Orchard Protection Program for Oregon

1931 Revision

By

H. P. Barss, Plant Pathologist

and

Don C. Mote, Entomologist

Oregon Agricultural Experiment Station

Codling-moth injury.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Special Notes on Particular Pests and Diseases</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Pests</td>
<td>5</td>
</tr>
<tr>
<td>San Jose Scale</td>
<td>5</td>
</tr>
<tr>
<td>Red Spider-mites</td>
<td>5</td>
</tr>
<tr>
<td>Aphids or Plant-lice</td>
<td>6</td>
</tr>
<tr>
<td>Pear and Cherry Slug</td>
<td>6</td>
</tr>
<tr>
<td>Bud-moth</td>
<td>6</td>
</tr>
<tr>
<td>Apple and Pear Pests and Diseases</td>
<td>6</td>
</tr>
<tr>
<td>Codling-moth</td>
<td>6</td>
</tr>
<tr>
<td>Apple Aphids</td>
<td>7</td>
</tr>
<tr>
<td>Leaf-rollers</td>
<td>7</td>
</tr>
<tr>
<td>Pear and Apple Fruit-worms</td>
<td>7</td>
</tr>
<tr>
<td>Pear and Apple Leaf Blister-mite</td>
<td>7</td>
</tr>
<tr>
<td>Apple-scab</td>
<td>8</td>
</tr>
<tr>
<td>Pear-scab</td>
<td>8</td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td>8</td>
</tr>
<tr>
<td>Fire Blight</td>
<td>8</td>
</tr>
<tr>
<td>Anthracnose-canker and Fruit Rot</td>
<td>8</td>
</tr>
<tr>
<td>Perennial Canker and Fruit Rot</td>
<td>9</td>
</tr>
<tr>
<td>European Canker</td>
<td>10</td>
</tr>
<tr>
<td>Stone Fruit Pests and Diseases</td>
<td>11</td>
</tr>
<tr>
<td>Pear and Prune Thrips</td>
<td>11</td>
</tr>
<tr>
<td>Brown Peach and Apricot Scale</td>
<td>11</td>
</tr>
<tr>
<td>Western Peach and Prune Root Borer</td>
<td>11</td>
</tr>
<tr>
<td>Prune and Peach Twig Miner</td>
<td>11</td>
</tr>
<tr>
<td>Cherry Fruit Maggot</td>
<td>11</td>
</tr>
<tr>
<td>Syneta Leaf Beetle</td>
<td>12</td>
</tr>
<tr>
<td>Cylindrosporium (Coccomyces) Leaf Spot of Cherry and Prune</td>
<td>12</td>
</tr>
<tr>
<td>Blossom Blight of Cherry, Prune, and Apricot</td>
<td>12</td>
</tr>
<tr>
<td>Peach Blight</td>
<td>13</td>
</tr>
<tr>
<td>Brown-rot</td>
<td>12</td>
</tr>
<tr>
<td>Peach Leaf Curl</td>
<td>13</td>
</tr>
<tr>
<td>Bacterial Gummosis</td>
<td>13</td>
</tr>
</tbody>
</table>
Important Points About Spray Materials ........................................ 13

Effective Results in Spraying ..................................................... 13
The Proportions of Lime-sulfur ................................................... 13
Liquid Lime-sulfur Dilution Table ................................................. 14
Where the Powdered or“Dry Lime-sulfur” is used ............................ 14
The Powdered Form of Lead Arsenate .......................................... 14
Lead Arsenate on Stone Fruits ..................................................... 14
Spreaderers ................................................................................. 14
Bordeaux Mixture ......................................................................... 15
Instant Bordeaux ........................................................................... 15
Non-caustic or Wettable Types of Sulfur Sprays .............................. 15
Oil Sprays .................................................................................... 16
Oil Spray Dilutions ........................................................................ 16
Spray Combinations ..................................................................... 17
Sulfur Shock ................................................................................ 17
Dusting ........................................................................................ 17
Spray Residue Removal .................................................................. 18

Spray Program I (Western Oregon) ................................................. 19
Apples and Pears .......................................................................... 19
Prunes and Plums .......................................................................... 21
Peaches ....................................................................................... 22
Cherries ..................................................................................... 23
Apricots ....................................................................................... 24

Spray Program II (Eastern and Southern Oregon) ......................... 26
Apples and Pears .......................................................................... 26
Peaches ....................................................................................... 27
Cherries ..................................................................................... 27
Apricots ....................................................................................... 27
Prunes and Plums ........................................................................ 27

Protecting the Home Orchard ....................................................... 27
Apples and Pears .......................................................................... 27
Prunes, Plums, and Apricots ......................................................... 28
Peaches ....................................................................................... 28
Cherries ..................................................................................... 28
Dry Lime-sulfur for the Home Orchardist .................................... 28
Dusting the Home Orchard .......................................................... 28

Bulletins for the Fruit Grower ...................................................... 29
Crop Pests, Diseases, and Spray Materials .................................... 29
Horticulture ................................................................................ 30
Miscellaneous ............................................................................ 31
Orchard Protection Program
for Oregon

By
H. P. Barss, Plant Pathologist
and
Don C. Mote, Entomologist

Oregon Agricultural Experiment Station*

On account of the climatic differences existing between the more humid orchard sections west of the Cascade Mountains and the semiarid 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. The full spray program for most of the state west of the Cascades is followed by paragraphs outlining the program for other sections. The spray calendars are preceded by special notes regarding particular diseases and insect pests, and by important suggestions about 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 usually shows a purple stain for a short distance around each scale especially on young trees and new growth. 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.

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 miscible oil diluted to give 4 to 6 percent actual oil, 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

*The authors gratefully acknowledge the contributions of their colleagues to the information presented herein.
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, 1 to 2 gallons to 100 gallons of water, are of value when used as a summer spray for red spider control. See page 16 for discussion of oil sprays. Dusting with sulfur is sometimes effective.

Aphids or plant-lace are particularly a pest of apple and cherry. On these trees the aphid spray of \( \frac{1}{4} \) pint of nicotine sulfate to 100 gallons should usually be applied. This is probably seldom required on other fruits, though in some sections the peach and plum aphids require attention.

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 owing 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, page 14.

APPLE AND PEAR PESTS AND DISEASES

Codling-moth. This is the common pinkish-white worm found in apple and pear fruit. 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 can be made in advance for the season. 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, bait-trap 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. Spray information for codling-moth control is sent out each season from the Central Experiment Station for the Willamette Valley, from the Hood River Experiment Station for the Hood River Valley, and from the Southern Oregon Station for Southern Oregon. Growers who want this information are advised to consult their county agent or nearest experiment station. The Oregon Experiment Station has issued a Circular Letter of Information on Timing Codling-moth Sprays that may also be helpful.

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

An additional cover spray two weeks after the first cover spray is advisable in Southern Oregon and in other 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, like 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. Chemically treated bands may be left until the end of the season. They should then be burned to kill the late fall worms. Increasing the dosage of lead arsenate to three or even four pounds to the hundred gallons is advisable for bad worm infestation.

Experiments are being conducted in Oregon as elsewhere in the Pacific Northwest with possible substitutes for the standard lead-arsenate spray in codling-moth control. Although some of these appear promising, there are certain problems to be met before their general use in Oregon can be recommended.

**Apple aphids.** The degree of success obtained in apple-aphis control with the standard aphid spray of lime-sulfur and nicotine in the pre-pink has not been in all cases satisfactory. Seasonal climatic conditions have a material influence on the development and control of apple aphids. Under Hood River conditions the best time for application is from the "green-tip" to the "early delayed dormant" stage of development of the tree. In the Willamette Valley best results are obtained usually when the spray is applied a few days previous to the "pre-pink" stage. A miscible-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** are small green caterpillars which occur as a major pest only in our more northern and eastern fruit districts. Irregular cavities are chewed in the side of the young fruit. Miscible oil in the early pre-pink (delayed dormant) is the standard control spray. Combining the oil with bordeaux 4-4-50 reduces danger of oil injury and aids in control of scab and anthracnose. 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 obtained 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 and apple fruit-worms.** Two or more species of small green caterpillars attack the 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 fruit, 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.** These microscopic mites produce small, bright-colored, slightly raised blisters on the leaves. The blisters turn brown to black with age. All indications show that the growers generally are not achieving the thoroughness of application 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 during the winter after the majority of the leaves fall. (See Oregon Agricultural Experiment Station Circular 59.)

**Pear and Prune Thrips.** (See page 11.)

**Apple-scab** produces blackish spots on the fruit, turning brown and scabby with age, and on the leaves appears as blackish spots or dusky areas often brown in age. 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 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 next 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** produces a powdery white coating on shoots and leaves. 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. 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. Dusting sulfur properly applied in warm weather gives excellent results against mildew.

**Fire blight.** Cannot be successfully controlled without surgical methods. Send for circular.

**Anthracnose-canker and fruit rot.** This causes elliptical dead spots on bark and circular slow-growing rot spots on fruit after fall rains and in storage.

It may be successfully prevented by a single thorough summer application of bordeaux mixture 4-4-50. It is best combined with the last arsenate spray for worms in August. A thorough application should be
made. In seasons of early fall rains the presence of spray on light-colored varieties may cause some reddish spotting around the lenticels. Such fruit should be picked as early as possible. In orchards which are badly infected the anthracnose fruit rot as well as the canker will be materially decreased by the late bordeaux spray. The residue is readily removed by the acid washing process.

To avoid the presence of bordeaux on the fruit, some growers do not give 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. With the addition of bordeaux both miscible and quick-breaking oils can be used with much less injury to buds and advanced foliage. This spring application of bordeaux must be put on before the fruit buds are much exposed or the fruit may be russeted. The spray must be carefully made and thoroughly applied as it must stay on the trees until fall at which time it becomes effective in controlling anthracnose. Since the spring spray at best will not protect either fruit or new shoot growth it is not recommended in place of the summer spray unless the disease is already well under control. (See Oregon Agricultural Experiment Station Circular 73.)

Perennial canker and fruit rot. This serious wound disease of apples occurs in the Hood River Valley and in localities east of the Cascades. It causes dying back of bark around pruning cuts and other wounds made while the trees are dormant and especially around calluses previously attacked by woolly aphis. The killing back of tissue is most extensive in years when extreme low temperatures come early in the winter and is insignificant in years when winters are mild. Successive advances about original infection centers give impression that the disease is perennial, which is not strictly true. These infections result, however, in large open wounds showing a series of concentric dead calluses. Following fall rains the fungus associated with the disease also causes serious rot infection of fruit which shows up in storage.

It has been demonstrated that attacks on the trunk and main framework can be economically controlled by suitable surgery, wound protection, and prevention of woolly aphis infestation, while fruitfulness can be maintained indefinitely by a careful plan of top renewal. The use of fungicides has proved entirely unsuccessful except in the case of fruit rot, which can be largely prevented by spraying the fruit with bordeaux in late summer. The control program worked out by Leroy Childs, Superintendent of the Hood River Branch Experiment Station, is as follows:

1. Trim back to sound tissue all cankered bark on trunk and framework of tree to a height of six or eight feet. Do this in early summer, preferably June.

2. Allow wounds to heal for 10 to 14 days to prevent paint damage and apply with brush, or better with paint gun, the following mixture: 6 parts Hood River Tree Paint, one part nicotine sulfate. Dilute, if necessary, to right consistency with gasoline. Repaint wounds annually with same material in June (or early July). This prevents woolly aphis infestation through the rest of the season.
3. Delay all pruning until after February 15. Avoid heading-back or making numerous small pruning cuts which are subject to later infection. Thin out trees by removing larger branches, protecting the cuts as directed above.

4. Renew tops of trees by saving one or two upright shoots on each scaffold branch at height of five to eight feet to be used as needed, removing older wood around them from time to time as they develop.

5. After the cankers have been cleaned out and painted in early summer, it is often advisable to spray in midsummer and again in late summer or whenever woolly aphids begin to show up. This spray should consist of 2 pint nicotine sulfate, 1 pound calcium caseinate, 100 gallons water. Three or 4 gallons should be used on each tree directed at the lower inside areas to kill woolly aphids and to prevent infestation of water sprouts.

6. In badly infected orchards, apply bordeaux 4-4-50 in the late August codling-moth spray to prevent fruit rot in storage. Yellow fruit like Newtown or Ortley should be picked as early as possible where bordeaux has been used, in order to avoid red spotting that appears on such sprayed fruit when prolonged rains occur before picking or when picking is delayed. See p. 18 regarding spray removal.

To insure success in perennial canker control every essential step must be followed out each season. Send for Oregon Station Bulletin 243 and for the Station Circular by Leroy Childs on “Perennial Canker and Its Control” which will be published during 1931.

European canker. This disease starts around leaf scars, in winter-injured crotches or pruning cuts. It is especially destructive to pear bark and is occasionally found on apple bark. The bark of newly formed cankers is often soft and oozy in wet weather. Old dead canker bark is rough and cracked. It may fall away and show concentric rings of callus wood beneath. 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 commercial prepared bordeaux powder until a very thick paint is formed. Winter-injured bark is extremely susceptible to infection unless coated with a
fungicide. (For further description see Oregon Agricultural Experiment Station Bulletin 222 or Oregon Agricultural Experiment Station Circular 73.)

STONE FRUIT PESTS AND DISEASES

**Pear and prune thrips.** These tiny insects about 1/20 inch long come from the ground in the early spring (about March 15 to 20) as the buds are swelling and opening. These insects work into the buds before they open and in parts of the Willamette Valley have caused serious bud injury. A spray of oil emulsion, 2 gallons, plus nicotine sulfate, 1 pint to 100 gallons, has proved effective on prunes. Two sprays are given, one when the winter buds are swelling and another when most of the buds are green at the tip. Possibly similar applications might be of value in the control of thrips on cherries. Good pressure and thoroughness in application are essential in thrips control. On pears, 1 pint of nicotine to the 100 gallons, added to the pre-pink and pink lime-sulfur sprays for scab has given encouraging results.

**Brown peach and apricot scale** occurs as a rather large, dark brown, strongly humped scale on the bodies and twigs of prune trees especially in Southern Oregon. The standard method of control is to apply a miscible-oil spray in the early spring as the winter buds are ready to open.

**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. The most satisfactory time for this is from August 15 to September 15. Apply \( \frac{1}{2} \) to one ounce of the chemical in a circular band an inch or two in width and about two inches from tree trunk. This band is covered with several shovelfuls of earth. Tests and observations indicate that it may be used on younger trees without danger to the trees if it is kept at least 2 inches away from the trunk.

**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 are usually 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. 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. Spray information for fruit-fly control is sent out each season from the Oregon Experiment Station. Growers who want this information should consult their county agents. (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. 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. From chemical considerations probably two pounds of lime would be sufficient to protect against arsenical burn. Help in brown-rot blossom blight prevention may be obtained in addition to syneta control if the lead arsenate is added to 4-4-50 bordeaux (without extra lime).

**Cylindrosporium (Coccomyces) leaf spot of cherry and prune** causes small spotting or speckling of leaves and fruit stalks. It may cause leaves to turn yellow and drop early in the season. Fruit may fail to fill out. 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. Leaf spot sprays help control brown-rot.

**Blossom blight of cherry, prune, and apricot** causes blossoms to turn brown and die. Certain varieties of pears and plums are also subject to this disease, caused by the common American brown-rot or by the European brown-rot. The best single control application is a spray of bordeaux, 4-4-50, given just as the first blossoms are beginning to open. Lime-sulfur, 3 gallons to 100 gallons, may be used but is usually not quite equal in effectiveness. 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** of fruit causes brown decay followed by gray spore dust on fruit surface. Spread 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 in hot spring or summer weather. Bordeaux mixture is effective in cool, damp weather, but may cause reduction in fruit size. As the weather gets warmer and drier, sulfur fungicides are likely to give better control than bordeaux.
It is wise to spray or dust as insurance whenever brown-rot seems to be getting a start in the orchard. An application about three or four weeks before picking will materially reduce harvest attacks but in some seasons earlier applications should be given.

Clean-up measures are of value against brown-rot but cannot be depended upon alone. Plowing early and harrowing every week during the blossoming period will help to reduce early attacks by destroying the spore cups of the fungus on the ground. Mummies hanging in the trees cause infection and 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.)

Pruning trees so as to open them up to light and air helps in brown-rot control and also makes possible more effective spraying.

**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. Bordeaux 4-4-50, applied in late summer before the fall rains, is an effective protection 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 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 or January. Later applications are a gamble. Lime-sulfur sometimes produces good results, but bordeaux has proved by far the most reliable material for Oregon.

**Bacterial gummosis** of cherry and other stone fruits causes large trunk and limb cankers on young trees and sometimes spur blight. Unknown east of Cascades where gumming is due to other causes. It 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 resistant seedling stock. Seedlings are not always resistant. Send for special circular on bacterial gummosis.

**IMPORTANT POINTS ABOUT SPRAY MATERIALS**

Effective results in spraying depend to a large extent on the use of proper methods in preparing, diluting and combining sprays. Send for Oregon Agricultural Experiment Station Bulletin 259 for information on the preparation of sprays and Oregon Agricultural Experiment Station Circular 68 for information on safe and unsafe ways of combining 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°F by Baume 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 accompanying Liquid Lime-Sulfur Dilution Table.
LIQUID LIME-SULFUR DILUTION TABLE

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

<table>
<thead>
<tr>
<th>Strength of stock solution</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degrees Baumé</td>
<td>Specific gravity</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>34°</td>
<td>1.304</td>
</tr>
<tr>
<td>32°</td>
<td>1.282</td>
</tr>
<tr>
<td>30°</td>
<td>1.260</td>
</tr>
<tr>
<td>28°</td>
<td>1.239</td>
</tr>
<tr>
<td>26°</td>
<td>1.218</td>
</tr>
<tr>
<td>24°</td>
<td>1.198</td>
</tr>
<tr>
<td>22°</td>
<td>1.179</td>
</tr>
<tr>
<td>20°</td>
<td>1.160</td>
</tr>
</tbody>
</table>

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.

Lead arsenate on stone fruits. There is a reasonable element of danger of burn in applying ordinary commercial lead arsenate to stone fruits. The basic or triplumbic lead is preferable. 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. The addition of some hydrated lime reduces the chance of burn to a minimum.

Spreaders. Materials used with a fungicide or insecticide spray to increase the spreading and adhesive powers are sometimes of advantage.
as wetting agents but frequently do not increase the fungicidal or insecti-

cidal value. Information concerning the way spreaders should be added in

spray combinations is to be found in Oregon Agricultural Experiment

Station Circular 68.

**Bordeaux mixture** of the highest quality can be made by the grower if

standard methods are followed, (see Oregon Agricultural Experiment Sta-

tion Bulletin 259 for details), but slip-shod methods give poor results. No

commercial powdered bordeaux has thus far been found superior to the

best home-made material although satisfactory commercial products are

being manufactured. Different brands, however, differ in quality and there

is evidence that deterioration may sometimes take place in storage. In

general they cost more than the home-made spray. Home-made bordeaux

must be used promptly unless a stabilizer is added as otherwise it soon

starts to deteriorate.

**Instant bordeaux.** Where the grower makes his spray up in the sprayer

tank using hydrated lime and pulverized bluestone separately, experience

shows that it is wise to dissolve the bluestone completely before adding it
to the tank of dilute milk of lime. The lime must be fresh when used since

it will air-slake if left standing around and then will not make bordeaux of

satisfactory quality. It is reported that somewhat better quality bordeaux

results where hydrated lime is soaked in water over night instead of wash-
ing the dry powder through the strainer when making the spray.

**Non-caustic or wettable types of sulfur sprays.** Within recent years

substitutes for ordinary liquid lime-sulfur and dry lime-sulfur have been

devised which do not have the caustic or burning action of lime-sulfur and

hence are safer to use on tender-skinned varieties of pears and apples and

on stone fruits. Most of these sprays are not so active as fungicides or

insecticides when the weather is cool and rainy 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 for the control of scab, mildew, leaf spot, and brown-rot. It is usual-

ly advisable to employ a spreader with them unless a spreader is used in the

manufacture. 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 the non-caustic types of sulfur sprays are: (1) Those pastes and

powders which consist of sulfur dust with or without hydrated lime pres-

cent and containing some material like casein or a clay which makes the

sulfur “wettable.” To this class belong the “dry mix” or “cold mix” type of

spray (see Oregon Agricultural Experiment Station Bulletin 259) and

many commercial preparations. (2) Those in which the sulfur is present

in colloidal form or as chemically precipitated particles. Some of these are

by-products of gas manufacture and appear promising. (3) Calcium mono-
sulfide, a material recently developed in the Eastern United States, which

appears to give excellent control of certain fungous diseases without
danger of burning in hot weather.

These preparations are added to the water in the spray tank. The

manufacturer's directions or published instructions should be followed, in
general, in determining the quantities of material to be used. During very
warm weather the presence of lime with the sulfur gives some protection from the danger of sulfur burn. In cool weather, however, the presence of any considerable proportion of lime may somewhat reduce fungicidal activity.

The comparative merits and limitations of these various kinds of non-caustic sulfur sprays have not as yet been tested out under Oregon conditions but the experience of growers thus far would lead to the expectation of good brown-rot control, at least, from any of them in warm weather.

**Oil sprays.** Great care should be exercised in the selection of the correct oil spray for the specific purpose needed. There are two contrasting types of oil sprays; those used for dormant sprays and those classified as summer oil sprays. Of the dormant oil sprays there are two contrasting types of emulsions: the miscible oil and the so-called quick-breaking oil emulsion. At present it is recommended that the commercial oil classified as miscible oil (50-70 sulfonation test, 100 to 220 viscosity) be used for all dormant spraying. To avoid injury, dormant oil sprays should be applied in the spring before the bud scales separate and before the buds show green. Injury may result if dormant oil sprays (4 gallons or more to 100 gallons of water) are applied during the critical period (delayed dormant) of bud development. This period occurs between the time the buds first show green and the cluster bud stage (pre-pink). In the Hood River Valley, however, miscible oils, where used for the control of leaf roller, have not ordinarily caused injury during this period when combined with bordeaux mixture.

In the use of summer oils the orchardist must know specifically what types of oils are suited for different purposes. If there is a question in his mind regarding the type of oil to buy, he should consult the nearest Experiment Station or county agent for definite information. The choice of the wrong oil may result in injury to fruit, burning of foliage, complications in the removal of the spray residue and in a general lowering of the vitality of the tree. The only specifications given here are for oils that may be used for the two following purposes; namely, for red spider control on pears and apples and for use in combination with lead arsenate in the control of the codling-moth. For these purposes an oil should be used having a viscosity between 60 and 65 and a purity test, commonly referred to as sulfonation test, of 85. This oil spray may be applied as late as July 15 for red spider control, but if it is necessary to use the spray after that date an oil spray should be selected having a similar sulfonation test of 85 but a viscosity of 55. This recommendation applies to pears and to apples other than Newtown apples. When oil sprays are to be used on Newtown apples, the viscosity test should never be more than 55 and the sulfonation test 85.

Oil sprays should not be used on foliage that has received previously an application of any sulfur-containing spray or sulfur dust. Unless six weeks is allowed to elapse between the date of the sulfur spray and the oil spray, severe burning will usually occur.

**Oil spray dilutions.** Commercial oil emulsions vary greatly in the amount of oil which they contain. The effectiveness of the diluted spray depends primarily upon its actual oil content. Hence all of the recommen-
dations in this Bulletin give the percentage of actual oil to be used. The proportion of oil in any commercial emulsion is or should be marked on the container. In order that the grower may know how much of the emulsion to use for every one hundred gallons of spray, the accompanying table is given, which specifies the amount in gallons and quarts required for commercial emulsions containing different percentages of oil. The figures give the amount to the nearest fraction of a quart, which is sufficiently close for all practical purposes. For emulsions carrying percentages of oil different from those listed, the grower should use correspondingly a little more or a little less than the nearest figures given.

**OIL SPRAY DILUTION TABLE**

<table>
<thead>
<tr>
<th>Percentage of oil in concentrated emulsion</th>
<th>70%</th>
<th>75%</th>
<th>80%</th>
<th>85%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gal. &amp; Qt.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 percent</td>
<td>1 &amp; 2</td>
<td>1 &amp; 1 1/2</td>
<td>1 &amp; 1</td>
<td>1 &amp; 3/4</td>
</tr>
<tr>
<td>2 percent</td>
<td>2 &amp; 3/4</td>
<td>2 &amp; 2 1/2</td>
<td>2 &amp; 2</td>
<td>2 &amp; 1 1/4</td>
</tr>
<tr>
<td>3 percent</td>
<td>4 &amp; 1 1/2</td>
<td>4 &amp; -</td>
<td>3 &amp; 3</td>
<td>3 &amp; 2</td>
</tr>
<tr>
<td>4 percent</td>
<td>5 &amp; 3 1/4</td>
<td>5 &amp; 1 1/4</td>
<td>5 &amp; -</td>
<td>4 &amp; 2 1/4</td>
</tr>
<tr>
<td>5 percent</td>
<td>7 &amp; 1 1/2</td>
<td>6 &amp; 2 1/2</td>
<td>6 &amp; 1</td>
<td>5 &amp; 3 1/2</td>
</tr>
<tr>
<td>6 percent</td>
<td>8 &amp; 2 1/2</td>
<td>8 &amp; -</td>
<td>7 &amp; 2</td>
<td>7 &amp; -</td>
</tr>
</tbody>
</table>

**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, 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. The dust should be fine enough so that practically all will pass through a sieve with 300 meshes to the inch. To prevent the particles from clumping some other material like hydrated lime or lead arsenate should be present in small amount, otherwise the covering power and spread are not satisfactory. In cool, moist, spring weather dusting 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 in certain districts when 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.

Effective dusting is impossible unless the air is perfectly quiet as in the early morning.

Spray residue removal. Information concerning the removal of spray residue from fruit may be obtained by writing the Oregon Agricultural Experiment Station (see Oregon Agricultural Experiment Station Bulletins 226 and 234). If two pounds of hydrated lime to each 200 gallons of spray are added to the last codling-moth cover spray, it will facilitate the removal of the spray residue by the hydrochloric acid washing process. When, for control of anthracnose canker or fruit rot, it is necessary to combine 4-4-50 bordeaux mixture with the last lead-arsenate cover spray, the lime may be omitted. If the bordeaux mixture is home-made it likewise will facilitate the removal of the residue when used in combination spray with lead arsenate.

For the year 1931, the United States health authorities have reduced the spray residue limit to a little more than .01 grain arsenous oxide per pound of fruit. This means that wherever two or more lead-arsenate cover sprays are used it will be necessary to wash fruit by an effective process before the fruit may be legally sold in this or any other country. Orchardists are advised to harvest their fruit at the proper time and not allow it to remain on the trees until excessive amounts of wax form since this prevents the removal of the residue. The fruit should be washed immediately after harvesting.
### SPRAY PROGRAM I

For humid sections of Oregon west of the Cascades

**Time of application** | **Pest or disease** | **Spray material and strength**
--- | --- | ---
1. Dormant spray. As winter buds swell just before opening. | San Jose scale, blistermite and spider-mites, except common red spider-mite. | Lime-sulfur 12 to 100, or miscible oil diluted to give 4 to 6 percent actual oil. (See p. 16.)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple leaf-roller (see p. 7).</td>
<td>Use miscible oil as above or bordeaux oil.</td>
</tr>
<tr>
<td>Apple scab.</td>
<td>Plow under old leaves.</td>
</tr>
</tbody>
</table>

2. Pre-pink spray. Little leaves separating just enough to expose blossom bud cluster. | Scab and powdery mildew. | Lime-sulfur 3½ to 100. |

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pear thrips.</td>
<td>1 pint nicotine sulfate to 100 gallons of spray.</td>
</tr>
<tr>
<td>Aphids on apples.</td>
<td>Add nicotine sulfate 2 pint to 100 gallons of spray.</td>
</tr>
</tbody>
</table>
Pink or pre-blossom spray. Just before blossoms open.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Pest</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calyx spray</td>
<td>Petals off, calyx lobes open</td>
<td>Scab and mildew</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pear thrips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruit worms and bud moth</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Stage</th>
<th>Pest</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calyx spray</td>
<td>Scab and mildew</td>
<td>Lime-sulfur 2½ to 100.*</td>
</tr>
<tr>
<td></td>
<td>Codling-moth. (On apple only.)</td>
<td>Lead arsenate 2 or 3 pounds to 100 gallons.</td>
</tr>
<tr>
<td></td>
<td>Leaf-roller where infestation is moderate (see p. 7).</td>
<td>Lead arsenate 4 pounds to 100 gallons.</td>
</tr>
<tr>
<td></td>
<td>Fruit worms</td>
<td>Lead arsenate 3 or 4 pounds to 100 gallons if omitted in pink spray.</td>
</tr>
</tbody>
</table>

Fifteen-day spray. About fifteen days after petals fall.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Pest</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fifteen-day spray</td>
<td>Scab and mildew</td>
<td>Lime-sulfur 2 to 100.*</td>
</tr>
<tr>
<td></td>
<td>Pear slug</td>
<td>Lead arsenate 2 pounds to 100 gallons.</td>
</tr>
</tbody>
</table>

*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 any reliable non-caustic or “wettable” sulfur spray or sulfur dust. See p. 15.
### ORCHARD PROTECTION PROGRAM FOR OREGON

<table>
<thead>
<tr>
<th>Time of application</th>
<th>Pest or disease</th>
<th>Spray material and strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6. First cover spray</strong> for worms. Three to five weeks after petals fall.</td>
<td>Codling-moth (see p. 6).</td>
<td>Lead arsenate 2 or 3 pounds to 100 gallons.</td>
</tr>
<tr>
<td></td>
<td>Scab and mildew.</td>
<td>Non-caustic or wettable sulfur spray, see p. 15.</td>
</tr>
<tr>
<td><strong>7. July spray.</strong> July 10 to 25 depending on locality and season.</td>
<td>Codling-moth.</td>
<td>Lead arsenate 2 or 3 pounds to 100 gallons.</td>
</tr>
<tr>
<td><strong>8. August spray.</strong> August 10 to Sept. 5, depending on season and locality.</td>
<td>Codling-moth (may usually be omitted on pear).</td>
<td>Same as for No. 7.</td>
</tr>
</tbody>
</table>

### PRUNES AND PLUMS

(Continued)

<table>
<thead>
<tr>
<th>Time of application</th>
<th>Pest or disease</th>
<th>Spray material and strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Dormant spray.</strong> As winter buds are ready to open.</td>
<td>San Jose scale, spider-mite, twig miner, except common red spider-mite.</td>
<td>Lime-sulfur 12 to 100. If scale is absent dilute 10 to 100. See Spider-mites, p. 5.</td>
</tr>
<tr>
<td></td>
<td>Brown apricot scale.</td>
<td>Miscible oil diluted to give 4 to 6 percent actual oil. (See p. 16.)</td>
</tr>
<tr>
<td></td>
<td>Thrips.</td>
<td>Miscible oil 2 gallons and nicotine sulfate 1 pint to 100 gallons of water.</td>
</tr>
<tr>
<td><strong>2. Green tip spray.</strong> Most of buds green at tip.</td>
<td>Thrips.</td>
<td>Miscible oil 2 gallons and nicotine sulfate 1 pint to 100 gallons of water.</td>
</tr>
<tr>
<td></td>
<td>Bud moth.</td>
<td>Lead arsenate 3 or 4 pounds plus hydrated lime 2 pounds to 100 gallons.</td>
</tr>
<tr>
<td></td>
<td>Aphids.</td>
<td>Nicotine sulfate ½ pint to 100 gallons.</td>
</tr>
</tbody>
</table>
### PEACHES

<table>
<thead>
<tr>
<th>Time of application</th>
<th>Pest or disease</th>
<th>Spray material and strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Leaf curl spray.</strong> December or January.</td>
<td>Peach leaf curl.</td>
<td>Bordeaux mixture 6-6-50. Cover every bud.</td>
</tr>
<tr>
<td>2. <strong>Late dormant spray.</strong> Just as first buds are ready to open.</td>
<td>Peach twig miner, San Jose scale, spider-mite, except common red spider-mite.</td>
<td>Lime-sulfur 12 to 100. If scale is absent dilute 10 to 100. See Spider-mite, p. 5.</td>
</tr>
<tr>
<td>3. <strong>First fruit spray.</strong> As soon as shucks fall.</td>
<td>Peach blight (fruit spot), mildew, or brown-rot.</td>
<td>Use a non-caustic type of sulfur spray. See p. 15. If bad repeat once or twice at 2- or 3-week intervals.</td>
</tr>
<tr>
<td>4. <strong>Summer sprays.</strong> Whenever disease appears and a month before picking.</td>
<td>Brown-rot.</td>
<td>Same as No. 3 or use dusting sulfur, applied when the air is still.</td>
</tr>
<tr>
<td>5. <strong>Early fall spray.</strong> As soon as each variety is picked.</td>
<td>Peach blight and die back.</td>
<td>Bordeaux 4-4-50. Cover every bud.</td>
</tr>
<tr>
<td>Time of application</td>
<td>Pest or disease</td>
<td>Spray material and strength</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>1. Dormant spray.</strong> As winter buds are about ready to open.</td>
<td>San Jose scale, European red mite and brown mite (but not common red spidermite).</td>
<td>Lime-sulfur 12 to 100 or miscible oil diluted to give 4 to 6 percent actual oil. See p. 16.</td>
</tr>
<tr>
<td></td>
<td>Leaf spot (Cylindrosporium).</td>
<td>Plow under old leaves before bloom starts.</td>
</tr>
<tr>
<td><strong>2. Pre-blossom spray.</strong> Blossom buds white just before opening.</td>
<td>Brown-rot blossom blight (Monilia).</td>
<td>Bordeaux 4-4-50. (See p. 12 regarding clean-up measures.)</td>
</tr>
<tr>
<td>Syneta beetle. Bud moth.</td>
<td>Lead arsenate 4 pounds plus hydrated lime 2 pounds to 100 gallons of water or bordeaux.</td>
<td></td>
</tr>
<tr>
<td>Aphids.</td>
<td>Add nicotine sulfate 1 pint to 100 gallons.</td>
<td></td>
</tr>
<tr>
<td><strong>3. Petal-fall spray.</strong> When most of petals have fallen.</td>
<td>Brown-rot blossom blight.</td>
<td>Same as in No. 2.</td>
</tr>
<tr>
<td>Syneta beetle.</td>
<td>Same as in No. 2.</td>
<td></td>
</tr>
<tr>
<td><strong>4. Shuck-fall spray.</strong> As soon as shucks fall from fruit.</td>
<td>Leaf spot (Cylindrosporium) and brown-rot.</td>
<td>Any non-caustic type of sulfur spray. See p. 15 or dust with 300-mesh sulfur in still air.</td>
</tr>
<tr>
<td><strong>5. Later sprays.</strong></td>
<td>Brown-rot and leaf spot.</td>
<td>Same as in No. 4. Apply at least every 3 or 4 weeks where these are serious. Give a last application 2 or 3 weeks before picking.</td>
</tr>
<tr>
<td>Cherry fruit maggot.</td>
<td>See p. 11. Use sweetened poison bait spray 1 pint per tree on leaves, first, when Royal Anns show good color; second, ten days later; third, a week after second. Repeat immediately after rain. (Do not combine with other sprays).</td>
<td></td>
</tr>
</tbody>
</table>
APRICOTS

**Brown-rot (Monilia) blossom blight.** Same as No. 3 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 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.

<table>
<thead>
<tr>
<th>Height (feet)</th>
<th>Number</th>
<th>Total</th>
<th>% Scab</th>
<th>Total Average Scab</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12</td>
<td>1020</td>
<td>15</td>
<td>1.46%</td>
<td></td>
</tr>
<tr>
<td>12-22</td>
<td>904</td>
<td>33</td>
<td>3.6%</td>
<td>3.41%</td>
</tr>
<tr>
<td>22-28</td>
<td>123</td>
<td>22</td>
<td>17.8%</td>
<td></td>
</tr>
</tbody>
</table>

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.
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, 4, and 5 in Program I for apples or pears. See page 17 regarding danger of sulfur shock.

Powdery mildew. Use applications Nos. 2, 3, 4, and 5 in Program I for apples. In warm weather use a non-caustic type of sulfur spray. See page 15. Supplement by winter and summer pruning out. The “Pink” spray is most important to avoid sulfur shock later.

Codling-moth. Use lead arsenate 2 to 4 pounds to 100 gallons, beginning with the “calyx” spray. Time by the recommendation of the local spray service. Where this is not available adopt the following program. Following the calyx application, the first cover spray (15- to 30-day) is applied just before first worms hatch. In general this will be earlier than for the Willamette Valley 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. Send for Oregon Station Circular Letter of Information, Timing Codling-moth Sprays.

For Southern Oregon one or two additional cover sprays are often necessary. In this locality lead arsenate 3 pounds to 100 gallons in all sprays is advisable. Calyx spray on pears is likewise advisable in Southern Oregon, but may be delayed somewhat for pear slug control. For pears three cover sprays are usually sufficient. The exact time of application is given out by the County Agent and the Branch Experiment Station.

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 7.

Red spider-mites. Use Spray No. 1 in Program I, but note especially discussion of red spider-mites on page 5. Summer applications of light oil emulsions give best results in control of the common red spider-mite on pears. Consult nearest experiment station or county agent on use of oils and timing of sprays. (See page 16.)

Blister-mite. Use Spray No. 1 in Program I. Take care to get application on before winter buds open.

Leaf-rollers, fruit-worms, San Jose scale, aphids. Follow Program I for these insects. Lime-sulfur may be used for scale control in the fall where later applications are difficult. Dormant oils are not advised on Winter Nelis pears in Southern Oregon.
PEACHES

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

CHERRIES

Usually no fungous diseases requiring spray are found in these localities. Insects in general would require no regular program of spray. For specific pests follow Program I for cherry and see page 5 regarding spider-mites.

APRICOTS

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

PRUNES AND PLUMS

As a rule there are no fungous diseases requiring spray in these districts.

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

PROTECTING 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 19-20.)

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 ½ 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.
First cover 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.

Midsummer 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 21 and 24.)

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 brown-rot.

PEACHES
(See Program I, on page 22.)

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.

Brown-rot sprays (No. 4). This will help against powdery mildew also.

CHERRIES

See spray program on page 23 and apply such sprays or dust as the pests present and the season seem to warrant.

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 about 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, an unpleasant task. Where trees are in close proximity to a building, the spray may cause injury to the paint, etc. Hence dusting may prove for many the more acceptable form of application. Dust outfits of the knapsack type serve very well for a few trees; they are comparatively inexpensive, of simple con-
struction, and handy. Substitutes for spray materials are, for the most part, available in the dust form. 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.

**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 39. Tree Borers and Their Control.
Station Circular 42. Insect Pests and Diseases of Currants and Gooseberries.
Station Circular 45. Insect Pests and Diseases of Bramble Fruits.
Station Circular 59. Apple Blister-mite and Its Control.
Station Circular 68. Sprays, Their Mixing and the Compatability of Various Combinations.
Station Circular 70. Cutworm Control in Oregon.
Station Circular 73. Cankers of Apple and Pear in Oregon and Their Control.
Station Circular 95. The Chemical Composition of Insecticides and Fungicides.
Station Bulletin 223. The Tree Crickets of Oregon.
Station Bulletin 242. The Occurrence and Prevention of Calyx Injury in Apples from the Hood River Valley.
Station Bulletin 243. The Relation of Woolly Apple Aphis to Perennial Canker Infection with Other Notes on the Disease.
Station Bulletin 259. Sprays, Their Preparation and Use.
Horticulture

Station Circular 40. Recirculation Driers.
Station Circular 48. The Cane Fruit Industry in Oregon.
Station Circular 76. Apple Thinning in Hood River Valley.
Station Circular 82. A Method for Testing Moisture in Dried Prunes.
Station Circular 91. English Walnut Production in Oregon.
Station Circular 92. The Oregon Apple-washer.
Station Bulletin 186. A New Test for Maturity of the Pear.
Station Bulletin 205. Drying Prunes in Oregon.
Station Bulletin 216. The Control of Core Break-down in Pears.
Station Bulletin 225. The Cranberry in Oregon.
Station Bulletin 227. Walnut Drying and Packing in Oregon.
Station Bulletin 228. Investigations on the Harvesting and Handling of Bosc Pears from the Rogue River Valley.
Station Bulletin 234. The Removal of Spray Residue from Apples and Pears.
Station Bulletin 239. Pollination Study of the Anjou Pear in Hood River Valley.
Station Bulletin 244. Oregon Apple Prices by Variety, Grade, and Size.
Station Bulletin 249. The Chemical Composition and Food Value of Oregon Dried Prunes.
Station Bulletin 252. Studies of Factors Influencing Separation of Dried Prunes into Quality Grades.
Station Bulletin 254. Further Investigations on the Harvesting, Storing, and Ripening of Pears from Rogue River Valley.
Station Bulletin 263. The Market Situation and Outlook for the Oregon Canned Fresh Prune.

Hood River Report for 1913-14.
Extension Bulletin 368. The Long or High Renewal System of Pruning.

**Miscellaneous**

Station Circular 63. Extraction and Clarification of Pectinous Fruit Juices.
Extension Bulletin 373. The Value and Use of Prunes.
Note: The Spray Program will not be reprinted for two or three years. Kindly preserve your copy for future reference.