of other chewing insects.

TABLE NO. XII.

RESULTS OF TREATMENT. COMMERCIAL GRADING.

Treatment	Grade No. I Per Cent.	Grade No. II Per Cent.	Culls Per Cent.
BALDWIN.			
Sulphur-nicotine-arsenate dust	61.	26.1	13.1
Sanders dust	53.6	35.6	10.7
GREENINGS.			
Sulphur-nicotine-arsenate dust	55.5	29.7	14.8
Sanders dust	52.2	27.3	20.4

By the commercial grading method of taking results the sulphur-nicotine-arsenate dust gives the highest percentage of No. I fruit. The fungous troubles (best controlled by Sanders dust) were apparently light enough to permit fruit showing their char-

acteristic injury to be placed in a No. I grade and some of the fruit scored as "good" by the other method of taking results may have been too small to go into this grade.

PEACH ORCHARDS.

Dusting versus spraying to control peach scab and brown rot was continued in the same orchards and with the same number of trees as in 1921. Dusting sulphur without lead arsenate, and "Atomic Sulphur," at the rate of 10 pounds to 100 gallons of water were the materials applied in both orchards.

Orchard No. I.	Peach orchard of M. L. Coleman, Cheshire	113 trees
Orchard No. II.	Station peach orchard Mount Carmel	150 trees
		263 trees

The dust was applied with a Niagara duster and the spray with an Arlington X. L. sprayer in both orchards. The picked fruit only was scored. This involved the counting and scoring of 41,980 peaches or about 600 baskets. Four applications were made on the following dates: May 29, June 22, July 11 and August 1. The results of the treatments are shown in Table No. XIII.

TABLE No. XIII.

RESULTS OF TREATMENT IN PEACH ORCHARD No. I.

		Good Per Cent.	Rot Per Cent.	Scab Per Cent.
Elberta	Spray	71	10	13
	Dust	66	17	13
	Check	20	20	62
Carman	Spray	69	5	18
	Dust	65	7	17
	Check	32	21	50

The last treatment was applied to only one-half of each plot and showed no advantage over the three treatments.

It will be seen from the table that the spray controlled the brown rot slightly better than the dust, and scab control was practically the same for both treatments.

TABLE No. XIV.

RESULTS OF TREATMENT IN PEACH ORCHARD No. II.

		Good Per Cent.	Rot Per Cent.
Elberta	Spray	97	3
	Dust	99	1
Champion	Spray	67	32
	Dust	88	11

In Orchard No. II the dust controlled the brown rot better than the spray on both Elberta and Champion varieties. There was no

scab in this orchard either on treated or untreated trees. The data for the check trees are not given because these trees were adjacent to the treated trees and the dust was blown upon the checks, controlling the rot nearly as well as upon the trees dusted directly.

SUMMARY.

1. In all apple orchards and on all varieties used in these experiments, liquid spray gave better results than any kind of dust used.

2. By the commercial grading method of taking results, sulphur-nicotine-arsenate dust gave a higher percentage of No. I fruit than Sanders dust. By the other method of scoring each individual apple, Sanders dust usually gave a higher percentage of perfect fruit than sulphur-nicotine-arsenate dust.

3. Sulphur-nicotine-arsenate dust gave decidedly better results in controlling aphids and red bugs, and slightly better results in controlling curculio, codling moth and other chewing insects than Sanders dust.

4. Sanders dust gave very much better results in controlling apple scab and other fungous diseases than sulphur-nicotine-arsenate dust.

5. Liquid spray was best for controlling most pests except that sulphur-nicotine-arsenate dust was nearly as good for control of aphids and red bugs.

6. Where fungous diseases are not likely to be present a fair grade of commercial fruit may be secured by use of dusts, but where the highest grade of apples is desired, liquid spray may be relied upon to give best results.

7. The brown rot and scab of peaches were controlled just as well by sulphur dust as by a spray of "Atomic Sulphur."