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Insuring the Peach Crop

University of Tennessee Agricultural Experiment Station

C. A. Cotton

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EFFECT OF SPRAYING WITH SELF-BOILED LIME-SULPHUR.

Left—Alexander: Unsprayed and unpruned. Heavy crop set but not a single fruit, harvested—all rotted. Center—Carman: Sprayed twice—no rot, little spot, despite very wet, warm weather in July. Right—Family Favorite: Sprayed 4 times. No rot, no spot, practically no leaf injury.

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INSURING THE PEACH CROP

BY

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KNOXVILLE, TENNESSEE

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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Bulletins of this Station will be sent, upon application, free of charge, to any farmer in the State.

INSURING THE PEACH CROP

FORMULAS EMPLOYED IN THESE EXPERIMENTS

1. Bordeaux mixture Dissolve ¾ pound of copper sulphate (also known as blue vitriol, or bluestone) in 5 gallons of water; slake thoroughly 10 pounds of lime in 5 gallons of water; strain the lime into a third vessel, at the same time adding the blue vitriol solution; dilute to 50 gallons. Wooden or stoneware vessels must be used.

2. Self-boiled lime-sulphur solution Have 10 gallons of boiling water ready. Put 15 pounds of hard lime (best quality available) into a barrel, and over it pour a bucket (2½ gallons) of boiling water. It should begin slaking immediately. As soon as slaking is well under way sprinkle in 10 pounds of sulphur. Throw a sack over the barrel, and with a long paddle stir the mixture to prevent burning, adding boiling water if necessary. Let it boil exactly 5 minutes, then fill the barrel with cold water; strain into spraying barrel, and apply.

3. Arsenate of lead Two pounds of arsenate of lead added to either of the above solutions.

SUMMARY

1. Very dilute Bordeaux mixture is almost as effective in preventing peach rot as a stronger mixture, and does not injure the foliage appreciably.

2. Bordeaux mixture is of no value as a remedy for peach scab, and is less valuable than self-boiled lime-sulphur as a remedy for peach rot.

3. The results of these experiments, while indicating a much less per cent of efficiency for spraying than has been recorded at other stations, yet prove the great value of the remedies.

4. Arsenate of lead added to the earlier applications of either Bordeaux mixture or self-boiled lime-sulphur reduces the amount of wormy fruit.

5. Thinning the fruit is profitable.

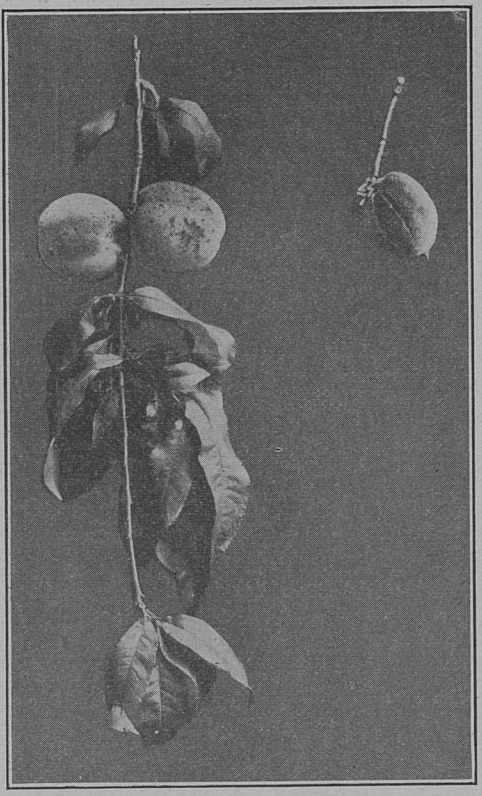
6. Fires in the orchard raised the temperature from 4 to 6 degrees and saved the crop.

SPRAYING EXPERIMENTS IN 1908

Dilute Bordeaux mixture Previous experiments having demonstrated the great susceptibility of peach foliage to injury by Bordeaux mixture of standard strength, the experiments of 1908 had for one object the determination of how weak a Bordeaux solution would be effective as a protection from rot with no injury to the foliage. Ninety trees were divided into 4

plots, and these plots were sprayed with Bordeaux mixture of ½ pound, ¾ pound, 1 pound and 1½ pound of blue vitrol; 10 pounds of lime in all cases; and 50 gallons of water. The first spraying was made during the first week in April. The second spray was applied during June 16-19.

The weather for the months of April to July, inclusive, was unusually dry, the rain for the period being 5.58 inches less than normal. This condition was not favorable to the development of the rot, which fact must be taken into consideration in judging the results. No rot developed in Sneed in either sprayed or unsprayed trees. In Alexander there was very little rot. In Greensboro a few rotted fruits were found on unsprayed trees and not a single specimen of rot was found on the sprayed trees. In Dewey (June 24-July 3) no rot could be found on 7 sprayed trees, and on 1 unsprayed tree half the fruit rotted. Eight sprayed Carman trees (July 3-13) had 89 rotted fruits, including all that dropped from the trees; and 1 unsprayed tree had 115 rotted fruits.



EFFECT OF SPRAYING WITH DILUTE BORDEAUX MIXTURE.

Family Favorite: Not sprayed. Note black spot (peach scab). Single fruit cracked as result of very bad infection.

The later varieties were so badly injured by a hailstorm on July 24 that observations were not recorded on them. Careful comparisons of the various plots — blue vitriol ½ pound, ¾ pound, 1 pound, and 1½ pound—showed so little difference in the amount of rot that it was thought ½ pound of blue vitriol and 10 pounds of lime to 50 gallons of water was as good a spray as the more concentrated form. Very little injury to the foliage was observed from the three weaker strengths, but 1½ pound of blue vitriol and 10 pounds of lime to 50 gallons of water showed marked injury. Even the weak-

est solution showed a little injury to the leaves, but it was so slight as to be negligible.

SPRAYING EXPERIMENTS IN 1909

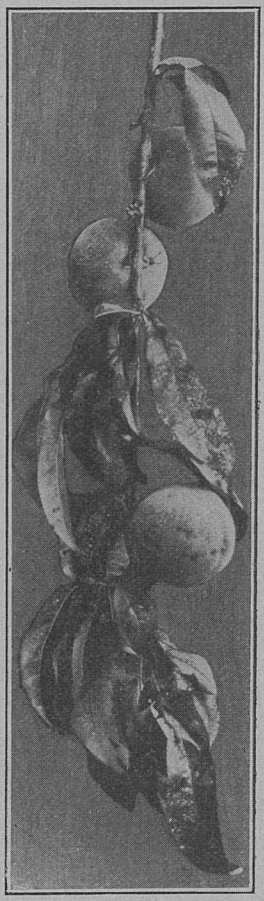
Self-boiled lime-sulphur solution—dilute Bordeaux mixture

In 1909 much the greater part of the peach orchard was sprayed with self-boiled lime-sulphur, made according to the directions at the head of this bulletin. The weather for the months of April to July, inclusive, in 1909, was very favorable for the development of rot. The mean temperature was only 1½ degree lower than for the same period in 1908, but the rainfall—27.47 inches—was 10.81 inches in excess of the normal, while in 1908 there was 5.58 inches less than the average for the same period. These facts should be kept in mind in judging the results of spraying.

The dates of spraying were as follows: April 19, June 10, July 10, and 3 days following each date. In Sneed, Alexander, Greensboro, and Dewey there was so little rot developed that it would not be considered commercially, so that the fruit of these varieties was not counted. In the other varieties under experiment all rotted fruits were picked from the tree each day after ripening began, and, together with all that had dropped from rot, were counted and recorded; and at the first count all the fruits on each tree were counted. In this way an accurate record of the development of the disease in the sprayed and unsprayed trees was kept. Forty trees were sprayed with self-boiled lime-sulphur, prepared as above, and 12 trees were sprayed with Bordeaux mixture of the following formula:

¾ lb. blue vitriol
10 lbs. lime
50 gals. water

One tree of each variety was left unsprayed for comparison.



EFFECT OF SPRAYING WITH DILUTE BORDEAUX MIXTURE.

Family Favorite: Sprayed 4 times. Note black spot (peach scab). Compare with cut on title page—right.

The following tabulation gives the per cent of rotted fruits:

Variety	Unsprayed		Sprayed with self-boiled lime-sulphur		Sprayed with Bordeaux mixture	
	No. of trees	Per cent	No. of trees	Per cent	No. of trees	Per cent
Carman	1	67.0	6	21.6	2	40.2
Mountain Rose	1	100.0	3	50.6	1	100.0
Family Favorite	1	99.2	7	48.0	1	37.0
Champion	1	64.0	6	41.0	2	54.0
Belle of Georgia	2	100.0	6	71.0	2	93.0
Old Mixon Free			6	68.4	2	74.7
Stump	1	19.0	6	12.0	2	11.0
Total	7	75.0	40	44.7	12	58.5

Peach scab

During two years' work with Bordeaux mixture no appreciable effect has been observed on the peach scab, a disease causing black spots, and, in bad cases, cracking of the skin. Self-boiled lime-sulphur proved an almost complete preventive of this disease, which causes only less loss to the grower than rot.

The peach curculio

In 1909, 2 pounds per barrel of arsenate of lead was added to all the first spray (April 19), the peaches averaging little more than ½ inch in length at the time. While a count was not made of wormy fruit, there was noticeably less wormy fruit in the sprayed than in the unsprayed trees.

DOES IT PAY TO SPRAY?

Receipts

Of the 59 trees included in this experiment, 4 unsprayed trees and 3 Bordeaux-sprayed failed to produce merchantable fruit. The crop from the 52 remaining trees sold for $184.00, an average of $3.54 per tree. The 3 varieties most affected by rot—in which all unsprayed trees produced no marketable fruit—yielded an average of $1.87 per tree from the sprayed trees.

The cost of spraying

The materials for spraying are inexpensive. Sulphur costs 3 cents a pound when bought by the barrel in Knoxville, and lime costs 62 cents a barrel (5 bushels) at the limekilns. The cost of 50 gallons of the mixture at the strength used in our experiments was thus less than 1 cent per gallon, and a barrel of the mixture will spray from 6 to 10 large trees (18 feet spread and 10 to 15 feet high.) Two men will make and apply from 4 to 6 barrels of the mixture a day, using a barrel spray pump. A liberal estimate of the entire cost would be 10 cents per tree for each application, or 30 cents for the season. In the case noted in the last paragraph the net result of spraying in the three varieties most affected by rot is thus $1.57 per tree.

Results not conclusive

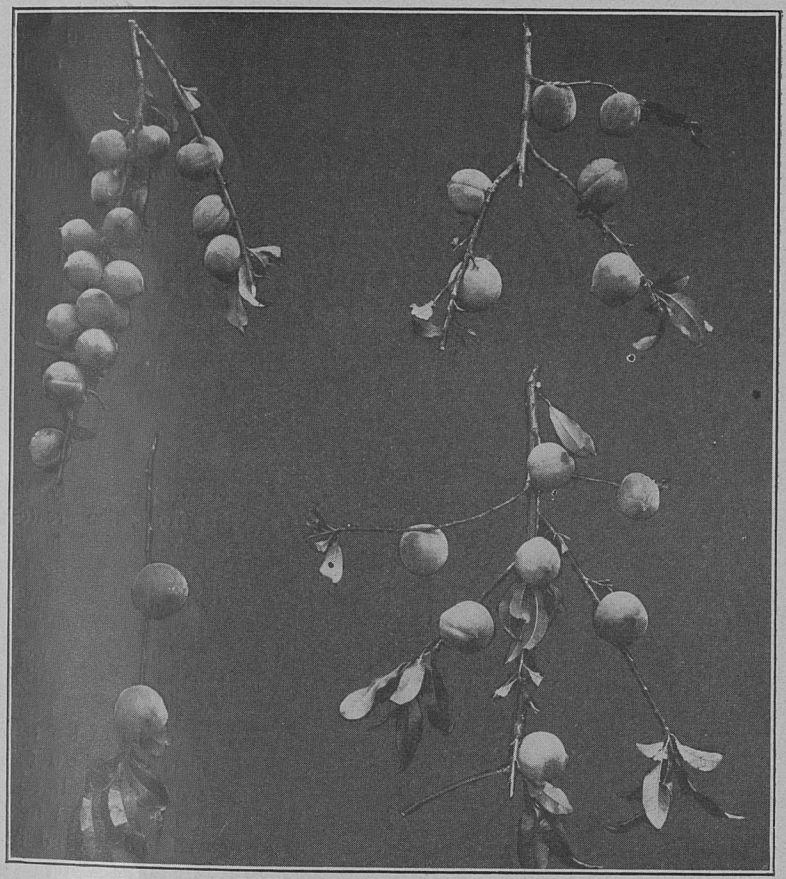
There yet remains much experimental work to be done in spraying the peach. Experiments at other stations, and under the U. S. Department of Agriculture, indicate that a much more dilute lime-sulphur spray than was used in the work here noted has proved effective. Many experi-

menters report much better results than are here indicated; but if results here recorded can be secured in a season such as that of 1909 it is reasonable to expect far better results in a normal season. Additional experiments will be made to determine the best time to apply arsenate of lead for destroying the curculio, and the value of weaker lime-sulphur solutions. A brief survey of other experiments appears in this bulletin.

THINNING

Methods and results

In both 1908 and 1909 the peaches were thinned. In 1908 various distances, from 4 to 12 inches, were left between fruits, and satisfactory results were secured by thinning approximately to 4 inches, though larger fruits were secured by thinning to 8 inches. In 1909 the workers were



EFFECT OF THINNING—VARIETY, ALEXANDER.

Upper left—neither pruned nor thinned. Upper right—moderately pruned (commercial), thinned to 4 inches. Lower right—moderately pruned, thinned to 6-8 inches. Lower left—heavily pruned, thinned to 6-8 inches.

told to thin to the width of the hand—about 4 inches. The work was begun before the fruit was 1 inch long, and finished before the stone hardened. In all varieties the thinning increased the size of the fruit, Sneed almost doubling as a result of the work. The workers were boys 12 to 15 years old, who were paid 5 cents an hour. The cost averaged 20 cents per tree. When the crop was ripe the average number of fruits (by count) on 60 trees was 412—a little less than 3 crates per tree. A large Champion tree, unthinned, bore 1228 fruits. This fairly represents the amount removed in thinning—approximately ¾ of the fruits that set. In the judgment of the writer, thinning is a profitable operation, even where heavy pruning is done.

Thinned versus unthinned

In 1908 a comparison was made of the fruit of the thinned Alexander trees in the Station orchard with unthinned, unpruned trees of the same variety in a neighboring orchard. The unthinned, unpruned trees were breaking under their load. A branch 16 inches long bore 16 fruits, and it was not exceptional. The largest fruit on this branch measured 1⅝ x 1⅞ inch. Average fruit from a well-pruned Station tree, thinned to 4 inches, measured as above (greatest diameter and length) 2⅛ x 2¼ inches. The unthinned crop was unsalable. The crop from the 8 thinned trees sold for $16.25.

Pruning and thinning

Very heavy pruning results in increasing the size of the fruit over light or no pruning, even when thinning is not practiced. In 1908 unthinned fruit on a very heavily pruned Carman tree averaged a trifle larger than fruit thinned to 4 inches on a lightly pruned tree, but the thinned tree matured much the larger crop, and the cost of thinning was more than offset by the greater yield.

PROTECTION FROM FROST

Coal and wood fires, 1908 and 1909

Throughout Tennessee, and the country generally, the peach crop is endangered by spring frosts, the greatest single cause of failure, probably, in the peach industry. In the spring of 1908 and 1909 coal fires were lighted in the experiment orchard, and on the nights of March 15 and 16, 1910, wood fires were burned. In 1908 baskets were made of galvanized wire netting (chicken fencing), 1-inch mesh. They were about 10 x 16 inches in size, and were set with their short edges resting on two bricks, thus affording draft. Coal fires were kept going in them, but required frequent attention. In most cases they were burned out in 3 firings, thus proving inadequate. The fires were placed 36 x 40 feet apart, in alternate spaces throughout the orchard. Two and a half tons of coal were used in keeping fires 8 hours per night for 3 nights in 2 acres of orchard. The temperature within the orchard and beyond its borders was read by standard thermometers hourly, the least difference being 4 degrees increased heat as the result of the fires, while on one night 6 degrees increased heat resulted.

Wood fires, 1910

On March 15 and 16, 1910, wood fires were used, the same distance as noted above. Stumps removed in clearing land the previous year were burned, and made better fuel than coal, the fires requiring less frequent attention. The minimum temperature outside the orchard was 21°, and within the range of the heat from the fires the minimum was 27°. Fortunately the weather was dry, and few of the buds were advanced enough to show the color of the petals. Some bloom was destroyed, but enough remains uninjured to insure a crop if no further frost injury comes.

Petroleum heaters

In Colorado, fire baskets of sheet iron resting in a strong wire support, and various types of crude petroleum heaters, are employed in orchard firing. Their use has been attended with such satisfactory results in the West that they may be safely recommended. The kind of fuel—coal, wood, or crude oil—to be used in any locality will of course depend upon its cost and the price of the labor necessary in its use.

The work here warrants a trial of fires whenever there is danger from frost.

THE CONTROL OF PEACH ROT AND SCAB

A Brief Summary of Bulletin No. 174, Bureau of Plant Industry, U. S. Department of Agriculture, by W. M. Scott and T. Willard Ayres

After describing the diseases and estimating the extent of the injury caused by them, the authors recommend the following treatment, based on three years' experiment: In 1907 small plots were used in one orchard; in 1908, 2000 trees were sprayed in several orchards; and in 1909, over 5000 trees, comprising large blocks of different varieties, were sprayed in a great commercial orchard. "This orchard was in good condition, having been well cultivated, fertilized, and pruned, but in recent years the brown-rot had become exceedingly bad." The spraying was done with a power outfit, consisting of a two-horse-power gasoline engine, a triplex pump, a 200-gallon tank, propeller agitator, two 25-foot leads of discharge hose, Vermorel nozzles, etc.

The mixture was prepared according to the following formula and directions:

"The mixture used in our experiments during the past season was composed of 8 pounds of fresh stone lime and 8 pounds of sulphur (either flowers or flour may be used) to 50 gallons of water. This appears to be about the correct strength, although in mild cases of scab and brown-rot a weaker mixture, containing 6 pounds of each ingredient to 50 gallons of water, may be used with satisfactory results. The mixture can best be prepared in rather large quantities—say, enough for 200 gallons at a time, making the formula 32 pounds of lime and 32 pounds of sulphur, to be cooked with a small quantity of water (8 or 10 gallons) and then diluted to 200 gallons.

"The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulphur

should be added after first running it through a sieve to break up the lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted, and applied.

"The stage at which cold water should be poured on to stop the cooking varies with different limes. Some limes are so sluggish in slaking that it is difficult to obtain enough heat from them to cook the mixture at all, while other limes become intensely hot on slaking and care must be taken not to allow the boiling to proceed too far. If the mixture is allowed to remain hot fifteen or twenty minutes after the slaking is completed, the sulphur gradually goes into solution, combining with the lime to form sulphids, which are injurious to peach foliage. It is therefore very important, especially with hot lime, to cool the mixture quickly by adding a few buckets of water as soon as the lumps of lime have slaked down. The intense heat, violent boiling, and constant stirring result in a uniform mixture of finely divided sulphur and lime, with only a very small percentage of the sulphur in solution. The mixture should be strained to take out the coarse particles of lime, but the sulphur should be carefully worked through the strainer.

The result of two sprays, first a month after the fall of petals, and second three weeks after, was 17 per cent of fruit affected with brown-rot, and none with scab; on unsprayed trees of the same variety 49½ per cent was affected with brown-rot and 91½ per cent with scab. In another block, sprayed once only, a month after the petals fell, 12½ per cent of the fruit was affected with brown-rot and 32½ per cent with scab, but the latter disease was confined for the most part to a few small scab spots on each fruit, only 2 per cent being badly affected. The variety used was Waddell, early, and very strongly subject to scab.

To test the spraying commercially the crop from 500 trees of each of the above plots and 500 unsprayed trees was noted, as follows:

2 sprayings, 160 crates; 1 spraying, 170 crates; no spraying, 80 crates.

The addition of arsenate of lead at the rate of 2 pounds per 50 gallons of self-boiled lime-sulphur solution gave fine results.

1100 7-year-old Elbertas were sprayed as follows:

March 31 (as the shucks were shedding), 2 pounds arsenate of lead to 50 gallons of water (for curculio only).

April 22 (3 weeks later), 2 pounds arsenate of lead, with 8-8-50 self-boiled lime-sulphur.

May 21, self-boiled lime-sulphur only.

June 9 (about one month before ripening), self-boiled lime-sulphur only.

In this plot only 4½ per cent of the fruit was affected by brown-rot, 6½ per cent affected by scab, and 27½ per cent by curculio. In a check plot of 1224 unsprayed Elbertas, adjacent and in all respects similar, 63

per cent of the fruit was rotten, 99 per cent scabby, and 97½ per cent wormy. The sprayed plot of 1100 trees yielded 327¼ crates of first-class fruit, and the 1224 unsprayed trees yielded 33¾ crates, all of poor quality.

Sprayed Elbertas sold for $2.00 per crate, and unsprayed for $1.50 per crate.

SPRAYING THE PEACH

The following course of treatment is recommended to control rot and scab and curculio (worminess) of the peach:

"1. About the time the calyces (or shucks) are shedding, spray with arsenate of lead at the rate of 2 pounds to 50 gallons of water. In order to reduce the caustic properties of the poison, add milk of lime made from slaking 2 pounds of stone lime. The date of this treatment is too early for scab and ordinarily no serious outbreaks of brown-rot occur so early, so that the lime-sulphur may be omitted with reasonable safety; but during warm rainy springs, especially in the South, the lime-sulphur will doubtless be necessary in this application.

"2. Two to three weeks later, or about one month after the petals drop, spray with 8-8-50 self-boiled lime-sulphur and 2 pounds of arsenate of lead.

"3. About one month before the fruit ripens spray with 8-8-50 self-boiled lime-sulphur, omitting the poison."

This treatment will apply to all mid-season varieties. For early varieties, such as Sneed, Alexander, Greensboro, Dewey, etc., the first two sprayings will be sufficient. For varieties that ripen later than Elberta an additional spraying, three weeks after No. 3 noted above, will be beneficial, though of course expense must be considered.

The mixtures must be kept thoroughly agitated. The earlier applications may be rather heavy, but the last spraying should be made with fine nozzles, giving a uniform coating of a mist-like spray. Heavy drenching of the trees should be avoided.