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Spraying Investigations

Apples Grown Under Good Culture and Proper Spraying.

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ABSTRACT

Oil sprays are valuable as dormant, delayed dormant, and summer applications. White oil emulsions are promising as summer sprays to replace arsenicals late in the spraying season, but on account of the danger of injury to fruit and foliage, it is suggested that they be used on comparatively small blocks and in an experimental way until more information is obtained.

Dry lime-sulphur is of questionable value for the control of San Jose scale, but is an efficient substitute for lime-sulphur in summer sprays for apples. It gives a higher finish to the fruit and is less likely to injure the foliage especially on some varieties and in seasons favorable to injury.

The concentrations of bordeaux sprays may be as low as 2-4-100 and still give efficient control of fungous diseases and at the same time be less likely to do injury by russeting or burning the foliage and fruit. The old platform dilution method of making bordeaux has been replaced by a more convenient and efficient commercial method.

On the average where insects or diseases, one or both, are serious sprays have generally given better control than dusts. Dusts may, however, effectively supplement sprays.

Bordeaux was found to have a dwarfing effect on the fruit of the sour cherry, also it leaves an objectionable residue on the fruit. Bordeaux showed a slightly better control of cherry leaf spot when infection was heavy, but when the disease did not develop to serious proportions, no difference could be noted between lime-sulphur and bordeaux.

Ammoniacal copper carbonate is not as effective a fungicide as bordeaux mixture and is more likely to burn, but is of value in spraying grapes during the several weeks before ripening time when spotting the fruit with bordeaux is undesirable.

Spraying work with apples and peaches shows that the spreaders used did not give enough better results to justify their use.

Spraying Investigations

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Horticultural crops in Missouri requiring spraying have an annual value of approximately $60,000,000. Of the entire range of horticultural crops, the fruits demand the greatest attention. The ravages of insects and diseases are so great that spraying is now considered the most important horticultural practice. In fact, the need for proper, timely and thorough spraying is so great that most competent and successful growers give the operation major consideration.

It is a well known fact, however, that the best known spray chemicals now used extensively fall far short of being ideal. Some are not as effective as is to be desired, while others cause injury to the foliage and fruit of the plants sprayed.

VALUE OF OIL SPRAYS

Oil sprays have long been known for their value particularly as dormant sprays for the control of scale insects. Their desirable qualities as to spreading, penetrating, sticking, and the ease and comfort with which they may be applied, are common knowledge. For the control of fungous diseases, however, they are of little or no value.

Under normal conditions oil and water do not mix freely. It is generally necessary to add a third substance known as an emulsifier. An oil-water combination is, therefore, known as an emulsion. Miscible oils when properly manipulated form emulsions and are as effective as the stock oil emulsions.

Spray chemical concerns are now engaged in the manufacture and sale of oils for spraying purposes. Many are sold under trade names and if used properly should give good results, especially as dormant sprays. Some products are known on the markets as "white oil emulsions". These are made from highly refined oils, the only type of oil that may be considered as safe for summer spraying.

Investigations and observations in spraying apples made yearly since 1923 regarding the use of oil sprays may be summarized as follows:

As Dormant Spray for Scale Insects.—Both the boiled lubricating oil emulsion made according to the so-called Government formula, and the cold-mix lubricating oil emulsion developed by the Missouri Experiment Station have been found to be very effective for the control of San Jose scale and for other scale insects attacking deciduous fruit trees under Missouri conditions. Moreover, no accumulative injury has so

far developed in peach, apple or cherry orchards as a result of applying dormant applications of these oil sprays.

As Delayed Dormant Spray for Scale Insects and Aphides.—Seven years' results of applying delayed dormant applications of lubricating oil emulsions mentioned above have in general given effective control of scale insects and as good control of aphides as was obtained through the use of nicotine sulphate, ½ pint to 50 gallons of spray, applied with summer dilutions of lime-sulphur. Moreover, these investigations have shown that for Missouri conditions oils may be safely applied at the rate of 2% without doing material injury to developing leaves or fruit buds up until the so-called cluster bud period.

As Combination Delayed Dormant Sprays.—The cold-mix lubricating oil emulsion has been successfully used in bordeaux made according to several formulae, and also in lime-sulphur solution, 1, 1¼ and 1½ to 50 gallons of water, plus arsenate of lead (1 pound), without doing injury to foliage or fruit buds. When applications have been delayed until the buds have broken and the leaf tips have emerged, oil-fungicide-lead combinations have in general proven effective in controlling such insects and diseases as are present at that period. If delayed this long, however, the oil may be less effective in aphid control as some of the insects may crawl into the opening buds and be harder to reach.

As Combination Summer Sprays.—Lubricating oil emulsions have been used throughout the summer in applying the regular summer combination applications, using the oil at 1% and 2% with the standard insecticidal and fungicidal sprays, lime-sulphur and bordeaux with lead arsenate. In general, 1% has not given serious injury when used on apples from the cluster bud period until the close of the spraying season, making in all seven or eight applications at intervals of about two weeks, except at the petal-fall, or calyx, period. In fact, seven years' investigations have shown that the only heavy injury occurred at the petal-fall application.

It is also true that there is a great variation as to injury with different varieties, some suffering worse than others, but in general the injury is too severe to justify applications of either one or two per cent oil at the calyx period in the regular combination lime-sulphur and arsenate of lead spray or bordeaux-lead spray. It should also be said that as a rule young, vigorous, growing trees suffer less from foliage injury than trees making a slow and unsatisfactory growth.

Moreover, 2% home-made boiled or cold-mix emulsion generally gives too much injury to fruit and foliage after the cluster bud period to permit its use. It is also true that 1% of either emulsion on some varieties during dry, hot seasons may give serious injury to foliage and

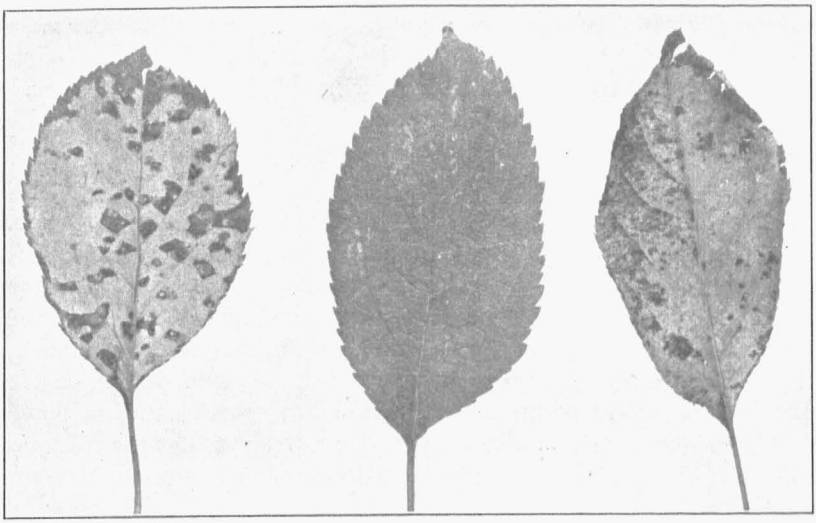

Fig. 1.—Apple leaves on the left and right show injury caused by a 1% application of cold-mix lubricating oil emulsion. The center leaf shows some spray material but is free from injury. Summer oils may cause a similar type of injury during hot dry weather.

fruit. One per cent cold-mix emulsion when applied on Jonathan as the last three summer applications to replace the arsenate of lead spray for codling moth, has caused in some seasons almost complete defoliation. The fruit was also badly russeted and small in size.

As Substitute for Insecticidal and Fungicidal Sprays.—For the past three years, applications have been made of oil alone at the close of the regular spraying periods as substitutes for the last two or three arsenate of lead and lime-sulphur or bordeaux and lead applications. The object, of course, has been to reduce the amount of arsenical residue on the fruit at harvest and to control codling moth by means of the oil applications.

The oils have shown in most cases as good or nearly as good control of codling moth as where arsenate of lead was used at the regular strength. In several instances, however, there was some foliage injury following the use of the white or summer oils late in the summer. Injury invariably followed their use soon after an application of lime-sulphur. Characteristic injury consists of brown spotting on leaves and marginal burning. The fruit may be russeted, the color clouded and dulled, and the finish destroyed.

It is believed that several weeks should intervene between the last lime-sulphur spray and the application of summer oils and there should be no residue of lime-sulphur in the sprayer. Results indicate that oil sprays as a substitute for the late arsenate of lead sprays should be used

with caution and in an experimental way until their value has been more definitely ascertained. To avoid objectionable spray residue at harvest, it should be said, however, that summer oils at this time are the most promising substitutes for the late arsenical applications.

DRY LIME-SULPHUR

Dry lime-sulphur is dried and powdered lime-sulphur solution. It is offered as a substitute for the liquid material and possesses some advantages over lime-sulphur solution in that it is less bulky and easier to handle. During the drying process, however, there occurs a partial decomposition of some of the constituents of the lime-sulphur solution. These chemical changes make necessary field tests to determine the relative effectiveness of the dry material as compared with the liquid and the correct proportions for using it. Tests conducted by the Missouri College of Agriculture soon after dry lime-sulphur appeared on the market indicated that 4 to 5 pounds of the material was needed to equal in efficiency 1¼ gallons of lime-sulphur solution (32° B.) in the control of fungous diseases on apples. Subsequent tests and observations confirm the earlier work and show the inadequacy of low dilutions of dry lime-sulphur in controlling apple scab on susceptible varieties and in years when the disease reaches epidemic proportions.

The results of some of these tests are presented in Table 1.

It will be noted that with 2 or 3 pounds of dry lime-sulphur to 50 gallons of water, the percentage of scab infection was appreciably greater than where liquid lime-sulphur was used 1¼ gallons in 50, and dry

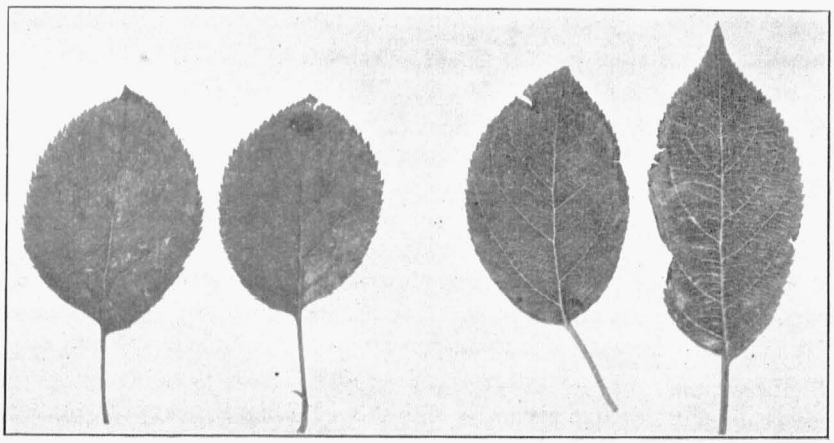

Fig. 2.—The two leaves on the left show lime-sulphur "tip burning" while the two leaves on the right show typical "marginal" spray burn. Both types of injury are generally greatly reduced through the use of dry lime-sulphur.

TABLE 1.—DRY LIME-SULPHUR VS LIQUID LIME-SULPHUR FOR APPLE SCAB CONTROL

Variety	Four Summer Sprays Rate of dilution per 50 gals.	Number of fruits	Percentage of Fruit		Number of leaves	Percentage of Leaves	
			Free of Scab	Scab		Free of Scab	Scab
Gano	Dry lime-sulphur 2 lbs.	2000	27.3	72.7	500	85	15
	Dry lime-sulphur 3 lbs.	1000	48.3	51.7	500	94	16
	Dry lime-sulphur 4 lbs.	1000	63.7	36.3	500	96	4
	Dry lime-sulphur 5 lbs.	1000	65.7	34.3	500	97	3
	Liquid lime-sulphur 1¼ gals.	1000	64.8	35.2	500	96	4
	Check, unsprayed	1000	0.0	100.0	500	56	44
Ben Davis	Dry lime-sulphur 3 lbs.	1000	60.1	39.9	----	----	----
	Dry lime-sulphur 5 lbs.	1000	72.3	27.7	----	----	----
	Liquid lime-sulphur 1¼ gals.	1000	73.9	26.1	----	----	----
	Check, unsprayed	1000	12.1	87.9	----	----	----
Jonathan	Dry lime-sulphur 3 lbs.	1000	32.6	67.4	----	----	----
	Dry lime-sulphur 5 lbs.	1000	71.9	28.1	----	----	----
	Liquid lime-sulphur 1¼ gals.	1000	52.2	47.8	----	----	----
	Check, unsprayed	1000	0.1	99.9	----	----	----
Gano*	Dry lime-sulphur 2 lbs.	----	----	----	400	6	94
	Dry lime-sulphur 3 lbs.	----	----	----	400	8	92
	Dry lime-sulphur 4 lbs.	----	----	----	400	23	77
	Dry lime-sulphur 5 lbs.	----	----	----	400	33	67
	Liquid lime-sulphur 1¼ gals.	----	----	----	400	33	67
	Check, unsprayed	----	----	----	400	0	100

*Records from orchard in which too little fruit was available for accurate counts.

lime-sulphur at 4 or 5 pounds to 50 gallons. Dry lime-sulphur at the rate of 4 or 5 pounds to 50 gallons, however, gave a control practically equivalent to that of the liquid material. Observations made of trees commercially sprayed with dry lime-sulphur 4 pounds and 4½ pounds to 50 also have shown that at this rate the dry material is in general as efficient as the liquid.

The percentage of scab is fairly high in all plots. However, the difference in control was greater than the table indicates. Apples receiving lime sulphur and the stronger mixtures of dry lime sulphur showed mostly only one or a few small lesions while apples on the other plots were conspicuously marked with scab, showing mostly several to many lesions. Data not presented here, but obtained from the same orchards for plots receiving liquid lime-sulphur 1½ and 1¾ to 50, show that no additional control of scab was secured by increasing the concentration of the spray beyond 1¾ gallons of liquid lime-sulphur in 50. Very thorough spraying was done, the high percentage of infection probably being due in part to the rainy weather prevailing at spraying time and preventing the application of the fungicide at the critical time and in part to late secondary infections.

Dry Lime-Sulphur Gives Better Finish.—There was a noticeably better finish on the fruit in the dry-lime-sulphur plots than in the liquid lime-sulphur plots. With dry lime-sulphur at 3 pounds to 50, the difference was striking and the trees and fruit could be picked out easily by those not familiar with the investigation. Dry lime-sulphur at 4 and 5 pound dilutions gave fruit of a higher finish than the liquid, but less striking than the 3 pound dilution.

These tests were conducted under conditions favorable for very heavy scab infection and with the exception of Jonathan, with very susceptible varieties. Under conditions less favorable for scab and with fairly resistant varieties, less dry lime-sulphur than 4 or 5 pounds to 50 would probably give good control, but under such conditions there seems to be no reason why a corresponding reduction in lime-sulphur solution could not be made so that the relative proportion of the two materials, which is, roughly, 1 pound of dry lime-sulphur=1 quart of liquid lime-sulphur, would remain the same.

In 1928 the dry lime-sulphur was used at only one strength, 4 pounds to 50. The dry weather of early spring was not conducive to scab infection and no conclusive results were obtained. Susceptible varieties showed less than 5% of scab infected fruit, and the lesions produced were of a very mild character. Fruit in both the liquid and dry lime-sulphur plots showed excellent control and nearly equal finish.

The season of 1929 was probably the worst for scab that apple growers in Missouri have ever experienced. The results of dry lime-sul-

phur 4 pounds in 50 as compared with liquid lime-sulphur 1¼ in 50 are presented in Table 2.

TABLE 2.—COMPARISON OF DRY AND LIQUID LIME-SULPHUR IN APPLE SCAB CONTROL AND SPRAY RUSSETING

Variety	Plot	No. of apples	Percentage of Fruit	
			Scab	Russet
Ben Davis	3 sprays, dry lime-sulphur 4 lbs. to 50 gals water	642	12.4	18.5
	3 sprays liquid lime-sulphur 1¼ gals. in 50 gals.	625	4.0	47.5
	3 sprays lime-sulphur 1¼-50, 1 spray bordeaux 1-1-50	1478	1.6	60.7
	Check, unsprayed	440	56.6	24

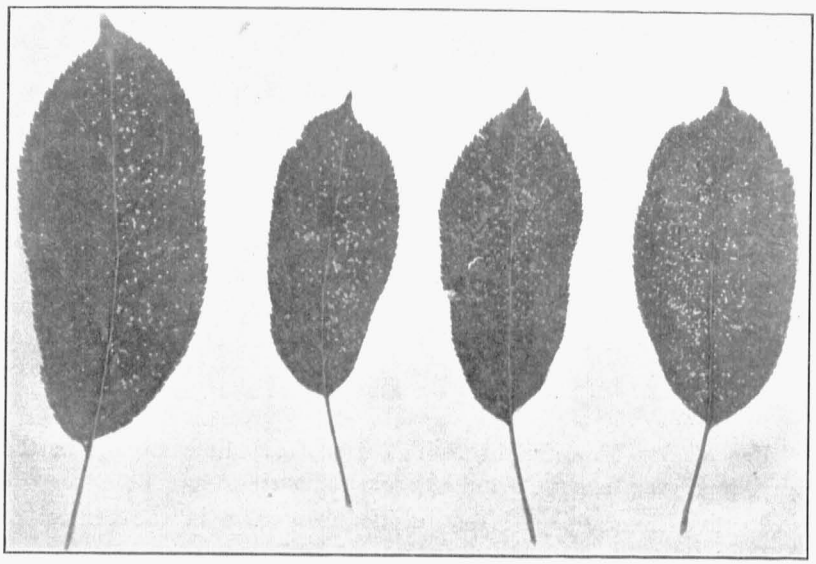

Fig. 3.—"Spot burning," a type of injury caused by lime-sulphur. This type of injury is practically nil with dry lime-sulphur.

The dry lime-sulphur at 4 pounds to 50 was hardly equal to the standard solution of the liquid material in the control of apple scab, but was superior in the matter of russeting of the fruit. The four applications of sprays did not materially reduce scab infection, the difference between three and four sprays being well within experimental error. The use of the 1-1-50 bordeaux, however, increased the percentage of russeted fruit. The injury from the bordeaux was greater than in the lime-sulphur plots. The finish of the fruit in the dry lime-sulphur plot was superior to that in any of the other sprayed plots. Nearly all of the russeting exhibited was of a very light character, while more than ⅓ of that in the liquid lime-sulphur plot was of a quite pronounced netted type.

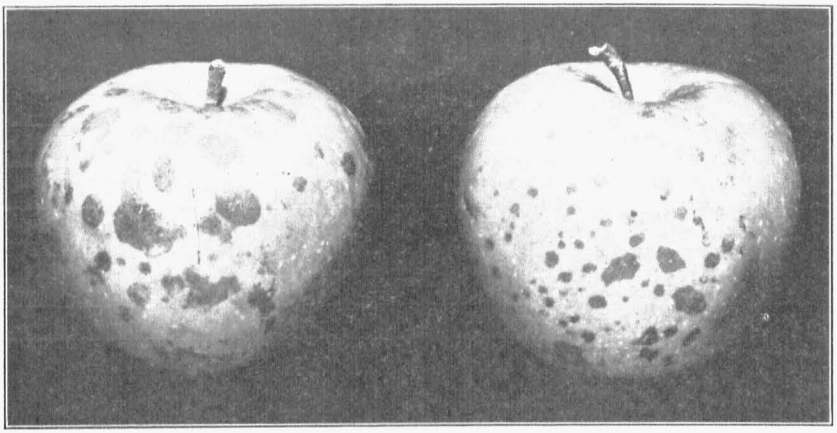

Fig. 4.—Spotting of Grimes Golden apples caused by a 1% summer oil emulsion. Jonathan may at times show quite similar injury.

Unsatisfactory Scale Control with Dry Lime-Sulphur.—The use of dry lime-sulphur did not give satisfactory control of San Jose scale. For commercial control 97% or more of the insects should be killed, and to meet this degree of efficiency the oil sprays are at present the best material to use. They are relatively inexpensive, convenient, and easy to use.

Use of Dry Lime-Sulphur.—The use of dry lime-sulphur in the spraying program may be summed up as follows:

1. Dry lime-sulphur is of questionable value in the control of San Jose scale.

2. Dry lime-sulphur is an efficient substitute for lime-sulphur solution in the summer spraying of apples if used in sufficient quantity. Roughly, a scant pound is equivalent in effectiveness to 1 quart of lime-sulphur solution and it should be used at about this ratio when replacing the liquid material. At this dilution and at present prices, the dry-lime sulphur is somewhat more costly than lime-sulphur solution.

3. The use of dry lime-sulphur results in a higher finish to the fruit under conditions favorable to lime sulphur injury; and, with varieties susceptible to skin injury, the better fruit secured may justify the use of the dry in preference to the liquid lime-sulphur. Investigations are under way at the Missouri College of Agriculture to determine the market value of apples sprayed with dry and liquid lime-sulphur, and it is hoped that after a few seasons definite information on this point will be obtained.

BORDEAUX SPRAYS MADE EASIER

Where only a small quantity of bordeaux is desired, it may often be best to purchase the prepared product although a small quantity of bordeaux may be made without difficulty. In using prepared spraying chemicals, it is very important that the grower carefully follow the directions given on the containers.

If more than a few gallons of bordeaux are needed, better results will generally be secured by making the spray mixture. At the present time the following formula and method of preparation has given satisfactory results for general use in Missouri:

Blue vitriol (copper sulphate).....	2 pounds
Stone lime.....	4 pounds
(or high grade Hydrated lime, 6 pounds)	
Water.....	100 gallons

Only the highest grade of lime should be used. Since metal containers are corroded by copper solutions or bordeaux, they should not be used in mixing or storing.

Making Stock Solutions.—The number of pounds of copper sulphate needed may be placed in a gunny sack or cloth bag and hung in a barrel or keg of water so that it is just below the surface of the water. This should be done a day or two before the spray is needed for use. When the copper sulphate is dissolved add sufficient water to make 1 gallon for each pound used. This is known and referred to hereafter as the copper sulphate solution.

If hydrated lime is used, the copper sulphate stock solution is the only one needed. The amount of hydrated lime required for each barrel or tank should be mixed with a little water and stirred into a thin paste, after which it is ready to be poured through the strainer into the spray barrel or tank.

Where stone lime is used, slake the required amount in just enough water to make a thin paste. Stir and mix thoroughly, after which add sufficient water to give 1 gallon for each pound of lime used. This is known and referred to hereafter as the lime stock mixture.

The stock solution of copper sulphate and water slaked stone lime will keep for several weeks without deterioration if evaporation is prevented. Stone lime and hydrated lime deteriorate unless kept in air-tight containers. Where evaporation does occur, water should be added to the stock mixtures before using to bring the dilution up to 1 pound to each gallon.

More Satisfactory Mixing Methods.—More than ten years of actual field practices, coupled with experiments and observations of the station workers, have shown that it is not necessary to mix bordeaux according to the old cumbersome platform dilution method formerly employed. A product equally as effective and no more likely to burn may be obtained by the quicker and easier way.

For example, to prepare a tank of 200 gallons of bordeaux according to the 2-4-100 or 2-6-100 formula, proceed as follows: Fill the spray tank about two-thirds full of water and begin the agitation by starting the engine. Pour through the strainer two gallons of the copper sulphate stock solution for every 100 gallons of spray. Add 4 gallons of stock lime mixture for every 100 gallons of spray. If hydrated lime is used add 6 pounds by making it into a thin paste. Then add the required amount of arsenate of lead, which is usually 2 or 3 pounds to the 100 gallons and enough water to bring the volume up to the required amount, after which the spray should be used at once for best results. It is generally best to dilute the copper sulphate first and not to add the stock lime mixture before the copper sulphate solution.

SPRAYING VERSUS DUSTING INVESTIGATIONS

Dusting has come into more general use during the past few years. All who have made a study of both dusting and spraying will acknowledge that each has certain advantages which are generally well known to the best fruit growers. Where for any reason the roughness and slope of the land, the labor difficulties, or other factors make it unprofitable to spray an orchard, dusting is to be recommended as preferable to an inefficient or poor job of spraying.

It must be remembered, however, that where scale is to be controlled sprays are necessary. Moreover, orchardists generally who are relying chiefly upon spraying should with our present information continue to place their chief dependence for the control of pests upon spraying operations instead of dusting.

Dusting may at times, however, serve the grower very well, indeed, by supplementing the spraying work. This is particularly true when the ground is wet and soft, making the operation of heavy spray tanks over the ground practically impossible. Dust applications also may be made nearer harvest time with less danger of an objectionable spray residue being left on the fruit.

Where growers have sufficient acreage and investment to justify the purchase of two types of outfits, it is believed that both dusting and spraying may prove profitable in the orchard enterprise, providing the equipment is used to advantage. It must also be said that in general

where either diseases or insects are very difficult to control, spraying usually gives better results than dusting.

Orchardists who have not had experience in dusting should try the practice out on a small plot or acreage before attempting to adopt the new method over the entire orchard. It is also important that final conclusions be based on at least two or three years' results rather than one.

Both dusting and spraying operations are being made better. The machinery for handling liquids and dusts are being improved from time to time; the chemicals used are also more satisfactorily made. It is believed, therefore, that the fruit grower in the not distant future may look forward to substantial advancement in both methods of protecting his fruit crop against the ravages of insects and diseases.

BORDEAUX VERSUS LIME-SULPHUR ON CHERRIES

Spraying sour cherries with bordeaux has resulted in a reduction in the size of the fruit. Comparative tests with bordeaux and lime-sulphur solution in 1925 showed a marked reduction in the size of the fruit on bordeaux sprayed trees as compared with the check and lime-sulphur sprayed trees, but data on relative size was not taken. In 1926 the dwarfing effect of bordeaux was evidenced, though less marked than in 1925. The relative size of the fruit in the two sprayed plots and the check is given in Table 3.

TABLE 3.—EFFECT OF BORDEAUX VS LIME-SULPHUR ON THE SIZE OF SOUR CHERRIES (1926)

Montmorency (4 sprays)	Tree No.	Average of Six Quarts of Cherries per Tree	
		Cherries per Quart Box	Average Weight per Cherry in Grams
Check, unsprayed	1	215	228	3.27	3.08
	2	242		2.90	
Lime-Sulphur 1½ in 50	3	235	234	2.91	2.88
	4	245		2.85	
	5	223		2.87	
Bordeaux 3-4-50	6	272	276	2.47	2.48
	7	272		2.60	
	8	278		2.37	
	9	283		2.48	

Bordeaux gave a reduction in the size of the fruit again in 1927. The effect is shown in Table 4. Defoliation of the check trees before picking time rendered counts from this plot valueless. Some defoliation before picking time occurred in the other plots, but was not sufficient to

prevent the cherries reaching a marketable condition. Of the sprayed trees, defoliation was greatest in the dritomic sulphur plot.

TABLE 4.—EFFECTS OF BORDEAUX VS LIME-SULPHUR SPRAYS ON THE SIZE OF SOUR CHERRIES (1927)

Montmorency (4 sprays)	Average of 12 quarts of cherries per tree. Three trees to the plot.
	Average weight per cherry in grams.
Dritomic sulphur, 3 lbs. to 50 gals.	3.47
Lime-sulphur 1¼ in 50	3.42
Bordeaux 3-4-50	3.28

Bordeaux, in addition to reducing the size of the cherries, leaves an objectionable residue on the fruit at picking time. This was true each of the three years of the experiment even though precautions were taken not to spray within two weeks of harvesting.

Cherry Leaf Spot Control.—A comparison between bordeaux and lime-sulphur solution for the control of cherry leaf spot, the original plan of the experiment, showed a slightly better control of the disease with bordeaux in years when leaf spot infection was heavy. In seasons when leaf spot did not develop to serious proportions, no difference could be noted between the two materials. However, owing to the dwarfing effect of bordeaux on the fruit and the objectionable residue which it leaves at picking time, lime-sulphur in general is to be preferred in spraying sour cherries in Missouri. All tests were conducted on the Montmorency variety.

AMMONIACAL COPPER CARBONATE SPRAY FOR GRAPES

Ammoniacal copper carbonate is not as effective a fungicide as bordeaux mixture and is more likely to burn, but is of value in spraying grapes during the few weeks before ripening time when spotting the fruit with bordeaux is undesirable. Ammoniacal copper carbonate solution leaves no stain on the fruit unless arsenate of lead has been added. It is made by dissolving copper carbonate in ammonia water in the following proportions:

Copper carbonate ..... 12 oz.
Ammonia (26° Baume) ..... 6 pts.
Water ..... 100 gal.

To prepare the solution, add the copper carbonate to about 5 pints of the ammonia and stir to dissolve the copper carbonate. If it does not all dissolve, add more ammonia, continuing to add ammonia until all or nearly all of the copper carbonate has been dissolved. Do not use more

than 6 pints of ammonia for each 100 gallons of spray, even though all the copper carbonate is not dissolved. A small portion of undissolved carbonate in the spray is more desirable than too much ammonia. To mix in larger quantities add about one-fourth of the ammonia, stir and draw off, continuing to add the ammonia and draw off until all is used.

Ammonia water 26° Baume strength can be obtained from nearly any large chemical company and from a number of companies handling spray materials. In 1928 it could be bought as low as 6 cents a pound in about 90-pound carboys, f. o. b. shipping point. Copper carbonate of 52-54 per cent copper content should be used. Copper carbonate of lower metallic copper content is not advisable.

SPRAY SPREADERS

Materials used with lime-sulphur, arsenate of lead, and bordeaux sprays to increase the adhesive and spreading powers of the spray are called spreaders. Many of the spreaders now being manufactured and sold by companies handling spraying materials have been carefully tried and tested in apple orchards at the Missouri Experiment Station. An effort has been made to carefully investigate each spreader as soon as it comes on the market. Calcium caseinate spreaders have been used for several years.

From the spraying work done in apple and peach orchards the results and observations to date show that the spreaders used did not give enough better results to justify their use. It is possible, however, that the use of spreaders in spraying grapes, cherries, plums, and other fruits having a smooth sleek surface would prove profitable.

TABLE 5.—LIQUID LIME-SULPHUR VS DUST APPLICATIONS FOR CONTROL OF DISEASES AND INSECTS IN MATURE APPLE ORCHARDS

PLOT I—UNIVERSITY ORCHARD—1928

Treatment of Plot	Variety	Fruits Counted	Scab Per Cent	Blotch Per Cent	Codling Moth Per Cent	Curculio Per Cent	Russet Per Cent
Dusted	Gano	1918	1.04	1.50	2.76	5.37	50.60
Sprayed	Gano	1000	.65	.74	2.50	4.50	45.50
Check plot, no treatment	Gano	1182	6.26	2.45	8.29	25.50	27.00
Dusted	Winesap	1239	4.92	.75	1.69	1.79	20.00
Sprayed	Winesap	1000	3.50	.60	1.20	1.51	30.00
Check plot, no treatment	Winesap	1412	15.15	1.42	11.68	2.05	18.00

PLOT I, University Orchard, consisted of 70 apple trees, 18 years old. The plot was divided equally and one half was sprayed and the other dusted experimentally.

On the Dusted Plot, 85-15 sulphur lead arsenate was used. Lime-sulphur at the rate of 1-¾ gallons and one pound of lead arsenate to 48-¾ gallons of water was employed on the sprayed plot. Seven applications of each material were made. The first spray was applied at the so-called cluster bud stage of development, the second at the calyx period and the later treatments were given at intervals of about two weeks. On each plot the date of application was the same for both dusting and spraying. Each plot received a total of seven applications.

PLOT II—ROCHEPORT ORCHARD—1929

Treatment of Plot	Variety	Fruits Counted	Scab Per Cent	Blotch Per Cent	Codling Moth Per Cent	Curculio Per Cent	Russet Per Cent
Dusted	Ben Davis	1000	7.42	53.04	14.27	24.74	66.75
Sprayed	Ben Davis	1000	1.62	50.33	14.74	12.92	60.75
Check plot, no treatment	Ben Davis	1000	56.59	76.13	38.63	50.68	24.09

PLOT II, Rocheport Orchard, contained 200 trees about 30 years old. As in the case of Plot I, the trees were divided about equally and one-half was dusted and the other sprayed.

The dusted plot received for the first or c luster bud application a 90-10 sulphur filler dust. An 85-15 sulphur lead arsenate application was made at the calyx period and for the three applications following this which were made at intervals of about three weeks, 5-3 copper lime arsenate dust was used. In all five applications were made on each plot.

PLOT III—ROCHEPORT ORCHARD—1930

Treatment of Plot	Variety	Fruits Counted	Scab Per Cent	Blotch Per Cent	Codling Moth Per Cent	Curculio Per Cent	Russet Per Cent
Dusted	Ben Davis	1671	none	9.00	10.24	18.74	88.80
Sprayed	Ban Davis	1417	none	2.82	5.37	13.20	91.25
Check plot, no treatment	Ben Davis	1484	1.30	27.00	87.50	31.70	9.40

PLOT III, Rocheport Orchard, consisted of the same plot of trees and number of trees as used in 1929. Moreover, the same dusting and spraying chemicals in the same proportions were used. The periods of applications were approximately the same. In all five applications were made on each plot.