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### **Spraying Fruit Trees**

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Fruit trees are sprayed for two reasons—to control plant diseases and to prevent damage from insects. So infrequently, however, trees suffer from one type of injury alone that most of the sprays in actual use are combined from fungicides and insecticides.

The fungicides most commonly employed are bordeaux mixture and some forms of the lime-sulphur compounds. Bordeaux mixture is decidedly the most efficient of all the fungicides, but since its use during rainy weather is almost certain to cause injury to both fruit and foliage, the lime-sulphur sprays are often substituted. There are many diseases, however, such as apple blotch and bitter rot, which cannot be controlled by lime-sulphur, while in hot weather bordeaux mixture is much safer. Hence the most satisfactory spraying method involves the use of the lime-sulphur compounds in the early season, when they are absolutely safe and will control any disease that may appear at that time, while the bordeaux mixture is applied later, when it is safer on account of the heat and most effective for the later appearing diseases.

#### **THE LIME-SULPHUR SPRAYS**

The lime-sulphur sprays may be prepared at home or some of the commercial brands may be used. Unless the grower has a large number of trees to be sprayed, it will not pay him to make the home-made solution, as the cost of securing the equipment and of purchasing the ingredients in small quantities would be prohibitive. Not only is the task of preparation very disagreeable, but unless directions are most carefully followed, failure will probably result. Since the commercial sprays are made in large quantities and with improved equip-

ment, it is possible to produce a more uniform solution than the home-made product. However, by carefully following directions one may prepare a very satisfactory spray, which can be made during spare time and stored away for future use. The home-made concentrate has the following ingredients:

|                      |             |
|----------------------|-------------|
| Stone lime . . . . . | 40 pounds   |
| Sulphur . . . . .    | .80 pounds  |
| Water . . . . .      | .50 gallons |

The lime used in making this concentrate should be the purest obtainable and as free as possible from magnesium. The sulphur should also be pure and finely ground. The ordinary ground brimstone is the cheapest form but is not as satisfactory as either the flour or flowers of sulphur. The solution may be cooked with steam in barrels or in a kettle over fire. In slaking, hot water should be used, if possible. Water should be added to prevent burning, but not in such quantities as to check the slaking. After the lime is thoroughly slaked the sulphur should be sifted into the paste and mixed with it.

The solution should be diluted to 50 gallons and this amount kept constant during the operation, This may be controlled easily by notching a stick at the level of the solution when the water is first added. If steam is used for cooking, water need not be supplied, but over a fire one must watch the amount of liquid closely. The mixture must be stirred constantly to prevent caking on the sides and bottom of the kettle. The boiling should continue steadily until the sulphur is all dissolved. This usually requires from 45 minutes to 1 hour, according to the amount of heat used.

When the boiling is completed the concentrate should be strained and stored for future use in air-tight barrels. It is frequently convenient to cover the surface with oils, such as the miscible oils, since they prevent drying, will not injure the trees, and will not ignite at the temperature of boiling water.

Before being used as a spray, the concentrate should be diluted. In order to dilute the mixture properly one should use a Beaume hydrometer, which may be obtained from any lens company, such as the Bausch & Lomb Optical Company, Rochester, N. Y., or the Spencer Lens Company, Buffalo, N. Y. Directions for using these hydrometers usually accompany them. By comparing the Beaume reading with Table I the proper amount of dilution may be determined. This table is

applicable for Kansas conditions and should be used rather than the tables sent out by the companies, which, while perfectly accurate in their make-up, are prepared on the basis of 1 ¼ gallon of lime-sulphur solution instead 1½ gallon, to every 50 gallons of water, as a summer spray.

TABLE I. — *Lime-sulphur sprays*

| Beaume reading of concentrated lime-sulphur solution | To make 50 gallons summer spray          |                      | To make 50 gallons dormant spray         |                      |
|--|--|----------------------|--|----------------------|
|  | Number gallons concentrated lime-sulphur | Number gallons water | Number gallons concentrated lime-sulphur | Number gallons water |
| 35   | 1.3                                      | 48.7                 | 5.1                                      | 44.9                 |
| 34   | 1.4                                      | 48.6                 | 5.3                                      | 44.7                 |
| 33   | 1.5                                      | 48.5                 | 5.5                                      | 44.5                 |
| 32   | 1.5                                      | 48.5                 | 5.8                                      | 44.2                 |
| 31   | 1.6                                      | 48.4                 | 6.0                                      | 44.0                 |
| 30   | 1.7                                      | 48.3                 | 6.4                                      | 43.6                 |
| 29   | 1.8                                      | 48.3                 | 6.7                                      | 43.3                 |
| 28   | 1.9                                      | 48.1                 | 7.1                                      | 42.9                 |
| 27   | 2.0                                      | 48.0                 | 7.4                                      | 42.6                 |
| 26   | 2.1                                      | 47.9                 | 7.9                                      | 42.1                 |
| 25   | 2.2                                      | 47.8                 | 8.4                                      | 41.6                 |
| 24   | 2.4                                      | 47.6                 | 8.9                                      | 41.1                 |
| 23   | 2.5                                      | 47.5                 | 9.5                                      | 40.5                 |
| 22   | 2.7                                      | 47.3                 | 10.2                                     | 39.8                 |
| 21   | 2.8                                      | 47.2                 | 11.0                                     | 39.0                 |
| 20   | 3.1                                      | 46.9                 | 11.7                                     | 38.3                 |
| 19   | 3.4                                      | 46.6                 | 12.5                                     | 37.5                 |
| 18   | 3.6                                      | 46.4                 | 13.3                                     | 36.7                 |
| 17   | 3.8                                      | 46.2                 | 14.2                                     | 35.8                 |
| 16   | 4.1                                      | 45.9                 | 15.3                                     | 34.7                 |
| 15   | 4.4                                      | 45.6                 | 16.5                                     | 33.5                 |

**SELF-BOILED LIME-SULPHUR**

- Stone lime . . . . . eight pounds
- Sulphur . . . . . eight pounds
- Water . . . . . fifty gallons

Self-boiled lime-sulphur is a mild form of the lime-sulphur solution, a mechanical mixture of the sulphur and slaked lime. It can be used as a summer spray on stone fruits where it would be dangerous to use bordeaux mixture. Lime for this solution should be good, fresh stone lime. Under no conditions should air-slaked lime be used, as the heat generated by the slaking is all that is used in cooking the sulphur. The lime should be placed in the bottom of a barrel and enough water added to start slaking. The sulphur should then be rubbed through a sieve onto the lime and the whole stirred to prevent it from burning. Water should be added from time to time to continue the slaking process, care being taken not to add enough water to "drown" the lime. After slaking has ceased, the barrel should be covered to conserve the heat for about 15

minutes, then enough water should be added to dilute to 50 gallons. The spray is then ready for use and should be strained into the spray tank. While this is a good spray to use on stone fruits it does not seem to control apple diseases as well as the more concentrated forms or bordeaux mixture.

**DRY LIME-SULPHUR**

There are several forms of powdered or dry sulphur compounds that are now appearing on the market but these as yet have not been tested thoroughly enough for Kansas conditions to warrant recommending them. However, if they will do what is claimed for them they will effect a considerable saving to the fruit grower, as he will no longer be obliged to pay freight on water.

**BORDEAUX MIXTURE**

- Copper sulphate . . . . . 3 pounds
- Stone lime . . . . . 4 pounds
- Water . . . . . 50 gallons

If only 50 gallons of bordeaux mixture are to be made, 3 pounds of copper sulphate should be dissolved in 25 gallons of water in one barrel, and 4 pounds of lime in a like amount of water in another barrel. The two solutions should be kept separate until ready for use when they should be poured simultaneously into the spray tank.

If any great amount of bordeaux mixture is to be made, it will greatly facilitate the work to prepare stock solutions in advance. This may easily be done by dissolving the copper sulphate and the lime in separate barrels in known quantities of water, for example, 2 pounds of the copper sulphate or lime to each gallon of water. This will make it easy to compute the amount of lime or copper sulphate to be used in the preparation of the spray. The copper sulphate, being much heavier than water, will not thoroughly dissolve unless it is suspended at the surface of the water. A good method of doing this is to put it in a bag and fasten the bag to a stick placed across the top of the barrel. In slaking the lime, the water should not be added too rapidly as there is danger of "drowning" it and thus checking the slaking.

The most satisfactory way of preparing bordeaux mixture is to have an elevated platform higher than the spraying ma-

chine, on which are placed two tanks, each holding a little more than one-half the capacity of the spray tank. If it is not feasible to get two tanks, four 50-gallon barrels may be used, two of which will be for the lime and the other two for the copper sulphate. The two tanks should be so connected that the contents of both will flow into a common pipe and from that into the spray tank. The solution from the lime barrels should flow into one pipe and the solution from the copper sulphate barrels into another pipe. The two pipes should then be connected with a common pipe which leads to the sprayer. The purpose of this connection is to have the diluted lime and diluted copper sulphate solutions flow into the sprayer as one stream. The stock solutions should never be brought together before dilution because a chemical combination results which is dangerous to the fruit and the foliage.

If stock solutions each contain 2 pounds of material to 1 gallon of water and it is desired to make 250 gallons of spray,  $7\frac{1}{2}$  gallons of the copper sulphate stock may be placed in one of the tanks and diluted to 125 gallons; and 10 gallons of the lime stock, after stirring well, may be placed in the other tank and diluted to the same amount. These two solutions should be well stirred and then the valves opened so that the two streams will flow into the spray tank at the same time. This material should be strained through a 20 to 40 mesh strainer. Poison may now be added and the material is ready to be applied to the tree.

The spray to be used depends upon the nature of the insect or plant disease to be controlled and upon the weather conditions which prevail at the time of spraying. If the insect has sucking mouth parts, such as plant lice and San Jose scale, a "contact spray" must be used, but if the insect has biting mouth parts, such as the codling moth and curculio, an arsenical spray should be used. The contact sprays most commonly used are the lime-sulphur solution, the miscible oils, kerosene emulsion, whale-oil soap, and some of the nicotine sprays, while the stomach poisons commonly used are arsenate of lead and paris green. While paris green has the higher percent of arsenic and consequently the greater killing powers, it is not as safe to use on fruit trees as arsenate of lead and does not adhere to the leaves as well.

Arsenate of lead is now manufactured in two forms—the paste, which contains 50 percent of water, and the powdered or dry, which is practically free from water. If the powdered form is used, only one-half the quantity by weight is required. The powdered arsenate mixes a little easier than the paste, has just as good killing powers, and has the advantage of keeping over winter without danger of leaking or freezing.

### DORMANT SPRAY

The dormant or winter spray is used similarly on all fruit trees, but the summer sprays differ somewhat according to the kind of trees that are being treated. The dormant spray is usually applied to control the San Jose scale, but if lime-sulphur is used it is equally valuable in controlling peach-leaf curl and blister mite. Because of the fact that the miscible oils will spread to a certain extent some prefer to use them rather than the lime-sulphur, but the constant soaking of the oil around the roots of the trees has an injurious effect upon them. Since the oils do not have any fungicidal qualities they cannot control the peach-leaf curl or any other plant diseases as does the lime-sulphur. In applying this dormant spray it is essential that the whole tree be covered with the spray because this is a contact spray and must hit the insect in order to kill it. If the home-made concentrate is used, it should be diluted according to the table previously given, while if the commercially prepared solution is used and the material is fresh, it should be used in the proportion of 1 gallon of the solution to every 8 or 9 gallons of water.

Since the summer sprays will vary according to the variety of the tree, the spraying of the different fruits will be considered separately.

The third, fourth, and fifth summer sprays should be applied at intervals of 10 days, using the same materials as above. As these treatments are designed to control the curculio, the fungicide may be omitted from the last two sprays if the foliage is free from any signs of disease.

Correction: This last paragraph  
should supplement Table V

TABLE II.—*Spray schedule for apple trees*

| When to spray   | What to spray for  | What to spray with   | Remarks   |
|---|--|--|---|
| When trees are dormant                                  | Aphid eggs, San Jose scale   | Lime - sulphur dormant strength  | Also valuable as a fungicide and to clear up shaggy bark  |
| When the buds are swelling and before the blossoms open | Curculio, canker-worms, tent caterpillar, apple scab, and rust                     | 2 pounds of paste arsenate of lead one pound of the powdered arsenate lead and 1½ gallon of lime-sulphur 33° Besume to every 50 gallons of water | If aphids are present they can be controlled by adding nicotine sulphate to this spray  |
| When the petals are one-half to two-thirds off the tree | Codling moth, curculio, canker-worm, tent caterpillar, cedarrust, and scab         | Same as above  | The object of this spray should be to fill every calyx cup with poison before it closes. A very important spray and one which should be applied thoroughly  |
| Three weeks after the blossom-fall spray                | Above-named pests and apple blotch*  | Arsenate of lead as above but 3-4-50 bordeaux should be substituted in place of the lime-sulphur   | The blotch spores are liberated at about this time and the codling moth eggs begin to hatch. As the larvae take their first meal from the leaves, it is well to have them well coated with poison |
| Five weeks after the blossom-fall spray                 | Apple blotch   | Bordeaux   | If blotch is bad it will be well to apply this spray to get complete control  |
| Ten weeks after the blossom-fall spray                  | Mainly for the second brood of codling moth, also to control blotch and bitter rot | Arsenate of lead as above and 3-4-50 bordeaux  | If neither blotch is present nor bitter rot expected, the bordeaux may be omitted   |
| When the fruit is beginning to ripen                    | Third brood of codling moth  | 2 pounds of arsenate of lead to every 50 gallons of water used   | An immense amount of codling moth damage has appeared late in the season. This has been caused either by a third brood or by late stragglers from the second                                      |

\*Better blotch control will be secured if this spray is applied about 15 days after blossom-fall.

TABLE III.— *Spray schedule for pear trees*

| When to spray                     | What to spray for                           | What to spray with   | Remarks   |
|-----------------------------------|---|--|---|
| When trees are dormant            | Aphid eggs, San Jose scale, and buster mite | Same as for apple  |   |
| Petal-fall                        | Codling moth curculio, and scab             | Same as for apple  |   |
| Three weeks after the petals fall | Same as above                               | Same as above  | The pear is not as susceptible to insect injury as the apple and does not need as many sprays |
| When slugs appear                 | Pear slugs                                  | Either dust or liquid arsenic spray. Arsenate of lead at the rate of 1 pound to 50 gallons of water will control this insect |   |

TABLE IV.— *Spray schedule for peach trees*

| When to spray                                  | What to spray for                          | What to spray with  | Remarks  |
|--|--|---|--|
| When trees are dormant                         | San Jose scale, peach-leaf curl, brown rot | Winter strength of lime-sulphur   | If scale is not present this spray is, valuable enough to justify its application                                |
| When most of the shucks have fallen            | Curculio and brown rot                     | Arsenate of lead, 2 pounds of paste or 1 pound of dry to 50 gallons of water and self-boiled lime-sulphur | Brown rot injury follows curculio damage. It is not safe to use bordeaux or concentrated lime-sulphur on peaches |
| Two to four weeks after the shucks have fallen | Curculio, brown rot, and scab              | Same as above   |  |
| About a month before the fruit ripens          | Brown rot and scab                         | Self-boiled lime sulphur  |  |

TABLE V.— *Spray schedule for cherry and plum trees*

| When to spray                                     | What to spray for               | What to spray with  | Remarks   |
|---|---------------------------------|---|---|
| When trees are dormant                            | San Jose scale and cherry scale | Lime-sulphur as for apples  | Plums and sweet cherries may have San Jose scale, while sour cherries have cherry scale |
| When leaf buds begin to open (First summer spray) | Curculio                        | Arsenate of lead, 3 pounds of paste or 1 1/2 of powdered to 50 gallon of water and self-boiled lime sulphur | If plant lice are present, nicotine sulphate may be used                                |
| At petal-fall (Second summer spray)               | Curculio and fungous diseases   | Same as above   |   |