

Missouri Apple Spraying;

Recommendations for 1936

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These recommendations were approved in conference of fruit growers and Station workers of the Departments of Horticulture, Entomology and Botany of the University of Missouri, College of Agriculture, at the Fruit Growers' Short Course held at Columbia, February 26, 1936.

DORMANT OR DELAYED DORMANT SPRAY

This spray is mostly made for the control of San Jose scale and as such is most satisfactory as the buds are swelling in the spring, but may be made any time during the dormant period when the spray will dry without freezing.

For scale control either oil sprays (as the lubricating oil emulsions and miscible oils), or strong lime sulfur may be used. Oil sprays generally are the more effective and pleasant to apply. If scale insects are not present, a spray is not needed; when localized, infested areas only need be sprayed. For severe infestations where two applications seem desirable, one should be made in the fall and the other about the time the buds are swelling in the spring. The recent cold killed most of the scales.

For 100 Gallons of Spray

Lubricating oil emulsions, 2% oil (3 gallons of ordinary emulsion).

If scale is abundant use 3% oil (4½ gallons of the home-made or Government formula emulsion).

OR

Commercial oil emulsions or miscible oils at concentrations recommended by the manufacturer.

OR

Lime sulfur solution 12½ gallons, (this is more expensive than home-made lubricating oil emulsion).

For a delayed dormant spray (silver tip until first leaves show) which will destroy aphid and red mites as well as scale, use $\frac{1}{2}$ gallon of a straw colored cresylic acid of the following approximate analysis: Benzophenol 2% by weight, cresols 8-18%, zyleneols 80-90%, with 100 gallons of spray made from lubricating oil emulsion of the Government formula.

The cresylic acid should be added to the oil spray just before applying. If a commercial oil is used, find out from the manufacturer whether it is compatible with cresylic acid. Commercial dormant oils containing cresylic acid have been used with satisfactory results.

Tar oils to kill aphid eggs and red mites may be used where experience indicates they may be applied with satisfactory results. Tar oils or sprays containing tar oils must be used while the trees are completely dormant. Such work as has been done with tar oils indicates that it is effective against rosy aphid when used alone at about $2\frac{1}{2}$ % tar oil. For control of scale and red mites, as well as aphid, 2% tar oil with the 2 or 3% lubricating oil emulsion spray is reported to be satisfactory. All grades of tar oil have not given good results.

PINK OR CLUSTER BUD SPRAY

Time of Application: After the clusters are open but before the blossoms open.

Materials: Lime sulfur solution is the cheaper material, but dry lime sulfur may be used.

Dilution:

Scab-susceptible Varieties:

Lime sulfur solution $2\frac{1}{2}$ gals.-100, or dry lime sulfur 8-9 lbs.-100 gals.

Some Scab-susceptible Varieties

Black Twig	Willow Twig
Rome	Ben Davis
Delicious	Gano
Winesap	Stayman
	Jonathan Foliage

Scab-resistant Varieties:

Lime sulfur solution 2 gals.-100 or dry lime sulfur 6-8 lbs.-100 gals.

Some Scab-resistant Varieties

Transparent	York
Duchess	Golden Delicious
Grimes	Ingram
King David	Wealthy
	Jonathan Fruit

The cluster bud spray is primarily for the control of apple scab but aids in the control of black rot. Cool cloudy weather with intermittent rains is highly favorable to apple scab. The period of heaviest infections usually ends 2 to 3 weeks after petals fall. With the warmer and drier weather that usually comes later in the season, infections decrease.

The cluster bud and calyx are the most important scab sprays and the disease must be checked at this time if satisfactory control is to be obtained.

If the cluster bud or blooming period is prolonged by cool weather, especially with rains, a supplementary spray for scab before the calyx spray is often advisable. One of the milder sulfur sprays, such as 8 pounds of flotation sulfur probably will give adequate protection. Do not use

lead arsenate in this spray. Lead arsenate is rarely needed in the regular cluster bud spray and when omitted the liquid lime sulfur probably causes no more fruit russetting than dry lime sulfur.

If canker worms or other leaf-eating insects are present, 2 pounds of lead arsenate should be added to the spray. Lead arsenate 2 or 3 pounds-100 gals. is used by some growers who feel that they reach a few early curculio feeding on the foliage. When lead arsenate is used, add 1 pound of fresh high grade hydrated lime for each pound of lead arsenate used.

If rosy aphid are present in considerable numbers at this time, nicotine sulfate, 1 pint to 100 gallons, may be added to the regular lime sulfur spray during the warmer periods of the day. Nicotine sulfate is not efficient against aphid below 70°F. Most rosy aphid injury is in the interior of the tree and special attention needs to be given to spraying the inside of the tree.

CALYX OR PETAL FALL SPRAY

Time of Application: Start when bloom is two-thirds to three-fourths off and finish before the calyx cups close.

Materials:

Insecticides

Lead arsenate 2 lbs.-100 gals. generally is sufficient. Greater quantities increase the residue in the calyx cup and increase the amount of arsenical injury. Use 2 lbs. of hydrated lime with the 2 lbs. of lead arsenate.

Fungicides

Dry lime sulfur has given the better finish but liquid lime sulfur is the cheaper material.

Scab-susceptible Varieties:

Dry lime sulfur 6-8 lbs.-100 gals. Liquid lime sulfur 1¾ to 2¼ gals.-100 gals.

Scab-resistant Varieties:

Dry lime sulfur 5-7 lbs. or liquid lime sulfur 1½ to 2 gals.-100 gals. One of the milder surfurs as flotation sulfur or bentonite sulfur may be used in the place of lime sulfur if it is felt that the risk with scab or frog-eye is not great.

If conditions have been favorable for scab since the cluster spray, the stronger dilutions are recommended; if weather has been unfavorable, the weaker concentrations might fairly safely be risked.

This is an important scab spray and under Missouri conditions is sometimes of as much importance as the cluster bud application. It is the first spray directed against the codling moth and is the one aimed at preventing the entrance of the worms through the blossom ends of the apples. For this reason the spraying should be completed before the blossom cups close.

FIRST COVER SPRAY

Time of Application: 10-12 days after the calyx spray.

Materials:

Insecticides

Lead arsenate 2 lbs.-100 gals. with 2 lbs. of fresh hydrated lime.

OR

Lead arsenate 3-100 with 3 lbs. of hydrated lime where curculio is serious and the spray advanced a few days.

Fungicides

When blotch is absent or light use dry lime sulfur as the safer material; liquid for the cheaper material, or such sulfur sprays as flotation sulfur or bentonite sulfur.

Scab-susceptible Varieties:

Dry lime sulfur 5-7 lbs.-100 gals. Liquid lime sulfur 1½ to 2 gals.-100 gals. Use dilution according to scab weather since calyx spray.

Scab-resistant Varieties:

Dry lime sulfur 4-6 lbs.-100 gals. Liquid lime sulfur 1¼ to 1¾ gals.-100 gals. Dilute according to the weather since the calyx spray.

Spray injury is an important consideration and the milder sulfur sprays such as flotation sulfur and bentonite sulfur are less injurious than the lime sulfurs. Both have been found to give very good control of scab especially where conditions have not been particularly favorable for scab since the calyx application. Sometimes when the season has been rather hot and dry the fungicide may be omitted altogether. This is especially true with the more scab-resistant varieties.

Codling moth is not out at the regular time for this spray and the use of lead arsenate is merely to build up a protective covering. Where codling moth is not abundant and other insects not serious, a number of growers have gotten good results without lead arsenate at this time. This and the calyx period usually are the two most critical periods for fruit russetting which is accentuated by lead arsenate.

Some Blotch-susceptible Varieties

Ben Davis
Duchess

Missouri Pippin
Paynes

Bordeaux is more effective in controlling apple blotch than are the sulfur sprays. When blotch has been moderate to severe, the use of Bordeaux (4 lbs. copper sulfate, 6 lbs. stone lime or 8 lbs. fresh high grade hydrated lime for each 100 gals.) in the place of the sulfur sprays generally is advisable. The hydrated lime recommended for use with the lead arsenate should be omitted when Bordeaux is used. However, injury

from the use of Bordeaux at this time sometimes is severe especially on the fruit. Cool rainy weather favors Bordeaux injury and with prevailing weather of this type, it is perhaps better to use liquid or dry lime sulfur. When Bordeaux is used in this spray, apply when conditions will permit of rapid drying to decrease injury.

SECOND COVER SPRAY

Time of Application: 10-12 days after the first cover spray.

Materials:

Insecticides

Lead arsenate 2 or 3 lbs.-100 gals. with 2 or 3 lbs. of hydrated lime.

Fungicides

Apple Scab Only—A fungicide at this time often is unnecessary for scab. If rains have been occurring, use some of the milder sulfur sprays, such as bentonite sulfur or flotation sulfur, or 4-6 lbs.-100 gals. of dry lime sulfur. If scab lesions are rather numerous on the leaves, a light fungicide is advisable to reduce secondary infections which are likely to occur following every shower.

Apple Blotch—Use Bordeaux (4 lbs. copper sulfate, 6 lbs. stone lime or 8 lbs. hydrated lime to 100 gals.) where apple blotch is serious.

THIRD COVER SPRAY

Time of Application: 10-12 days after the second cover spray.

Materials:

Insecticides

Lead arsenate 2 lbs.-100 gals. with 2 lbs. of hydrated lime when codling moth is not an acute problem.

OR

Lead arsenate 3 lbs.-100 gals. with 3 quarts to 1 gallon of summer oil emulsion may be used when codling moth infestation promises to be heavy. To aid in removal, 2 or 3 lbs. of hydrated lime or 4-6-100 Bordeaux may be used with the lead-oil combination.

OR

Lead arsenate as high as 3 or 4 lbs. to 100 gals. may be used when codling moth is serious, but there is risk of arsenical injury. Two or 3 lbs. of hydrated lime or Bordeaux should be used with the lead arsenate.

Fungicides

Fungicides are not likely to be needed unless blotch is a problem. Then use Bordeaux (4 lbs. copper sulfate, 6 lbs. stone lime or 8 lbs. hydrated lime to 100 gals.).

For the control of the leaf hopper $\frac{3}{4}$ pint of nicotine sulfate may be added to the other materials used at this time. This spray usually is early enough to catch the most of the first brood nymphs or young

wingless forms, but since the development of the leaf hopper varies from year to year, information will be given in the regular spraying news letter as to which cover spray to use the nicotine most effectively. Thorough spraying must be done, directing the spray upward and through the tree so as to wet the insects on the under sides of the leaves. It is of no use to attempt to kill the adults but if nymphs are still abundant, nicotine may be added to the next spray. One well timed spray usually will give sufficient control, but if a second brood builds up, nicotine in a late July or early August spray will prove effective.

FOURTH COVER SPRAY

Time of Application: 10-12 days after third cover spray.

Materials:

Insecticides

Lead arsenate 2 or 3 lbs. with 2 or 3 lbs. of hydrated lime. If codling moth is serious and the grower wishes, a summer oil may be added to this spray.

Fungicides

For apple blotch use; Bordeaux 4-6-100. Bitter rot seldom appears in North Missouri and is localized in South Missouri. When present to the extent to require sprays, use Bordeaux 4-6-100, applying the latter part of June and follow with about three more applications at 10 to 12 day intervals.

FIFTH COVER SPRAY

(First Half of July)

Time of Application: During the first part of July but not longer than 12 to 15 days after the fourth cover spray.

Materials:

Insecticides

Lead arsenate at the rate of 2 to 3 lbs.-100 gals. with 2 or 3 lbs. of hydrated lime. Omit the additional lime if used with Bordeaux.

OR

The lead-oil combination given in the third cover spray may be used in this application if codling moth is serious, but it is not recommended generally.

Fungicides

Use Bordeaux as previously given when blotch or bitter rot may become serious.

Where red spider threatens to be serious the lead oil combination suggested in the spray will aid in reducing red spider injury. Experience indicates that the addition of nicotine does not materially add to the kill.

SIXTH COVER SPRAY

(Last Half of July)

Time of Application: About 10-12 days after the fifth cover spray.

Materials: Lead arsenate 2 or 3 lbs.-100 gals. with hydrated lime. (Omit additional lime if used with Bordeaux for bitter rot). Heavy dosages of lead arsenate in this and later sprays increases the residue problem and the danger of spray injury.

Later Sprays

When late entries of codling moth (the so-called pin worms) are likely, one or two additional sprays at 10 to 15 day intervals, depending upon codling moth activity, made during early August and the latter half of August should be applied to late varieties.

Use lead arsenate 2 lbs.-100 gals. with 2 or 3 lbs. of hydrated lime.

Should bitter rot suddenly make its appearance, start spraying at once with a 6-8-100 Bordeaux and apply every week until three or four applications have been made. During hot "muggy" weather bitter rot develops rapidly and drastic measures must be taken to check its spread.

Study These Supplementary Suggestions

This schedule of sprays properly timed and applied if supplemented with scraping and banding and complete orchard and packing house sanitation should give effective control of the codling moth and other insects and diseases. It is also likely to give residue in excess of the tolerance, which will necessitate washing unless there is abundant rainfall prior to picking time. The following are the supplementary measures suggested:

1. Most lime sulfur substitutes are less injurious to fruit and foliage than liquid lime sulfur or dry lime sulfur during the spring. In the hot summer, sun-sulfur-scald is roughly proportional to the amount of sulfur applied, irrespective of the kind.

The use of lime sulfur substitutes except dry lime sulfur is not advised before the calyx spray. They are not as effective in killing out scab infections as are liquid and dry lime sulfur. They are preventive only. Lime sulfur substitutes are of doubtful value against blotch.

2. In young bearing orchards and orchards where codling moth infestation is light and diseases not serious, the first, second, third, and fifth cover sprays in addition to the cluster and calyx sprays may prove sufficient.

3. Sometimes an orchardist will omit the cluster spray, but the risk is greater than justified when it is considered that the cost of spraying

is only a small fraction of the value of the crop. A few primary scab lesions at this time with later rains will increase many fold. The control of the primary infections is the secret of success.

4. On account of danger of injury to fruit and foliage, oil and sulfur-carrying sprays usually must not be applied within two weeks of one another and the greater the interval the greater the safety with which they may be used. In any seasons with little rain severe injury may result from oil sprays applied several weeks after the last sulfur spray. The likelihood of injury by the use of sulfur in the cluster spray following a delayed dormant application of oil is not great even with a shorter interval than two weeks, provided the delayed dormant spray of oil is not applied after the early leaves have grown out more than $\frac{1}{2}$ inch.

5. Too much lead arsenate or lead arsenate and oil may cause not only severe injury to fruit or foliage but also difficulty in removing the material. The use of Bordeaux or lime assists in the removal.

6. When codling moth is serious, supplementary measures in addition to spraying are necessary. We recommend the full use of methods of control other than spraying, including scraping and banding, pruning to permit the most thorough spraying, thinning to remove wormy apples, the destruction of wormy windfalls and culls, screening packing sheds and complete orchard sanitation.

7. Thoroughness of spraying and timing according to seasonal variations are necessary and cannot be compensated for by use of more or different spraying materials.

8. For varieties like Golden Delicious, which are easily injured by the lime sulfur-lead arsenate combination, the use of the lime sulfur substitutes (other than dry lime sulfur) is advised after the cluster bud application.

9. In areas near packing sheds, the variation and greater emergence of moths may make supplementary spraying very important.

10. On account of spray residue, the application of sprays near the harvest period on summer varieties should be avoided unless conditions make necessary such a practice.

11. Sooty blotch and fly speck may be controlled in rainy seasons and in locations favoring their development with one or two weak Bordeaux sprays applied during July and August.

12. Every orchard is an individual problem and must be treated as such. Consequently, for best results each grower must adapt the spraying suggestions to his particular needs. Timely reports on insects and diseases will be sent to all growers throughout the summer.