

Oregon Agricultural College Extension Service

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Orchard Spray Program for Oregon

1928 Revision

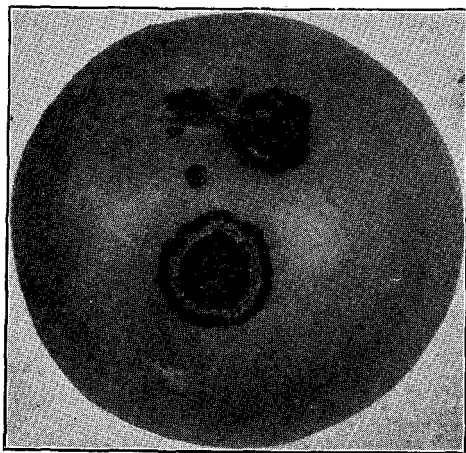
By

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Oregon Agricultural Experiment Station



Apple scab (black spot).

CORVALLIS, OREGON

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

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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. A dilution of 6 gallons oil emulsion to 100 gallons of water is the strength recommended for scale control in Oregon, although good kill apparently has been obtained in some instances with the dilution of 4 gallons to 100 gallons of water. Some growers, however, after using oil for several years at the above strength, are going back to the use of lime-sulfur. Where there is no other occasion for the dormant spray, if using lime-sulfur, the application can very acceptably be delayed until the delayed dormant. In such a case the dormant strength of lime-sulfur, 12 to 100, should be used.

Red Spider-mites. Three species of mites, the European red spider-mite, brown orchard mite, and the common red spider-mite attack Oregon orchards. Mites are more frequently serious on prune and cherry where no spray program is regularly applied, and of late years on pear where ordinary lime-sulfur russets the tender-skinned varieties. The first two species overwinter in the egg stage on the tree. Lime-sulfur 12 to 100, or oil emulsion 6 to 8 gallons to 100, applied just before the buds open, is recommended for the control of these forms. The common red spider-mite, however, cannot be controlled by a dormant or

delayed dormant spray since it migrates to the orchard from adjacent weeds and other plants later in the season. Summer sprays of oil or lime-sulfur are recommended for the common red spider-mite. Lime-sulfur, 1 to 2 gallons plus 5 pounds wettable sulfur mixed with 100 gallons of water, is the standard summer lime-sulfur spray for mites. Oil sprays, sometimes called "summer" oil sprays or white oils, are of value when used as a summer spray for red spider control. See page 17 for discussion of oil sprays.

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 in Spray Program I 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.

APPLE AND PEAR PESTS AND DISEASES

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.

For this reason the grower should supplement the suggested program with all the trained assistance and advice obtainable.

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 to three or even four pounds to the hundred gallons is advisable for bad worm infestation.

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 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. The oil spray applied as indicated in Application No. 1 just as the buds begin to show green has proved effective at the Hood River Branch Experiment Station. If blister-mite is present, however, the oil spray cannot be delayed this late.

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 (delayed dormant) 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 double strength lead arsenate (4 to 100) in the pink and calyx sprays.

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. Every bud in the tree must be covered with the spray for in these buds the mites overwinter. Wind renders effective spraying impossible. Lime-sulfur, 12 to 100, applied any time in the spring before buds begin to open, is the ideal application. The increasing abundance of blister-mite on apples in some districts is serious. Although spring applications are very effective, fall applications of lime-sulfur 12 to 100, appear to give good results in blister-mite control on apples. Apply any time after the majority of the leaves fall and until early December. Oil emulsion 8 to 100 is effective during a much more limited time; this period is between the time the scales are separating on the buds and before the green tips show. (See Oregon Agricultural Experiment Station Circular 59.)

Apple-scab. This is the most serious disease of the apple in Oregon. It is carried over on the old leaves of the season before. Therefore 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 most 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 tender skinned pears like d'Anjou or Comice 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 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. Cannot be successfully controlled without surgical methods. Send for circular.

Anthracnose canker and fruit rot. Anthracnose canker and fruit rot may be successfully prevented by a single, thorough July application of bordeaux mixture 44-50 combined with arsenate for worms. A fine, misty spray should be used. Fruit will often require wiping after a summer bordeaux spray, and the use of a spreader makes this more difficult without materially improving anthracnose control. On dark varieties the color may be somewhat affected. In seasons of early fall rains the presence of spray on varieties like the Newtown may cause some reddish spotting around the lenticels. In orchards which are badly infected the anthracnose fruit rot as well as the canker may be materially decreased by applying bordeaux with an excess of free lime *just* before fruit is picked. This will facilitate spray residue removal.

The trouble resulting from the presence of bordeaux on the fruit has induced many growers to give up the summer application. They are using instead a bordeaux application for both scab and anthracnose in the "pre-pink" spray, or where oil is used against leaf-roller, in the leaf-roller spray. This spring application of bordeaux must be put on before the fruit buds are much exposed or the fruit may be russeted. It must be carefully made and thoroughly applied as it must stay on the trees until fall at which time it becomes effective in controlling the disease. Since the spring spray at best will not protect either fruit or new shoot growth it is not recommended in place of the July spray in orchards where the disease is not already reasonably well controlled. (See Oregon Agricultural Experiment Station Circular 73.)

Perennial canker and fruit rot. This canker is particularly destructive to apple trees in the Hood River Valley and farther up the Co-

lumbia River Valley. It infects pruning cuts and other wounds, and its perennial enlargement is stimulated by, if not dependent upon, bark injuries due to low temperatures and by woolly aphis.

Existing cankers can be eradicated only by the cutting out of the diseased tissues well back into healthy bark and painting over all cleaned-out wounds, whether cleaned canker wounds, pruning cuts or other injuries, with an antiseptic wound dressing. Leroy Childs of the Hood River Branch Experiment Station says that for particular use in districts where perennial canker is prevalent "a paint must meet a very specific requirement; that is, it must persist so closely in the tissue itself that the woolly aphid cannot become established. * * * When applied in the spring the Hood River Tree Paint acts as a repellant to woolly aphid practically all summer and adheres closely and forms no crust." Such tree-surgical methods as mentioned here are essential in cleaning up infected orchards.

No preventive measures of control are yet positively known for this disease, although the liberal use of bordeaux mixture particularly in the spring application as used in the Hood River Valley in connection with the oil spray for leaf-roller, appears to be of some assistance in checking new infections. This early pre-pink spray is bordeaux 6-6-50 to which is added a good 6 to 8 percent oil spray for leaf-roller. Exposed woolly aphid can be controlled by the application of Black Leaf 40, 1 part to 1000 parts of water, plus calcium caseinate spreader, 2 parts to 100 parts of water. This should be applied as soon as the insects begin to appear on the sprouts, usually in July. (See Oregon Agricultural Experiment Station Bulletin 217 or Circular 73).

The fruit-rot caused by this disease may be considerably decreased by the application of bordeaux, which has an excess of free lime, *just* before the fruit is picked. This will also facilitate spray residue removal and if thoroughly applied will serve to prevent anthracnose, canker, and fruit rot. (See paragraph on spray residue removal, p. 16.)

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 at once with an antiseptic coating. Bordeaux paint has given excellent results. This must be made the day it is used, slowly stirring raw linseed oil into a quantity of prepared bordeaux powder like Sherwin-Williams "Fungi-Bordo" until a very thick paint is formed. Winter-injured bark is extremely susceptible to infection unless coated with a fungicide.

STONE FRUIT PESTS AND DISEASES

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. Preliminary tests indicate that it may be used on younger trees without danger to the trees if used with care. (Write for Oregon Agricultural 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 Agricultural Experiment Station Circular 38.)

Cherry fruit maggot. Occurs as a small white maggot inside the ripe fruit. The standard spray, 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 a 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 Agricultural Experiment Station Circular 35.)

Syneta leaf beetle. This insect occurs in April and May on foliage, fruit clusters, and in open blossoms as a creamy-white beetle about $\frac{1}{4}$ inch long. It eats holes in the leaves and blossom petals and gnaws small cavities out in fruit and fruit stems. The syneta beetle is especially injurious to cherry. Commercial orchards which receive the calyx spray of arsenate are usually not seriously injured. A satisfactory spray on cherries has not as yet been developed, but in tests conducted by the Oregon Agricultural Experiment Station, 4 pounds of lead arsenate plus 4 pounds of lime to 100 gallons of water applied both as a pre-blossom spray and also when most of the petals have fallen, has given a fair degree of control.

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.

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. Where attacks are severe another spray in full bloom and a third as the petals drop may be warranted. 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. 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. 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. 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. (Send for Oregon Agricultural Experiment Station Circular 53.)

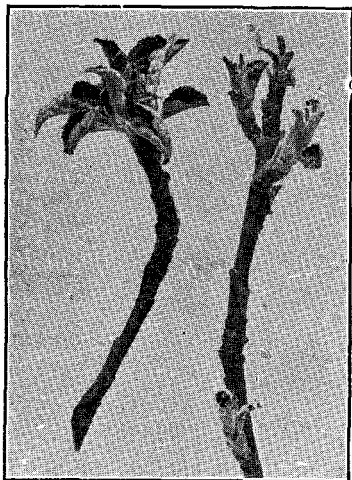
Peach blight. This is the most serious disease of peach trees in the state, blighting the buds during fall and winter and spotting the fruit, twigs and leaves during the growing season. Just after the fruit is off, bordeaux 4-4-50 is an effective protection against fall and winter attacks unless early rains have already given the disease a start. 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 a non-caustic 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.

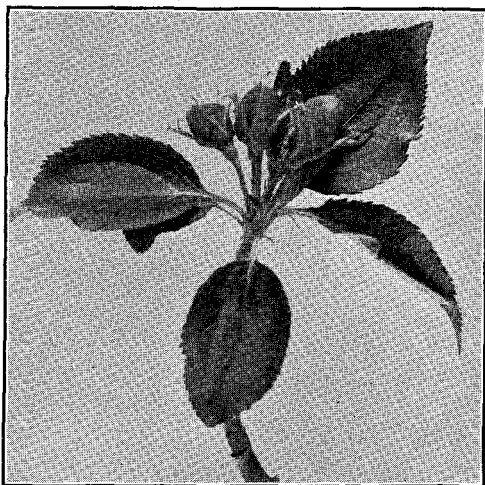
Bacterial gummosis of cherry and other stone fruits cannot be controlled by sprays. Surgical methods are advisable. The most serious effects in cherry orchards are absent where the body and frame-work limbs are of Mazzard seedling stock, which is in general highly resistant to the disease. Send for special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

SPRAY PROGRAM I

For humid sections of Oregon west of the Cascades



"Pre-pink" 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 p. 5).	Dormoil 8 to 100.
2. Pre-pink spray. Little leaves separating just enough to expose blossom bud cluster.	Scab and powdery mildew.	Lime-sulfur 3¼ to 100.
	Anthrachnose (see p. 6).	Bordeaux 6-6-50.
	Aphids on apple.*	Add nicotine sulfate ¾ pound to 100 gallons of spray.
3. Pink or pre-blossom spray. Just before blossoms open.	Scab and mildew.	Lime-sulfur 2½ 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.

PRUNES AND PLUMS (Program I, continued)

Time of application	Pest or disease	Spray material and strength
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 10 to 100. See Spider-mites, p. 3.
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 gals.
	Aphids.	Nicotine sulfate $\frac{3}{4}$ lb. to 100 gals.
3. First fruit spray. As soon as shucks fall.	Cylindrosporium leaf spot and brown-rot.	Use a non-caustic sulfur spray with spreader or sulfur dust. See pp. 16-17.
	Syneta beetle.	Lead arsenate 4 lbs. plus lime 4 lbs. to 100 gal.
4 and 5. About June 1, and July 1.	Cylindrosporium 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	Spray material and strength
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 10 to 100. See Spider-mites, p. 3.
	Bud moth.	Lead arsenate 2 lbs. plus lime 2 lbs. to 100 gals.
3. First fruit spray. As soon as shucks fall.	Peach blight (fruit spot), mildew, or brown-rot.	Use a non-caustic sulfur spray with spreader. See pp. 16-17. 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 gals. with pre-blossom spray (same as No. 2 for prune). Use tanglefoot bands on trees to prevent aphid reinfestation by ants.

Syneta beetle. Lead arsenate 4 lbs. plus lime 4 lbs. to 100 gals. water applied both as a pre-blossom spray and when most of the petals have fallen. If the orchardist has been spraying for syneta beetle for several years experimental tests indicate that the second spray may be omitted.

Cherry fruit maggot. Use sweetened poison spray for adult flies. See special discussion under Cherry Pests, page 8.

Brown-rot (*Monilia*) blossom blight. Same as No. 2 on prune program. If disease is severe repeat when petals fall.

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

Brown-rot on fruit. Use a non-caustic or wettable sulfur spray, see pp. 16-17, one month before picking. Begin earlier if disease shows up sooner and repeat every two or three weeks till a month before picking. Dusting with sulfur when the air is still may be substituted for sprays in warm weather, with good results.

APRICOTS

Brown-rot (*Monilia*) blossom blight. Same as No. 2 on prune program, but where severe it may be necessary to spray again in full bloom and when petals are off. 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 in only 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 later.

Codling-moth. Following the calyx application, the first cover spray (15-30-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 sprays is advisable. Calyx spray on pears is likewise advisable in Southern Oregon.

For the Grand 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 page 5.

Red spider-mites. Use Spray No. 1 in Program I, but note especially discussion of red spider-mites on page 3. Of recent years a summer application of light oil emulsions is proving of value in control of the common red spider-mite on pears.

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 spray. 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 11.

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

Information concerning the preparation of spray materials may be secured by writing to the chemist of the Oregon Agricultural Experiment Station. Effective results in spraying depend to a large extent on the use of proper methods in preparing and combining sprays. (See Oregon Agricultural Experiment Station Circular 68 for information on the proper way to combine sprays.)

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°) when tested by hydrometer

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+	2¾+
26°	1.218	15	10	4	3	2½
24°	1.198	16½—	11	4½—	3½+	2¾
22°	1.179	18½+	12½	4¾+	3¾—	3+
20°	1.160	20¾+	13¾	5½—	4½—	3½

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

Where the powdered or "dry lime-sulfur" is used it will take, according to chemical analysis, 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 sometimes of advantage. Calcium caseinate and skim milk are the "spreaders" in most general use. Such spreaders have not given increased control of codling-moth. Information concerning the use of spreaders in spray combinations is to be found in Oregon Agricultural Experiment Station Circular 68.

Bordeaux mixture is satisfactory when freshly made according to standard methods, as are also some of the "ready mixed" types of commercial bordeaux as they have been prepared very recently, providing casein spreader or some other equally efficient stabilizer is used. There is no need of failure in the preparation of "home-made" bordeaux, but unless properly prepared it may be worse than some ready-made bordeaux.

Powdered bluestone and hydrated lime are sometimes sold in separate packages containing the right amount of each for a tank of spray. Experience shows that it is wise to dissolve the bluestone completely before adding to the tank of dilute milk of lime. The hydrated lime must be fresh when used. It gradually deteriorates by air-slacking if allowed to stand around and thus becomes unsatisfactory for making bordeaux mixture.

Home-made bordeaux must be used promptly after 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.

Non-caustic or wettable sulfur sprays. Within recent years substitutes for lime-sulfur have been devised which do not have the caustic or

burning action of the latter and hence are safer to use on tender-skinned varieties of pears and apples and on stone fruits. These sprays are not very active as fungicides or insecticides when the weather is cool and hence cannot always be relied upon for effective action in the early spring. They are, however, active in warm weather such as may usually be expected from the time the pear and apple blossoms have fallen. They are safe and effective in warm weather in the control of scab, mildew, leaf spot, and brown-rot. It is usually advisable to employ a soap or casein spreader with them unless a spreader is used in the composition. These spray materials are much easier to prepare or use than the old self-boiled lime-sulfur and are to be recommended wherever the latter has been advised in the past. Among these wettable sulfur sprays may be mentioned the well-known Atomic Sulfur (use 12 lbs. to 100 gals.), "Dry-Mix" sulfur and lime, and "Oregon cold-mix" lime and sulfur. To prepare the last named, use superfine sulfur 8 lbs. and hydrated lime 4 lbs. Mix together (thoroughness not required). Pour into the mixture 2 quarts milk (skimmed is entirely satisfactory) and stir into a smooth paste, adding water if too thick, and finally pour through a strainer into spray tank with enough water to make 50 gals. with the amounts of materials mentioned. Other satisfactory materials are now on the market. Self-boiled lime-sulfur has been reported by government workers to cause reduced size in cherries in some seasons and this may prove true of other lime and sulfur mixes.

Oil sprays. The commercial oil emulsions and miscible oils are manufactured from petroleum oils of different degrees of refinement. The so-called "dormant" or "clean-up" oil sprays are made of less highly refined oils. They are accordingly less safe to use on trees in foliage. The so-called "summer" oil sprays are made of the more highly refined petroleum oils. Summer oils apparently are less injurious to foliage and fruit than "dormant" oils. Their use, however, upon apples the last two summers has induced certain effects upon the fruit which have not been sufficiently studied to be adequately understood. The summer oils are proving of value in the control of common red spider on pear without apparent injury to the fruit or foliage.

Care should be exercised to obtain a good quality oil emulsion in order that the oil may be dispersed uniformly throughout the diluted spray. If the oil separates out, injury to the tree will likely follow. *The application of oil sprays during freezing weather or when the temperature is likely to drop to freezing or below, has caused severe damage and even death of the tree.* The use of oil preceding or following a sulfur spray has caused severe burning in many cases.

Spray combinations. Any of the materials mentioned in this spray program in connection with any particular application may be successfully combined except the combination of oil and lime-sulfur. The combination of bordeaux mixture and lime-sulfur should never be used. The best order in which they should be added to the spray tank is given in Oregon Agricultural Experiment Station Circular 68, Sprays, Their Mixing and the Compatibility of Various Combinations, by R. H. Robinson.

Sulfur shock. Under certain climatic conditions if lime-sulfur has not been used on apple trees in the earlier pre-pink or pink applications,

HEIGHT	TOT. APPLES	TOT. SCAB	% SCAB	TOT. AVE. SCAB
15-25 FEET	2278 25.13 %	1042	45.72	22.52%
10-15 FEET	3567 39.56 %	800	22.31	
0-10 FEET	3201 35.29 %	209	6.52	

Spray the top well!

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

Spray the top well!

Distribution of wormy apples in an experimental block sprayed with guns on a 3½ 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.

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 obtained 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. Dusting with finely divided sulfur prepared for orchard use has given good results where properly applied in warm weather for the control of such troubles as brown-rot and powdery mildew. In cool, moist, spring weather it has not proved as effective as the usual liquid sprays for such a trouble as apple scab. No practicable dusting method for the control of such diseases as apple-tree anthracnose or peach blight has so far been demonstrated in Oregon.

For red spider-mites sulfur dusts have not proved as effective as have the standard liquid sprays. Dusting with lead arsenate for codling-moth control has given good results where properly applied. Dormant dusting for scale insects, peach twig miner, and blister-mite control is yet to be demonstrated as effective. In cool, moist spring and early summer weather nicotine dust has not proved as effective as the liquid spray for aphid control. Later in the season when summer temperatures are high nicotine dusting may be used with good results. Wind makes effective dusting impossible.

Spray residue removal. Information concerning the removal of spray residue from the fruit may be obtained by writing to the Chemist of the Oregon Agricultural Experiment Station. (See Oregon Agricultural Experiment Station Bulletin 226.) An application of spray containing an excess of free lime *just* before the fruit is picked will facilitate spray residue removal when washing methods are used.

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 10-11 for guidance.)

Dormant spray (No. 1). Worthless against scab, mildew, worms, or anthracnose. Apply only when scale or blister-mite is 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 arsenate spray for codling-moth worms everywhere. Add a non-caustic or wettable sulfur if scab or mildew is 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 canker 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 pages 11-12 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, on page 12.)

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 13 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 well 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 obtained. Conditions are usually best very early in the morning.

OTHER BULLETINS FOR THE FRUIT GROWER

As long as the supply lasts any of the following publications may be obtained free of charge by any resident of Oregon on application to Oregon State Agricultural College. Complete lists of literature available for free distribution will also be sent on request.

Crop Pests, Diseases, and Spray Materials.

Station Circular 35. The Cherry Fruit Fly.

Station Circular 38. The Peach and Prune Twig-miner.

Station Circular 42. Insect Pests and Diseases of Currants and Gooseberries.

Station Circular 45. Insect Pests and Diseases of Bramble Fruits.

Station Circular 50. Control of the Western Peach and Prune Root-Borer.

Station Circular 53. Brown-rot and Related Diseases of Stone Fruits in Oregon.

Station Circular 59. Apple Blister Mite and Its Control.

Station Circular 65. Insect Pests of Truck and Garden Crops.

Station Circular 70. Cutworm Control in Oregon.

Station Circular 73. Cankers of Apple and Pear in Oregon and Their Control.

Station Circular 79. Strawberry Root-weevils and Their Control in Oregon.

Station Bulletin 214. Blight Resistance in Pears.

Station Bulletin 217. Perennial Canker of Apple Trees.

Station Bulletin 221. Potato Wilt and Its Control.

Station Bulletin 222. European Canker of Pomaceous Fruit Trees.

Station Bulletin 223. The Tree Crickets of Oregon.

Station Bulletin 226. A Progress Report on the Removal of Spray Residue from Apples and Pears.

Extension Bulletin 390. Controlling Rodents and Other Small Animal Pests in Oregon.

Station Circular 84. The Chemical Composition of Insecticides and Fungicides.

Station Circular 68. Sprays, Their Mixing and Compatibility of Various Combinations.

Horticulture.

Extension Bulletin 368. The Long or High Renewal System of Pruning.

Extension Bulletin 384. Grafting and Budding.

Station Circular 32. Strawberries.

Station Circular 48. The Cane Fruit Industry in Oregon.

Station Bulletin 208. Filberts.

Station Bulletin 212. Pollination and Growing of the Cherry.

Station Bulletin 181. Hood River Apple Orchard Management with Special Reference to Yields, Grades, and Value of Fruits.

Station Bulletin 206. Studies Relating to the Harvesting and Storage of Apples and Pears.

Station Bulletin 228. Investigations on the Harvesting and Handling of Bosc Pears from the Rogue River Valley.

Station Circular 75. Studies Relating to the Harvesting of Italian Prunes for Canning and Fresh Fruit Shipment.

Station Bulletin 216. The Control of Core Breakdown in Pears.

Station Bulletin 186. A New Test for Maturity of the Pear.

Station Circular 61. Preliminary Studies Relating to the Harvesting and Canning of Sweet Cherries.

Station Circular 40. Recirculation Driers.

Station Bulletin 205. Drying Prunes in Oregon.

Hood River Report for 1913-14.

Hood River Report for 1914-15.

Miscellaneous.

Extension Bulletin 401. Beekeeping in Oregon.

Station Circular 78. Commercial Fertilizers.

Station Bulletin 213. Common Vetch.

Station Circular 63. Extraction and Clarification of Pectinous Fruit Juices.

Extension Bulletin 373. The Value and Use of Prunes.

Farmers' Bulletin 1471. Canning Fruits and Vegetables at Home.

Note: The Spray Program will not be reprinted until 1930.
Kindly preserve your copy for reference during 1929.

