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Orchard Spray Program for Oregon

1924 Revision

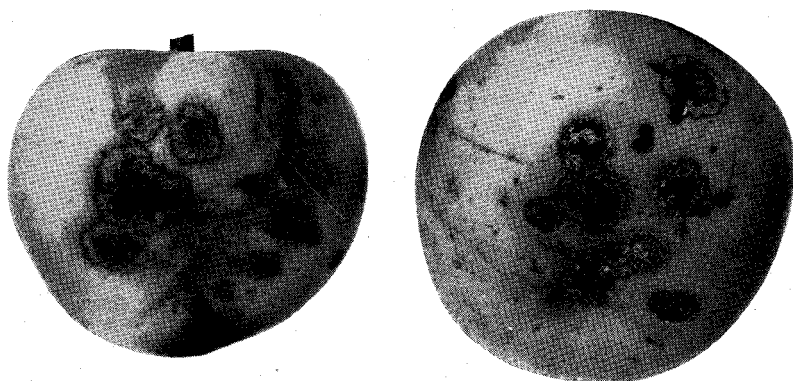
By

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Oregon Agricultural Experiment Station



Apple scab

CORVALLIS, OREGON

The regular bulletins of the Oregon Agricultural College are sent free to the residents of Oregon who request them.

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Orchard Spray Program for Oregon

By

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On account of the climatic differences existing between the more humid orchard sections west of the Cascade Mountains and the semi-arid or arid and irrigated regions east of these mountains, the conditions as to pests and diseases are different and require a somewhat different spray program. In general there are a greater number of diseases and pests to be sprayed for in the typical Western Oregon fruit districts than in the drier orchard sections of Eastern and Southern Oregon. Hence the full spray program for most of the state west of the Cascades is presented, followed by paragraphs outlining the program for other sections. First are presented some special notes regarding the control of particular diseases or insect pests, and finally a few paragraphs which deal with spray materials and spray practices.

SPECIAL NOTES ON PARTICULAR PESTS AND DISEASES

GENERAL PESTS

San Jose scale manifests itself as small, ash-grey or blackish pimple-like scales clustered on the bark. The bark is usually thin and the inner bark shows a purple stain; the trees become bark-bound and devitalized. Infested fruit shows bright red spots. The pest seldom becomes serious in well-sprayed commercial orchards. Where present, the dormant spray of lime-sulfur or oil is advisable. Where there is no other occasion for the dormant spray, if using lime-sulfur, the application can very acceptably be delayed until the pre-pink (delayed dormant). In such a case the dormant strength of lime-sulfur, 12 to 100, should be used. (Send for circular discussing use of oils for control.)

Red spider-mites. Remarks in general as given above concerning prevalence of and control for San Jose scale will apply. Oils as for leaf-roller appear equal to lime-sulfur in effectiveness. Summer sprays of 1 to 2 percent lime-sulfur plus 5 pounds of wettable sulfur to 100 gallons are of value. Details of preparation and application on request. More frequently serious on prune and cherry where no spray program is regularly applied.

Aphids or plant lice are particularly a pest of apple and cherry. On these trees the aphid spray of nicotine should usually be applied. Probably seldom required on other fruits, though in some sections the peach aphid requires attention. Ants carry aphids up to reinfest cherry trees. Band the trees with tanglefoot to prevent this.

Pear and cherry slug. Occurs as a greenish-brown, slimy, slug-like larva, which skeletonizes the foliage of pear and cherry. Spray with lead arsenate as advised if pest is prevalent.

Bud moth. This is a chocolate-brown worm one-third inch long found inside a mass of webbed leaves at the tip of the twig. Attacks all fruit trees, but due to arsenate sprays for other pests on apple and pear, bud moth is rarely serious there. Cherries are often seriously attacked and other stone fruits to a varying degree. Lead arsenate in the pre-blossom spray will control. See remarks on lead arsenate on stone fruits.

APPLES AND PEARS

Codling-moth. Codling-moth control is such a complex problem and of such outstanding importance, that too much dependence should not be placed upon a general spray program of this nature. Seasonal climatic variations and differences in altitude, humidity, and temperature have a material influence on the activities of the codling-moth so that no definite rules of procedure for the season are possible. The trained entomologist encounters puzzling variations and must determine each spraying date for the season from a variety of evidence, accumulated from breeding-cage records, temperature data, and careful field observations.

Where available get the advice of your county horticulturist, agricultural agent, or other specialist to assist in determining spray dates. In the absence of such an agency one may depend with a fair degree of accuracy on the spray dates sent out through the press from the Experiment Station.

Pears are less susceptible to worm injury than are apples. Where worms are particularly bad the calyx application on pears is advised. The late spray may usually be omitted on pears.

An additional cover spray two weeks after the first cover spray is probably advisable in Southern Oregon and in areas subject to high temperatures or where worm control has been unsatisfactory. This extra spray seems especially advisable on varieties of apple which grow rapidly, as the King, to afford protection for the rapidly expanding surface.

Supplement the spray control with a careful collection and destruction of wormy apples at thinning time. Also scrape the scaly bark from the trees during the winter. Before June 1, band the scraped trees with burlap strips of three thicknesses and approximately six inches in width. Visit these bands every two weeks during the summer and destroy the accumulated worms, giving a final treatment after harvest. Increasing the dosage of lead arsenate in the last cover spray to three or even four pounds to the hundred gallons is a fairly common practice and, for bad cases, it is advisable.

Apple aphids. The degree of success secured in apple-aphis control with our standard aphid spray of lime-sulfur and nicotine in the pre-pink (delayed dormant) has not been in all cases satisfactory. Evidence obtained through studies by the Experiment Station indicates that in many cases the pre-pink spray is applied too early for best results in aphid control. Where aphids are particularly bad, postpone the pre-pink spray as late as possible, or if scab control is a minor factor, bring

forward the pink spray, adding the nicotine to this solution and applying in early pink as soon as the blossom buds are separated from each other.

Leaf-rollers. Leaf-rollers occur as a major pest only in our more northern and eastern fruit districts. Miscible oil 8 to 100 in the early pre-pink is the standard control spray. Dormoil has given uniformly better results in leaf-roller control than the majority of oils tested. Some oils appear to be of little value in control. Rain within four days to a week subsequent to the application may materially decrease the efficiency of the oil spray. Where conditions develop which prevent complete control being secured from the oil application and for very light infestations of leaf-roller, use triple strength lead arsenate 6 to 100 in the pink spray.

Pear fruit-worms. Two or more species of caterpillars attack the pear fruit from the time the fruit sets until it is the size of a walnut. Many injured fruits drop but others mature as scarred and malformed pears, typical examples of fruit-worm injury. These worms appear very early and feed promiscuously over the foliage before the fruit sets. Lead arsenate in the pink spray affords excellent control. The calyx application is not equally successful as it is too late for best results in control.

Pear and apple leaf blister-mite. All indications show that the growers generally are not achieving the thoroughness of application so essential to successful blister-mite control. It is very important to cover the terminal twigs and the four feet at the top of the tree, as well as those portions more easily reached with the spray. Wind renders effective spraying impossible. Lime-sulfur, 12 to 100, applied any time from early February to early March, is the ideal application on pears. A combination of lime-sulfur, 7 to 100, plus two gallons of miscible oil is an especially effective spray, and probably advisable for aggravated cases. The increasing abundance of blister-mite on apples in some districts is serious. Ordinarily, spraying cannot be delayed as late in the spring on apples as on pears. Fall applications of lime-sulfur 12 to 100 appear to give better results in blister-mite control on apples. Apply any time after the majority of the leaves fall and until early December.

Apple-scab. This is the most serious disease of the apple in Oregon. Since it is carried over on the old leaves of the season before, these leaves ought, if possible, to be plowed under in the early spring before the winter buds burst. Winter or dormant sprays are of no advantage for this trouble. The early spring sprays are of utmost importance and a clean crop of fruit in Western Oregon is practically impossible unless the "pre-pink," "pink," "calyx," and "15-day" sprays are given at the proper time. With highly susceptible varieties like Newtown the "30-day" spray can rarely be omitted with safety in the moister sections of the state. The leaves must be covered as well as the fruit.

Pear-scab. Very similar to apple-scab. Early spring sprays are very important. The leaves should be turned under during the winter. Only after several seasons of careful spraying can the full measure of scab control be attained on very susceptible varieties in Western Oregon. Non-caustic sulfur sprays must be used in place of ordinary lime-sulfur on d'Anjou and Comice pears to avoid spray russet.

Powdery mildew. This is serious on certain varieties of apples like the Jonathan, Grimes, and Rome and is suspected of causing much russetting of d'Anjou and some other varieties of pears. The disease winters over in the buds, and all mildewed twigs that can be discovered should be pruned out during the dormant season. The most troublesome effects on the fruit arise from the attacks that come early in the season as the fruit buds are developing and opening. The most effective applications are, therefore, the "pre-pink" and the "pink." Later sprays will keep the foliage clean, and when these are combined with systematic pruning of the white mildewed shoots that appear, there will be a noticeable reduction in the mildew infection the following season. Spreaders will aid the spray to wet and penetrate the mildew growth. Dusting sulfur applied in warm weather gives excellent results against mildew if the dusting is done when the air is still.

Fire blight. Successfully controlled only by surgical methods. Send for circular.

Anthracnose canker and fruit rot. Anthracnose canker and fruit rot may be successfully prevented by a single, thorough summer application of bordeaux mixture 4-4-50. For the sake of economy this may be put in with the July or August worm spray. A fine, misty spray should be used. If casein spreader is added, it should be dissolved first in water before going into the tank. Fruit will often require wiping after a summer bordeaux spray, and the use of a spreader is apt to make this more difficult without materially improving anthracnose control. On dark red varieties the color may be somewhat affected by the shading action of the spray. In seasons of early fall rains the presence of spray on varieties like the Newtown may cause some reddish spotting around the lenticels. The protection given by a summer spray against fall infections on fruit and bark is positive and effective, while spraying after harvest is a "gamble" at best and is never advised unless the disease is already well under control.

European canker. This disease is especially destructive to pear bark and is occasionally found on apple bark. On such pear varieties as d'Anjou and Bartlett the fungous infection reaches the cambium the first year, while on Surprise, Bosc, and Howell varieties, the infection may be merely superficial the first year, striking in to the cambium during its second year's growth. On apple the cankers reach the wood. Cutting out of cankers is necessary and spraying with bordeaux 4-4-50 before fall rains set in will materially reduce the number of new infections.

Superficial cankers should be shaved off with a sharp instrument like a farrier's knife. This cutting away of the surface should extend well beyond the visible limits of the canker so as to uncover all dark streaks in the pulpy portion of the bark. From deep cankers clean away all diseased bark and any of the surrounding bark which covers discolored cambium. All exposed wood and bark should be covered with an antiseptic such as bordeaux paste made up in water. After callus formation a permanent coat of bordeaux paste in raw linseed oil may be applied. Winter-injured bark is extremely susceptible to infection unless coated with a fungicide.

STONE FRUITS

Western peach and prune root borer. This serious pest of prune trees is not controlled by spray applications, but special treatment must be given. The paradichlorobenzene treatment appears the most promising and practical treatment for older trees. This material is at present inadvisable for trees six years old or younger. For the younger trees the whitewash treatment is advisable; in fact observations by the Experiment Station over a period of years indicate that where the whitewashes are regularly and carefully applied young orchards may be kept practically free of the borer. Write for Oregon Experiment Station Circular 50 on the peach and prune root borer and its control.

Prune and peach twig miner. This small, pinkish worm works havoc by tunneling into the terminal growth of both bearing and non-bearing peach, prune, and apricot trees. In recent years a later brood of worms has attacked the fruit also. Mature peaches and apricots have shown an alarming degree of infestation, and a heavy prune drop has sometimes resulted from the attack of the worms. The pest is almost invariably present in destructive numbers in both young and bearing orchards. Lime-sulfur, 12 to 100, or even 10 to 100, applied any time from late February until early pink will give excellent control if thoroughly applied, and is probably advisable in the majority of the orchards. Oil sprays are not equally effective. Write for Oregon Experiment Station Circular 38.

Cherry fruit maggot. Occurs as a small white maggot inside the ripe fruit. If the regular lead arsenate sprays are applied for cherry slug control (see calendar) they will usually serve to check the maggot. The standard spray, however, applied in the form of a poison bait for the adult fly, is lead arsenate, one-half pound; sirup or molasses, two quarts; water, eight gallons. Three applications should be given: the first, when the adult flies appear; this will be about the time the Royal Anns show good color, or about June 8 to 20; a second application should follow ten days later, and a third one week after the second. Two applications will probably suffice if carefully timed and no rain interferes. Rains will discount the effect of previous applications and necessitate a repetition of the spray.

The spray should be applied at the rate of about one pint to the tree, applying the solution as fine droplets to the upper surface of the outer leaves where the adult flies will feed upon it. Seedling trees and adjacent foliage should receive the treatment as well. Write for Oregon Experiment Station Circular 35.

Cylindrosporium (Coccomyces) leaf spot of cherry and prune. This trouble is not found in all orchards. It seems to be worse where trees are crowded or the soil thin. Because the old leaves carry the disease over winter they should be plowed under before blossom time. Where it regularly causes losses it should be sprayed for, following directions in the spray calendar. The spray program recommended for Cylindrosporium may have but little effect on certain leaf spot or shot hole troubles which are not caused by this fungus but which occasionally make their appearance in Oregon orchards and are sometimes confused with it.

Blossom blight of cherry, prune, and apricot. Certain varieties of pears and plums are also subject to this disease, caused by the common

brown rot fungus or by another species of *Monilia*. The best single control application is a spray of bordeaux, 4-4-50, given just as the first blossoms are beginning to open. Thorough work should be done. Complete control is not likely, but a repetition of this spray over a period of several years should bring gradual reduction of the disease.

Brown rot. This disease varies so much with the weather and with the locality that no fixed program of sprays will fit all years or all districts. Brown rot is checked rather effectively and safely by non-caustic, sulfur-containing sprays or by sulfur dusts when the weather is warm. Ordinary lime-sulfur is very likely to cause injury to stone fruits. Bordeaux mixture is effective in cool, damp weather as in spring or fall and so far has caused injury only rarely in tests conducted in the West. During the drier weather of midsummer, however, sulfur fungicides are likely to give better control than bordeaux.

It is wise to spray as insurance *whenever* brown rot seems to be getting a start in the orchard. Cracked and injured fruit is likely to go down with brown rot in spite of spraying but sound fruit will be afforded considerable protection. An application about a month before picking will materially reduce harvest attacks. This is usually the best single spray that can be given.

Clean-up measures are of value against brown rot but cannot be depended upon alone to keep it down in a bad season. Plowing early and cultivating repeatedly during the blossoming period will help to reduce early attacks by destroying the spore cups of the fungus on the ground. Mummies should be removed from the trees at pruning time and destroyed. Rotted fruit on the ground in the fall should be cleaned up by hogs if possible. Patrol the peach or prune orchard regularly all summer, knocking out all rotting clusters of fruit with a pole hook and destroying them.

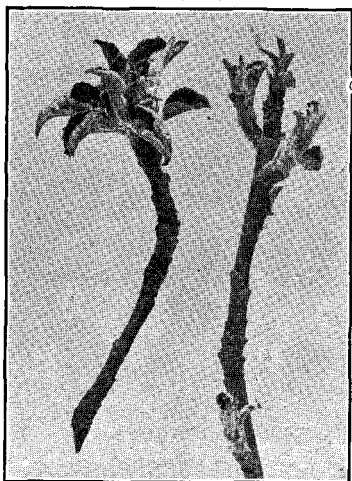
Peach blight. This is the most serious disease of peach trees in the state. It causes the blighting of the buds during the fall and winter and results in spots on the fruit as well as on twigs and leaves during the growing season. A spray for the disease given just after the fruit is off, using bordeaux 4-4-50, is an effective protection unless early rains have already given the disease a start. This spray aims to protect the buds and twigs against fall and winter attacks. Where the disease is bad it may be necessary to spray again in the spring, beginning when the shucks drop off the fruit and using self-boiled lime-sulfur, or other safe form of sulfur spray. Unless this disease is sprayed for at the right time it will quickly ruin an orchard.

Peach leaf curl. This destructive disease causes thickening and distortion of the leaves, resulting in their eventual death and depleting the vitality of the trees. It can be controlled easily by applying a bordeaux spray some time during December, January, or early February. Later applications are a gamble. Lime-sulfur sometimes produces good results, but bordeaux has proved by far the most reliable material. Early fall sprays for blight do not control leaf curl, and spring sprays are without effect on the disease.

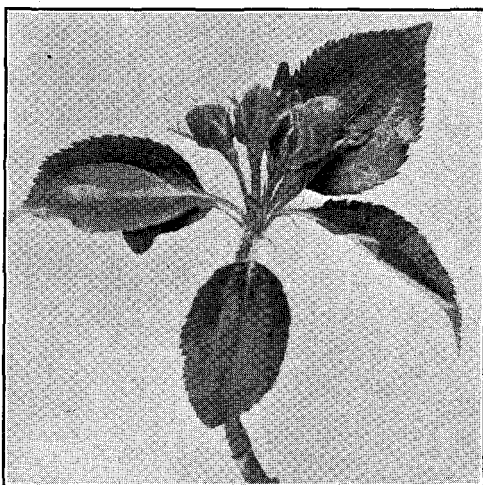
Bacterial gummosis of cherry and other stone fruits cannot be controlled by sprays. Surgical methods are advisable. The most serious effects in cherry orchards are absent where the body and frame-work limbs are of Mazzard seedling stock, which is in general highly resistant to the disease. Send for special circular.

SPRAY PROGRAM I

For humid sections of Oregon west of the Cascades



"Pre-pink" (delayed-dormant) stage.
Winter buds just opening.



The "Pink" stage. Blossom buds just ready to open.

APPLES AND PEARS

Time of application	Pest or disease	Spray material and strength
1. Dormant spray. As winter buds swell just before opening.	San Jose scale, blister-mite and spider-mites.	Lime-sulfur 12 to 100 or miscible oil 8 to 100.
	Apple leaf-roller (see special discussion, p. 5).	Dormoil 8 to 100.
2. Pre-pink (delayed dormant) spray. Cluster buds separating just enough to expose blossom buds.	Scab and powdery mildew.	Lime-sulfur $3\frac{1}{2}$ to 100.
	Aphids on apple.*	Add nicotine sulfate $\frac{1}{2}$ pound to 100 gallons of spray.
3. Pink or pre-blossom spray. Just before blossoms open.	Scab and mildew.	Lime-sulfur $2\frac{1}{2}$ to 100.
	Fruit worms on pear and bud moth.	Add lead arsenate 3 pounds to 100 gallons of spray.

* Where aphids are very bad, especially with varieties somewhat resistant to scab, omit nicotine from Spray No. 2, adding to it Spray No. 3, which should then be applied just as soon as the blossom buds separate from each other.

APPLES AND PEARS (Program I, continued)



The "Calyx" stage. Petals off, calyx lobes open.

4. Calyx spray. As last petals fall. Before apple calyx closes on central fruit in cluster.	Scab and mildew.	Lime-sulfur 2½ to 100.†
	Codling-moth on apple.	Lead arsenate 2 lb. to 100 gal.
	Fruit worms on pear (if pink spray was omitted).	Lead arsenate 2 lb. to 100 gal.
5. Fifteen-day spray. About fifteen days after petals fall.	Scab and mildew.	Lime-sulfur 2 to 100.
	Pear slug.	Lead arsenate 2 lb. to 100 gal.
6. Thirty-day or first cover spray for worms. Three to five weeks after petals fall.	Codling-moth (see special discussion).	Lead arsenate 2 lb. to 100 gal.
	Scab and mildew.	Lime-sulfur 2 to 100.
7. July spray. July 10 to 25 depending on locality and season.	Codling-moth, second generation.	Lead arsenate 2 lb. to 100 gal.
	Anthraxnose canker.	Bordeaux 4-4-50.
8. August spray. August 10 to Sept. 5, depending on season and locality.	Codling-moth (may usually be omitted on pear).	Same as for No. 7.
	Anthraxnose (if not sprayed for earlier).	Bordeaux 4-4-50.

† Ordinary lime-sulfur is likely to russet the skin of some varieties of pears like d'Anjou, Comice, and Howell, and may cause burning of apples when hot weather comes on. Under such circumstances substitute self-boiled lime-sulfur 8-8-50, Atomic Sulfur 12 pounds to 100 gallons, or any other reliable, tested, non-caustic sulfur spray.

PRUNES AND PLUMS

(Program I, continued)

Time of application	Pest or disease	Material and strength to use
1. Dormant spray. As winter buds are ready to open.	San Jose scale, spider-mite, twig miner.	Lime-sulfur 12 to 100. If scale is absent dilute 8 to 100.
2. Pre-blossom spray. Buds white just before opening.	Brown rot (<i>Monilia</i>) blossom blight.	Bordeaux 4-4-50 with spreader or lime-sulfur 3 to 100.
	Bud moth.	Lead arsenate 2 lbs. plus lime 2 lbs. to 100 gallons.
	Aphids.	Nicotine sulfate $\frac{3}{4}$ lb. to 100 gal.
3. First fruit spray. As soon as shucks fall.	<i>Cylindrosporium</i> leaf spot and brown rot.	Self-boiled lime-sulfur 8-8-50 with spreader, Atomic Sulfur 12 lb. to 100 gal., or other reliable non-caustic sulfur spray.
	Syneta beetle.	Lead arsenate 2 lb. plus lime 2 lb. to 100 gal.
4 and 5. About June 1, and July 1.	<i>Cylindrosporium</i> or brown rot if troublesome.	As under 3.
6. August spray. About a month before harvest.	Brown rot.	As under 3.

PEACHES

Time of application	Pest or disease	Material and strength to use
1. Leaf curl spray. From December to mid-February.	Peach leaf curl.	Bordeaux mixture 6-6-50.
2. Late dormant spray. Just as first buds are ready to open.	Peach twig miner, San Jose scale, spider-mite.	Lime-sulfur 12 to 100. If scale is absent dilute 8 to 100.
	Bud moth.	Lead arsenate 2 lbs. plus lime 2 lbs. to 100 gal.
3. First fruit spray. As soon as shucks fall.	Peach blight (fruit spot), mildew, or brown rot.	Self-boiled lime-sulfur 8-8-50 with spreader, Atomic Sulfur 12 lb. to 100 gal. or other reliable non-caustic sulfur spray. If bad repeat once or twice at 2 or 3 week intervals.
4. Late summer spray. About 4 to 6 weeks before harvest.	Brown rot.	Same as No. 3 or use dusting sulfur, applied when the air is still.
5. Early fall spray. As soon as each variety is picked.	Peach blight and die back.	Bordeaux 4-4-50.

CHERRIES

San Jose scale. Same as No. 1 on prune program.

Aphids. Use nicotine sulfate 1 lb. to 100 gal. with pre-blossom spray (same as No. 2 for prune). Use tanglefoot bands on trees to prevent aphid reinfestation by ants.

Cherry fruit maggot. Use sweetened poison spray for adult flies. See special discussion under Cherry Pests.

Brown rot (*Monilia*) blossom blight. Same as No. 2 on prune program.

***Cylindrosporium* leaf spot (Yellow Leaf).** Same as Nos. 3, 4, 5, on prune program.

Brown rot on fruit. Use self-boiled lime-sulfur 8-8-50 with spreader, or Atomic Sulfur 12 lb. to 100 gal. or a reliable non-caustic sulfur spray, one month before picking. Begin earlier if disease shows up sooner and repeat every three weeks till a month before picking.

APRICOTS

Brown rot (*Monilia*) blossom blight. Same as No. 2 on prune program. Prune out and destroy all dead twigs and spurs in winter.

Fruit spot (peach blight fungus). Same as Nos. 3 and 5 on peach program.

San Jose scale and other insects. Same control as for similar insects on peach.

SPRAY PROGRAM II

For all sections east of the Cascade Range
and for the Rogue River Valley

APPLES AND PEARS

Scab. Present and troublesome only in a few localities. Where sufficiently abundant to justify spraying, apply Nos. 3 and 4 in Program I for apples and pears.

Powdery mildew. Use applications Nos. 2, 3, 4, and 5 in Program I for apples. Continue if necessary.* Use casein spreader first dissolved in water. Supplement by winter and summer pruning out. Pink spray most important to avoid sulfur shock.

Codling-moth. Following the calyx application, the first cover spray (30-day) is applied just before first worms hatch. In general this will be earlier (15 days) than for coast area. Follow with second cover spray two weeks after first cover spray; third cover spray four weeks later, and fourth cover spray four weeks after third.

For Southern Oregon an additional late cover spray may be necessary. Double strength lead arsenate in late sprays is advisable. Calyx spray on pears is likewise advisable in Southern Oregon.

For the Grande Ronde Valley follow Program I, although in higher altitudes probably two cover sprays will generally suffice.

Apple aphids. Follow Spray Program I, but note especially discussion of apple aphids on pages 4-5.

Citrus red spider. Use Spray No. 1 in Program I, as for red spiders.

Blister-mite. Use Spray No. 1 in Program I. Take care to get application on apple early.

Leaf-rollers, fruit-worms, San Jose scale, aphids. Follow Program I for these insects.

PEACHES

Leaf curl, mildew, California blight, twig miner, San Jose scale, spider-mite. Follow Program I for these diseases and insects.

CHERRIES

Practically no fungous diseases requiring spray. Insects in general would require no regular program of sprays. For specific pests follow Program I for cherry.

APRICOTS

California blight. Follow Program I for peach blight. Insect pests and treatment same as for peach in Program I.

* See foot-note on ordinary lime-sulfur under apple and pear spray Program I on page 10.

PRUNES AND PLUMS

As a rule no fungous diseases requiring spray.

San Jose scale, twig miner, and spider-mite are principal insect pests. Where present control with Spray No. 1 in Program I for prunes and plums.

IMPORTANT POINTS ABOUT SPRAY MATERIALS

The proportions of lime-sulfur recommended for sprays in this bulletin are based on the use of the standard concentrated liquid lime-sulfur testing about 32° by Baumé hydrometer test. Thus, for example, where the recommendation "lime-sulfur 12 to 100" appears in the calendar, use 12 gallons of the standard concentrated liquid lime-sulfur and add water to make 100 gallons of dilute spray. Where the stock lime-sulfur is different from standard strength, dilute according to the following table.

LIQUID LIME-SULFUR DILUTION TABLE

For use when stock solution is different from standard commercial strength (32°)

Strength of stock solution		To make 100 gallons of dilute spray use the number of gallons of concentrated stock lime-sulfur indicated in the columns below and add water to make 100 gallons.				
Degrees Baumé	Specific gravity	1 Dormant strength for scale clean-up (12-100)	2 Dormant strength for blister mite and twig miner (8-100)	3 Early spring spray (3½-100)	4 Mid-spring spray (2½-100)	5 Late spring spray (2-100)
		gal.	gal.	gal.	gal.	gal.
34°	1.304	11+	7½	3+	2½+	1¾+
32°	1.282	12	8	3½	2½	2
30°	1.260	12¾+	8½	3½	2½+	2+
28°	1.239	14—	9½	3¾	2¾+	2¼+
26°	1.218	15	10	4	3	2½
24°	1.198	16½—	11	4½—	3½+	2¾
22°	1.179	18¼+	12¼	4¾+	3¾—	3+
20°	1.160	20¾+	13¾	5½—	4¼—	3½

Note: Where the + sign is used, employ a little over the number of gallons indicated. Where the — sign appears use scant measure.

Where the powdered or "dry lime-sulfur" is used it will take about 4 pounds of the dry powder to equal one gallon of the standard concentrated liquid lime-sulfur in active ingredients. For example, where this bulletin recommends "lime-sulfur 12 to 100" the grower employing the dry form should use 48 pounds of the dry lime-sulfur with every 100 gallons of water to get the same strength of spray.

The powdered form of lead arsenate is the basis of the formulas for this poison recommended in this bulletin. Where arsenate in paste form

is used the grower should employ double the number of pounds indicated in the bulletin.

Arsenate on stone fruits. There is a reasonable element of danger of burn in applying ordinary commercial lead arsenate to stone fruits. The neutral or triplumbic lead is preferable, but almost impossible to obtain. Using the lead in combination with lime-sulfur increases the opportunity for injury and is possibly inadvisable on stone fruits. Serious burn on stone fruits from lead arsenate spray is extremely rare, however, and even an appreciable burn is uncommon. Probably in the majority of cases the defoliation by the pest against which arsenate might be applied would prove much more extensive and deleterious if unchecked than the defoliation or leaf burn resulting from the spray application.

Spreaders. Materials used with a fungicide or insecticide spray to increase the spreading and adhesive powers are rapidly coming to the front. Calcium caseinate is one of the best spreaders for use with lead arsenate alone. Where added in powder form to sprays containing bordeaux, lime-sulfur, or other fungicides it sometimes gums things up badly. In such cases it is suggested that the spreader be completely dissolved in water before adding to the spray tank.

Bordeaux mixture is most satisfactory when freshly made according to standard methods. The "ready-mixed" type of commercial bordeaux is in general decidedly inferior to good home-made spray. The commercial bordeaux powders in which the powdered bluestone and hydrated lime are sold in separate packages and added separately to the spray tank appear to be better than the materials combined by the manufacturer. The hydrated lime must not have become air-slaked (carbonated) when used and directions must be followed carefully or poor results will be obtained.

Home-made bordeaux must be used the same day it is made or else ordinary cane sugar must be added at the rate of 1 oz. (1 heaped tablespoon) for every 8 pounds of stone lime or 10 pounds of hydrated lime employed. The sugar should be dissolved before adding to the tank of bordeaux. It prevents the spray from crystallizing and deteriorating.

"Wettable" or "dry-mixed" and colloidal sulfurs. Within recent years efforts have been made to devise ways by which ordinary sulfur dust can be made "wettable" so that it could be mixed readily with water and used as a spray. Certain types of sulfur pastes have appeared which, like "Atomic Sulfur," have given very good results. Among the most promising of wettable sulfurs is a dry mixture made by thoroughly combining 8 pounds of finest ground dusting sulfur, 4 pounds of hydrated lime, and 6 or 8 ounces of powdered calcium caseinate spreader. This gives enough material for 50 gallons of spray. This material has shown itself to be safe for use on any kind of fruit where lime-sulfur is unsafe on account of danger of spray injury. The material appears to be easily handled and applied and to spread and adhere exceptionally well. It can be readily mixed with water and added to the spray tank, and some have even secured good results by dusting the material into the spray tank gradually while the agitator is running. The apparent merits of the material justify trial in the Northwest, but it is important in mixing the

ingredients to do the work so thoroughly as to combine them into a perfectly homogeneous mixture. Furthermore, ordinary grades of sulfur flour will not give good results equal to those that may be expected of the extra fine grades of sulfur. This type of dry-mixed wettable sulfur and lime is likely to prove an excellent substitute for the more troublesome self-boiled lime-sulfur wherever the latter is advised in the usual spray program as for brown rot control or for the control of mildew, *Cylindrosporium* leaf-spot, etc.

Sulfur in colloidal form is of interest to spray chemists and pathologists because certain types of this material appear to have rather greater efficiency in weak dilutions than do other types of sulfur suspensions. Colloidal sulfurs, however, have not been entirely standardized and may still be considered in the experimental stage.

Spray combinations. Any of the materials mentioned in this spray program in connection with any particular application may be successfully combined. In adding lead arsenate to a tank of dilute lime-sulfur, however, it is best not to put in the arsenate until the last thing before starting to spray.

Sulfur shock. Under certain climatic conditions if lime-sulfur has not been used on apple trees in the earlier pre-pink or pink applications, a very severe injury with foliage and fruit drop may result when lime-sulfur is applied later on. This is known as sulfur shock and occurs without regard to strength of spray. Immunity against this danger can be secured only by application of the pre-blossom sprays as scheduled. Trees in a run-down condition due to poor care or to the effects of previous drought or poor soil conditions and culture are much more susceptible to spray injury than are healthy trees in fertile, well-cared for soils.

Dusting. Experimental work in the Northwest in general has not been very encouraging to the substitution of dusting for spraying, especially in those sections subject to severe attacks of fungous diseases under relatively cool and moist climatic conditions. Tests with improved materials, machinery, and application methods may eventually show that dusting is worth while for the control of particular diseases or pests in Oregon, but the Experiment Station is not advocating the adoption of dusting as a general orchard practice as yet.

Directions for preparing sprays. Directions for the making of lime-sulfur, self-boiled lime-sulfur, bordeaux mixture, etc., will be supplied free if the fruit grower will send a request to the Oregon Agricultural College, Corvallis, Oregon.

HEIGHT	TOT. APPLES	TOT. SCAB	% SCAB	TOT. AVE. SCAB
15-26 FT.	2279 ON 28.13 %	1042	45.72	22.52%
10-15 FT.	3567 ON 38.56 %	800	22.31	
0-10 FT.	3201 ON 35.29 %	209	6.52	

Distribution of scabby apples on an average sprayed tree. Note that the percentage of scab rapidly increases toward the top of the tree. All evidence indicates that the average grower can decrease his percentage of scabby fruit by giving more attention to spraying the top ten feet of the tree.

HEIGHT	NUMBER OF APPLES	TOTAL WORMY	% WORMY	Ave. % WORMY
22-28 FEET	123	22	17.8	3.41
12-22 FEET	904	33	3.6	
0-12 FEET	1020	15	1.46	
		UNSPRAYED		53.6

Distribution of wormy apples in an experimental block sprayed with guns on a $3\frac{1}{2}$ h.p. sprayer. Good control was obtained up to a height of 22 feet. Above this point worminess rapidly increased. The average worm control was good, but poor in the tops of the trees. A gun on a low-capacity outfit tends to slight the top of the tree.

SPRAYING THE HOME ORCHARD

As a general rule the man with a small home orchard finds it next to impossible to carry out the full spray program as outlined in the foregoing calendar. His desire is rather for a reduced spray program enabling him to obtain a crop of fruit reasonably free from worms and blemishes. With this objective as a guide, the following program of sprays for the home orchardist is suggested. In seasons when pests or diseases are very bad only partial control can be expected; but ordinarily a fair proportion of good fruit should be harvested.

APPLES AND PEARS

(See Program I on pages 9 and 10 for guidance)

Dormant spray (No. 1). Worthless against scab, mildew, worms, or anthracnose. Apply only when scale or blister mite are troublesome.

Pre-blossom (pink) spray (No. 3). Important spray for scab (black spot) and mildew in sections where these are troublesome. Arsenate usually not essential on home orchard. Where aphids are bad, add nicotine sulfate at the rate of three-fourths pint to 100 gallons of spray.

Calyx spray (No. 4). Immediately after the petals drop. A very important spray for scab, mildew, and apple worms.

Thirty-day spray (No. 6). Important spray for codling-moth worms everywhere. Add lime-sulfur if scab or mildew are likely to be bad.

Mid-summer spray (No. 7). Apply last of July or in early August. The final spray for codling-moth and important. If apple-tree anthracnose or European cankers are present in the trees add bordeaux 4-4-50 in this application. This will also cut down the amount of fruit rot after harvest.

PRUNES, PLUMS, AND APRICOTS

(See Program I on page 11 for guidance.)

Dormant spray (No. 1). Advisable for general clean up and for twig miner and scale.

Other sprays are not advised unless severe attacks of leaf spot or brown rot have affected the trees before, in which case Nos. 4 and 5 are best for leaf spot and No. 6 for brown rot.

PEACHES

(See Program I, page 11.)

Leaf curl spray (No. 1). Apply only where leaf curl is generally bad as on Elbertas.

Late dormant spray (No. 2). Important for scale and twig miner.

Peach blight spray (No. 5). Necessary every year to keep trees healthy.

If brown rot is likely to be bad use No. 4. This will help against mildew also.

CHERRIES

See spray program on page 12 and apply such sprays as the pests present and the season seem to warrant. Oftentimes good cherry crops are obtained entirely without sprays.

DRY LIME-SULFUR FOR THE HOME ORCHARDIST

The greater convenience in handling small amounts of material recommends the dry lime-sulfur to the home orchardist. In calculating amounts for use, determine the number of gallons of liquid lime-sulfur called for and multiply the figure so obtained by 4. This will give the number of pounds of dry lime-sulfur to use. In other words, one gallon of liquid lime-sulfur is equal in strength* to four pounds of dry lime-sulfur.

DUSTING THE HOME ORCHARD

Small liquid spray outfits are not entirely free from faults. The preparation and application of liquid sprays is, admittedly, a sloppy task. Where trees are in close proximity to a building, the spray may cause injury to the paint, etc.

Dust outfits of the knapsack type serve very nicely for a few trees; they are comparatively inexpensive, of simple construction, and handy. The spray materials are, for the most part, available in the dust form. Dusting may prove, for many, the more acceptable form of application. One precaution is always necessary where dusting: Do not dust in the wind; wait until the air is still if good results are to be secured.

