UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
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Spraying Apples, Peaches and Cherries

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Spraying Program for Apples

DORMANT AND DELAYED DORMANT SPRAYS

San Jose Scale and other Scale Insects.—The spray for the control of the scale insects is most satisfactorily applied 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 alone, either the petroleum oil sprays (oil emulsions and miscible oils) or strong lime sulfur may be used. Oil sprays generally are the more effective. Where scale is not present a spray will not be needed; when localized, infested and adjoining areas only need be sprayed. For severe infestations where two applications seem desirable, one should be made in the fall and the other in the spring, preferably about the time the buds are swelling.

Materials.—Petroleum oil emulsions, 2% actual oil (3 gallons of the government formula emulsion in 100 gallons of diluted spray).

If scale is abundant, use 3% oil ($4\frac{1}{2}$ gallons of the above emulsion in 100 gallons).

OR

Commercial oil emulsions or miscible oils at concentrations recommended by the manufacturer. Observe directions for time of application, method of mixing and use with other materials.

OR

Lime sulfur solution $12\frac{1}{2}$ gallons to $87\frac{1}{2}$ gallons of water (this is more expensive than ordinary oil sprays).

These sprays are of value in checking the red mite as well as the scale insects.

Aphids, Red Mites and Leaf Rollers.—Dormant sprays for the control of the rosy aphid, red mite and leaf roller may be made whenever conditions warrant their use. The infrequency with which these insects develop to serious proportions does not justify the general use of sprays.

Tar oils have been developed that will give a good kill of aphid eggs. They are not, however, effective against San Jose scale or red mite. For this purpose petroleum oil is required. Many of the tar oil preparations on the market are in reality combinations of tar and petroleum oils. Only tar oils or tar oil preparations made specially for spraying purposes should be used. Directions of the manufacturer should be carefully observed.

CAUTION:—Tar oil or any combination containing tar oil should be applied only while the trees are completely dormant.

Where fruit tree leaf roller is serious, including an average of from 10 to 20 or more egg packets per tree, use 6% actual oil of home-made or government formula lubricating oil emulsion (9 gallons in 100) or a 6% emulsion of one of the regular commercial miscible oils. In 1939, the leaf roller threatens to be serious only in the eastern half of the state, in the western part of the state arsenate of lead in the cluster and calyx sprays will probably control the pest.

CAUTION

Make sure no free oil floats on the surface in the spray tank, apply before the buds swell, with the temperature high enough for the spray to dry before freezing and preferably late enough to avoid severe cold afterward. Such high oil concentrations are attended with some risk but much weaker dilutions are not effective. Spray all the way through the trees and cover all parts but do not over-spray. With proprietary sprays, follow the recommendations of the manufacturer.

PINK OR OPEN CLUSTER SPRAY

Time of Application.—After the blossom buds in the cluster have more or less separated and are showing pinkish color but before many of the flowers have opened.

Materials.—Liquid lime sulfur or dry lime sulfur.

On a control basis from 3½ to 4 pounds of dry lime sulfur is equivalent to 1 gallon of a high grade commercial liquid lime sulfur as a summer spray on apples. At comparable concentrations, dry lime sulfur is safer than the liquid material, especially when used with lead arsenate. The liquid lime sulfur is the cheaper.

Lead arsenate generally is omitted from this spray in a regularly sprayed orchard.

Dilution:

Scab-susceptible Varieties:
Liquid lime sulfur 2½ gals.—100 gals. or dry lime sulfur 8 to 9 lbs. —100 gals.

Some Scab-susceptible Varieties:
Black Twig
Rome
Delicious
Winesap
Willow Twig
Ben Davis
Gano

Scab-resistant Varieties:
Lime sulfur solution 2 gals.—100 gals. or dry lime sulfur 7 to 8 lbs. —100 gals.

Some Scab-resistant Varieties:
Transparent
Duchess
Grimes
King David
Collins
York
Wealthy
Stayman (moderately susceptible)
Golden Delicious (moderately susceptible)
Jonathan (leaves susceptible)

Diseases.—The cluster bud spray is primarily for the control of apple scab but aids in the control of black rot (frog-eye leaf spot). This and the following spray generally are the most important scab sprays and the disease must be checked at this time if satisfactory control is to be obtained. Otherwise these early infections will serve as sources for the spread of the disease later in the season whenever favorable weather conditions occur.

Insects.—For orchards that have not been sprayed regularly in the past or where canker worms are troublesome, add lead arsenate at the rate of 2 pounds to 100 gallons of spray.

Rosy aphid control at this stage or later is questionable. Before much curling of the leaves occurs, 1 pint of nicotine sulfate in 100 gallons of spray may prove effective but usually by this time so many of the aphids will be protected against contact by the spray that the benefits will not justify the expense.

Lime.—Lime may be added to the lime sulfur-lead arsenate combination to lessen arsenical injury. The lime reduces the efficiency of the spray but improves the finish on the more easily russeted varieties.

Only fresh, finely divided (300-mesh or smaller) hydrated lime should be used. It should be free of grit and lumps and be fluffy or somewhat buoyant when poured from the bag. Stored in bags, lime, freshly hydrated, will be satisfactory through a spraying season. The use of a hydrated lime carried from one year to another is attended with risk.

Further Suggestions.—Control of apple scab is based primarily upon preventive rather than curative measures. For more complete coverage it is desirable to apply the spray between the time

the stems of the flowers have separated in most of the clusters and the flowers have begun to open. Under some circumstances it may be necessary to begin spraying a little before and continue beyond the proper stage of development but the risk from scab is increased.

In these earlier critical scab periods, the interval between sprays should seldom exceed 14 days, and with cool rainy weather especially of the showery type, the interval might well be shortened to 10 or 12 days.

If the cluster bud or blooming period extends longer than normal, a supplementary spray for scab before the calyx spray is often advisable. One of the milder sulfur sprays of the bentonite or flotation sulfur type probably will give adequate protection. Do not use lead arsenate when spraying in bloom.

Flotation sulfur paste has been used at Columbia through the entire scab period and has under more or less ordinary conditions given satisfactory control, but with the vagaries of weather, it seems best, for the present at least, if protection is to be assured, to depend upon the lime sulfurs in the prebloom spray.

Calyx Cup or Petal Fall Spray

Time of Application.—Start when most of the petals are off and finish before the calyx cups close.

This is an important scab spray and under Missouri conditions is sometimes of as much importance as the cluster 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. To properly place the poison, the spraying must be completed before the blossom cups close.

Materials.—Dry lime sulfur or liquid lime sulfur and lead arsenate.

Lead arsenate 2 pounds to 100 gallons generally is sufficient when used without lime. Greater quantities increase the residue in the calyx end of the apple and increase the amount of arsenical injury. Finely divided fresh hydrated lime may be added to reduce arsenical injury and give better finish to the fruit but because lime reduces the efficiency of the lead arsenate it may be advisable where codling moth has been an acute problem to increase the lead arsenate dosage to 3 pounds to 100 gallons. Use 4 to 5 pounds of the hydrated lime depending upon the amount of lead arsenate.

Where curculio has been serious, use the lead arsenate at the rate of 3 pounds in 100 gallons of spray.

Dry lime sulfur has given better finish than liquid lime sulfur when used in conjunction with lead arsenate but the liquid material is the cheaper.

Scab-susceptible Varieties: Use dry lime sulfur 7 lbs. to 100 gals. or liquid lime sulfur 2 gals. in 100 gals.

Scab-resistant Varieties: Use dry lime sulfur 5 lbs. to 100 gals. or liquid lime sulfur 1½ gals. in 100 gals.

When conditions have not been particularly favorable for scab, the cluster spray well applied, and the interval between sprays not too long, certain of the milder sulfur sprays may be substituted for the lime sulfurs, especially on the more scab-resistant varieties.

Flotation sulfur and bentonite sulfur in studies at the Missouri Agricultural Experiment Station have given good control at the calyx period. However, whenever there is indication that scab may become serious and certainly when there is evidence of scab development, one or the other of the lime sulphurs should be used.

FIRST COVER SPRAY

Time of Application.—10-14 days after the calyx spray.

Materials:

Insecticides

Lead arsenate 2 lbs.—100 gals. is generally sufficient, but where codling moth has been serious, 3 lbs. of lead arsenate in 100 gals. is advisable. When the lead arsenate is used without a fungicide or in combination with liquid or dry lime sulfur, 4-5 lbs. of hydrated lime, depending upon the amount of lead arsenate, may be added to reduce arsenical injury.

In orchards where there was no fruit in 1938, the carryover of codling moths will be light and growers will naturally consider reducing their spray schedule somewhat. The absence of a fruit crop in 1938 will not affect scab this spring and it is surprising how fast the codling moth can build up again. As a result, it seems that the wise thing to do would be for growers to apply the regular cluster and calyx sprays and then follow with perhaps three well-timed early cover sprays with the view of thoroughly disposing of first brood worms. Then keep a close watch on second brood worms, and keep in touch with the codling moth field specialist in your part of the state and if worms threaten to build up do not hesitate to apply the later regular cover sprays. Where worms have been greatly reduced by the absence of a crop in 1938, it is believed that the growers can, by concentrating on the

complete control of first brood worms, safely omit some of the later sprays but they should not let the pest build up again.

Where curculio has been serious, use 3 pounds of lead arsenate and apply within 10 days after the calyx spray.

Substitutes for Arsenate of Lead.—Tank-mix nicotine bentonite, commercial fixed nicotine, phenothiazine, and a number of other possible substitutes for arsenate of lead for codling moth control are included in present investigations. Results to date do not justify a recommendation that Missouri growers abandon arsenate of lead in the spray program for general use of these or other possible substitutes. For special use of these insecticides write to the Missouri Agricultural Experiment Station.

Fungicides

Either dry lime sulfur at the rate of 5 or 6 pounds in 100 gallons, or liquid lime sulfur 1½ gallons in 100 gallons will be adequate under ordinary conditions. Dry lime sulfur is the safer material from the standpoint of fruit russeting.

Flotation sulfur and bentonite sulfur have been found effective in scab control and are desirable substitutes for the lime sulfurs where scab has been checked by the earlier sprays. Spray injury is an important consideration and these materials are among the safer fungicides for use on apples.

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

Some Blotch-susceptible Varieties

Ben Davis	Missouri Pippin
Duchess	Paynes

SECOND COVER SPRAY

Time of Application.—Two weeks after the first cover spray (3-4 weeks after the calyx spray).

Materials.—

Insecticides

Use lead arsenate 3 lbs. in 100 gals. of spray for ordinary codling moth conditions. The addition of 5 to 6 lbs. of hydrated lime is recommended to reduce arsenical injury. In this and all other sprays where Bordeaux is used, omit the lime. The lime required in preparing the Bordeaux is sufficient.

Where codling moth infestation is known to be light, 2 lbs. of lead arsenate may prove sufficient, while with high populations, 4 lbs. of lead arsenate in 100 gals. of spray is advisable. Every effort should be made to keep the first brood worms to a minimum and the use of too weak a dosage of lead arsenate may lead to a heavy build up and require an unnecessarily heavy schedule later in the season.

Fungicides

Apple Scab.—A fungicide at this time is often unnecessary for scab, but with rainy weather since the last spray, use some of the milder sulfurs such as flotation sulfur or bentonite sulfur; or dry lime sulfur may be used at the rate of about 5 lbs. in each 100 gals. of spray. Also, with a rather general appearance of scab lesions 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 a problem.

THIRD COVER SPRAY

Time of Application.—12-14 days after the second cover spray (5-6 weeks after the calyx application).

Materials.—

Insecticides

Use lead arsenate 3 lbs. with 5 or 6 lbs. hydrated lime where codling moth is not a serious problem.

Where codling moth infestation promises to be heavy, use lead arsenate 3 lbs.-100 gals. and 5 or 6 lbs. hydrated lime with enough stock summer oil to give about 2 quarts of actual oil in 100 gals.

OR

Lead arsenate may be used without the oil at the rate of 4 lbs. in 100 gals. with 6 lbs. of hydrated lime.

NOTE: Oil should not be used with nor follow too closely any sulfur-containing spray. Usually there is little danger from the use of oil at this time but where a rather heavy application of sulfur has been made within two weeks and without rain to remove the greater portion, there is risk of injury.

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 in 100 gals.).

FOURTH COVER SPRAY

Time of Application.—12-14 days after the third cover spray. (7-8 weeks after the calyx application).

Where codling moth is not a serious problem and the third cover spray was applied as late as June 15, this spray may be omitted unless diseases are present.

Materials.—

Insecticides

Lead arsenate 3 lbs. in 100 gals with 5 or 6 lbs. of hydrated lime. Where codling moth is serious and the grower wishes, a summer oil may be added, but a summer oil in this or later sprays increases the difficulty of residue removal.

Fungicides

Apple Blotch.—Use Bordeaux 4-6-100 for apple blotch control.

Bitter Rot.—Bitter rot seldom appears in North Missouri and is localized in the southern part of the state. When present to the extent to require sprays, use Bordeaux 4-6-100.

FIFTH COVER SPRAY

(The beginning of the second brood codling moth cover sprays)

Time of Application.—During the first part of July but not longer than 15 to 20 days after the last cover spray. The spray should be timed to the emergence of the second brood codling moth, information on which will be given in the seasonal news letters.

Materials.—

Insecticides

Lead arsenate 3 lbs. with 5 to 6 lbs. hydrated lime in 100 gals.

OR

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

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

Fungicides

Use Bordeaux 4-6-100 when blotch or bitter rot may be serious.

Note On Bitter Rot: Should bitter rot at any time make a sudden appearance, start spraying at once with 6-8-100 Bordeaux and apply every 8 to 10 days until four applications have been made.

SIXTH COVER SPRAY

Time of Application.—About 10 to 12 days after the fifth cover spray.

Materials.—Lead arsenate 2 or 3 lbs.-100 gals. with 4 or 5 lbs. of hydrated lime. Heavy dosages in this and later sprays increase the residue problem.

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 the codling moth activity, should be applied to late varieties.

Use lead arsenate 2 lbs. in 100 with hydrated lime.

Spraying Program for Peaches

Thoroughness in application is one of the most important essentials in spraying. The right materials must be applied at the right time and in the right way, otherwise poor results or injury may follow. Moreover, if the spray does not entirely cover the parts of the plant needing protection, it is not likely to be effective.

Dormant Spray.—This spray is for San Jose scale and peach leaf curl. To control peach leaf curl, the spray must go on before there is any evidence of growth, and where a spray for curl only is used, it is often applied in the fall after the leaves have dropped. Oil sprays or any sprays containing oil should not be applied until late winter or early spring. It should be applied before the buds begin to swell.

For the control of both scale and curl, use liquid lime sulfur 12½ gals. in 100 gals.

OR

Bordeaux 6-6-100 with 3 gals. of cold-mix or government formula lubricating oil emulsion in each 100 gals. of spray.

If commercial oils are used, follow instructions regarding the fungicide to be used with them.

For curl alone (in orchard where scale is not present), use Bordeaux 6-6-100 or lime sulfur 7 gals. in 100 gals.

First Summer Spray.—This spray is chiefly for the control of plum curculio. It is applied about 7 to 10 days after the blooming period when the shucks are half to two-thirds off the fruit.

Use 2 lbs. lead arsenate in 100 gals. with a zinc-lime mixture made of 2 lbs. zinc sulfate and 3 lbs. of hydrated lime. See method of mixing and cautions in spraying peaches which follow.

CAUTION

Lead arsenate is necessary for curculio but no more than 3 lbs. in 100 gals. should be used, and where curculio is not abundant, 2 lbs. in 100 gals. will usually suffice. The peach is quite sensitive to arsenic. Injury may occur on leaves, twigs, and fruit. The zinc sulfate-hydrated lime mixture is particularly effective in reducing arsenical injury and is recommended in all sprays where lead arsenate is used. The formula given seems to be as strong as is necessary. Should a zinc-lime mixture not be used, 8 to 10 lbs. of high grade, freshly hydrated lime should be added to each 100 gals. in all sprays containing lead arsenate.

Lime sulfur solution, dry lime sulfur and Bordeaux used in spraying apples and many other crops should not be applied to peaches after growth begins because of danger of injury. Even when very diluted they may cause much injury. For a fungicide, use some of the wettable sulfurs either home-made or commercial, such as dry mix sulfur and lime, flotation sulfur and the various proprietary brands prepared for spraying peaches.

MAKING ZINC-LIME MIXTURE

The spray tank is partly filled with water and powdered zinc sulfate is added (If a granular form is used which does not dissolve quickly, it should first be dissolved in a bucket of water or a stock mixture made ahead of time). With the tank nearly filled with water, add the hydrated lime which has previously been made into a thin paste in a separate container. Then add the lead arsenate which has also been made into a thin paste. Finish the filling of the tank, allow agitation for a few minutes and spraying may begin.

Where curculio is serious, it may be advisable to repeat the first summer spray in 3 or 4 days or as soon as the first application has been completed.

Second Summer Spray.—For curculio and peach scab. Apply in about 10 days after the first summer spray. Use lead arsenate 2 lbs. in 100 gals. with a 2-3-100 zinc-lime mixture (2 lbs. zinc sulfate, 3 lbs. hydrated lime, with water to make 100 gals.). When trouble has been experienced with peach scab or brown rot, or when favorable weather for the development of these diseases occurs, or when susceptible varieties are being grown or other conditions exist which are likely to cause an unusual development of these diseases, flotation sulfur paste at the rate of 10 lbs. in 100 gals. or some of the other wettable sulfurs should be added.

Third Summer Spray.—For this spray use the same materials in the same proportions as for the second summer spray and apply 2 or 3 weeks later. For early peaches this application will usually be sufficient.

Fourth Summer Spray.—Midseason and late varieties some seasons may require this application against curculio or brown rot. If needed apply about one month ahead of harvest. With rainy weather and brown rot threatening, use 10 pounds of flotation sulfur paste for each 100 gallons of spray, or use one of the commercial wettable sulfurs as recommended by the manufacturer. Ordinarily, lead arsenate is not required but if curculio is abundant, add 2 lbs. of lead arsenate to 100 gals. of spray with a 2-3-100 zinc-lime mixture.

Later Sprays.—It is important that the spraying be discontinued, if possible, a month before picking time. With brown rot serious, however, sprays may be required to within a few days of harvest. When required for brown rot, applications of flotation sulfur, 8 lbs. of paste in 100 gals., or other wettable sulfurs are suggested in about 3 weeks, again in 10 days and, if necessary, 3 or 4 days before picking. Do not use lead arsenate or zinc sulfate and lime in these sprays.

Oriental Fruit Moth.—Where the Oriental fruit moth has become serious, it bores into and kills much of the tip growth during the early part of the season. This results in a severe top pruning but it may not seriously hold back tree growth. However, as tip growth hardens and fruit begins to approach ripening the small caterpillars turn to the fruit and here may prove a real menace. Early summer applications of either internal poisons or contact insecticides have no appreciable effect on the early broods of worms working in the tip growth. However, our results to date indicate that sprays and dusts applied just prior to ripening may greatly reduce damage to fruit. Four sprays, consisting of one pint of 40%

nicotine sulphate and one gallon of one of the summer oil emulsions in 100 gallons, applied four times at weekly intervals, beginning one month prior to picking time, have reduced the wormy fruit from 18% on unsprayed trees to less than 2% on sprayed trees. Four applications of a sulfur-oil dust made at the same time as the sprays, have given equally good control. Varieties which ripen much later than Elberta have been much more difficult to protect.

Spraying Program for Cherries

Dormant Spray.—For Forbes scale and occasionally San Jose scale, use oil or liquid lime sulfur as recommended for apples.

First Summer Spray.—To control leaf spot, brown rot and curculio, apply when most of the petals are off using liquid lime sulfur 2½ gals. in 100 gals. of spray with 2 lbs. of lead arsenate.

Second Summer Spray.—This application is effective against leaf spot, brown rot and curculio. Apply about 10 to 12 days after the first summer spray, using 2½ gals. of lime sulfur and 3 lbs. lead arsenate in 100 gals.

Third Summer Spray.—Apply 12 to 14 days after the second summer spray, using 2 gals. of lime sulfur in 100 gals. Ordinarily lead arsenate should be omitted from this spray but where curculio is abundant add lead arsenate 2 lbs. to 100 gals. of spray.

After Harvest Spray.—If leaf spot, which causes the yellowing and dropping of the leaves, has not been thoroughly checked by the early sprays, make another application as soon as the fruit has been picked, using Bordeaux 4-6-100 or 1½ gals. of lime sulfur in 100 gals.

If leaf spot is not well checked, make a second post-harvest spray 2 to 3 weeks later.

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

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