How and When to Spray the Orchard

BY

H. S. JACKSON, Plant Pathologist,
and
H. F. WILSON, Entomologist.
Oregon Experiment Station.

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DEPARTMENT OF

Botany and Plant Pathology

H. S. Jackson, Botanist and Plant Pathologist.
H. P. Barss, Assistant Professor (Research).
W. E. Lawrence, Instructor.
F. D. Bailey, Research Assistant.
E. P. Walls, Instructor.
C. E. Owens, Instructor.
W. M. Atwood, Instructor.
J. R. Winston, Plant Pathologist, Hood River Experiment Station.
G. H. Godfrey, Assistant (Research).

Department of Entomology

H. F. Wilson, Entomologist.
V. I. Safro, Assistant Professor.
A. L. Lovett, Assistant.
HOW AND WHEN TO SPRAY THE ORCHARD.

GENERAL NOTES ON SPRAYING.

That spraying for insect pests and fungous diseases must be made a part of general orchard practice if success is to follow this line of agriculture, is rapidly being learned by fruit growers in all parts of the world. It should be understood, however, that spraying is neither a preventive nor a cure for everything. There are many diseases and insect pests of orchard crops which must be combated in some other way than spraying and there are still important troubles for which no definite remedy has yet been devised.

It is not essential that the grower familiarize himself with a great number of sprays; but he should be familiar with, and be able to prepare and apply, a few standard remedies, which, if properly used, will give the greatest possible efficiency with the least cost for materials and labor.

It is highly important that spraying for any pest be done at the proper time with the right spray. Each pest, whether a fungus or an insect, has its own particular life history and a definite time at which it attacks plants. This life history determines the method of treatment, consequently every grower must study orchard conditions in his district and must be familiar with the pests which occur in his district in order that he may practice the proper method of control.

The proper spray applied out of season will not be effective; neither will the wrong spray applied at the right season for some particular pest, be effective. It is useless to expect one application with any spray mixture to prove effective for all kinds of pests. In general, while a few remedies have more or less effect both against insects and fungous diseases, it is folly to expect every fungicide to be of use in the control of insect pests, or every insecticide to be of value for the control of fungous diseases. The information as to the proper time to spray and the proper sprays to use, should be obtained from reliable sources, and the recommendations thus given should be the result of careful experimentation.

It is important that pure and fresh materials be used. It is better, in general, for the grower to mix his own sprays than to buy ready made mixtures. It is highly important, however, that the mixtures be prepared correctly, carefully following directions. It is also important that the spraying
be carefully and thoroughly done. Do not economize on spray. A mixture should be very carefully made, and in applying it, every portion of the tree should be covered. With the possible exception of the calyx spray for codling moth, it is in general best to use nozzles that will give a fine mist-like spray. High pressure of 200 pounds is generally preferable to a low pressure.

INSECTICIDES.

Generally speaking, the term insecticide is applied to those substances which will destroy insects or prevent their attacking plants. Insects are defined as air breathing members of the animal kingdom, having three distinct divisions of the body—head, thorax, abdomen—and with one pair of antennae and three pairs of legs in the adult stage. Most insects are produced from eggs either in or outside the body of the female. Some few are produced by a budding process inside the parent. All insects are developed in such a way that their mouth parts are modified for eating or sucking. This being true, insecticides may then be divided into—

1. Contact insecticides for sucking insects.
2. Food poisons for tissue eating insects.

CONTACT INSECTICIDES.

The contact insecticides in common use are:

Lime-sulfur. (See under Combination Sprays).

Black Leaf-40 is a commercial spray made by the Kentucky Tobacco Products Company, Louisville, Kentucky. When diluted with water, one part to 1000 parts of water or to 1200 parts of diluted lime-sulfur spray, it makes a very efficient spray against plant lice, scale insects, etc.

Soluble Sulfur compound is a comparatively new spray that is now being sold throughout the United States and Canada and is claimed to have the same insecticidal and fungicidal values as lime-sulfur. The Entomological Department has in a limited way tried the spray against San Jose scale and found it to be efficient where used. For lack of experimental evidence, no other recommendations can be given at this time. It should be pointed out, however, that because of the similarity in composition between this substance and lime-sulfur, grow-
ers should not assume that one can in all cases replace the other.

Atomic Sulfur, a spray used primarily for fungous diseases, is said to have insecticidal value and may be used for different spider mites.

Pyrethrum is a powder made from the flowers of the pyrethrum plant. It can be used either as a powder or with water as a carrier, and can be secured at the drug store or from your local insecticide dealer. When used with water, add one pound to each fifty gallons of water. It can be used against pear and cherry slug if the use of poison is undesirable.

Kerosene Emulsion, one of the oldest sprays, is always satisfactory if the materials used in making it are good and the emulsion is properly made. This is usually prepared as a stock solution and then diluted to the required strength for spraying. The necessary materials are as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whale oil soap</td>
<td>1/2 pound</td>
</tr>
<tr>
<td>Water</td>
<td>1 gallon</td>
</tr>
<tr>
<td>Kerosene</td>
<td>2 gallons</td>
</tr>
</tbody>
</table>

The soap should be dissolved in boiling water, and when thoroughly dissolved, the containing vessel should be removed from the fire and the kerosene added. The mixture should then be thoroughly agitated until it is creamy white. This is best done by a hand-pump, forcing the mixture through the hose and back into the container. This then forms three gallons of stock solution which can be diluted to the required strength by adding given amounts of water. To get the amount for any given percentage, divide 200 by the percent, subtract three from the answer, and this gives the amount of water necessary to add to each three gallons of stock solution for the percent.

Example: We desire a 15% solution.

\[ \frac{200}{15} = 13 \frac{1}{3} \]

\[ 13 \times 3 - 3 = 10 \times 3 \]

1-3—3=10 1-3 gallons of water to be added to three gallons of stock solution to get a 15% solution.

Crude Oil Emulsion. This spray is made somewhat similar to kerosene emulsion, except that liquid whale oil or fish oil soap should always be used. Making upon a basis of 200 gallons, fill the spray tank with 175 gallons of water and add
three gallons of soap. Agitate until the soap is well dissolved. Then, keeping the agitator going, add 25 gallons of crude oil. If the liquid soap cannot be bought, it is easily made as follows:

Dissolve three pounds of lye in ten gallons of water and as soon as the latter boils, add ten pounds of hard whale oil soap. When the soap is entirely dissolved it may be used at once for forming an emulsion.

Distillate Oil Emulsion is a spray not yet commonly used in Oregon, but well known in California, where it is combined with Black Leaf-40 for pear thrips. It is made as follows: Dissolve thirty pounds of whale oil soap in twelve gallons of boiling water, and add twenty gallons of distillate (28 degrees Baume) while still hot. Mix thoroughly to make a complete emulsion. For use, add twenty gallons of water to each gallon of stock solution.

FOOD POISONS.

The Food Poisons for biting insects are usually arsenicals and are at the present time used in the form of arsenate of lead and arsenate of zinc.

Arsenate of Lead. Of the various spray materials that have been used in combating the codling moth and the various leaf eating insects, arsenate of lead is now the standard. Competition has compelled the manufacturers to improve their spray chemicals to the highest possible point of perfection; and arsenate of lead has passed through a strenuous development from the crude home-made product to the almost perfect manufactured article of today.

This does not mean that all brands have reached perfection, nor does it mean that somewhat imperfect brands are not satisfactory in codling moth control. There are two different known arsenates of lead used in insect control and most commercial brands are a mixture of these two. These conditions will, no doubt, account for the variable results obtained. Just why we should have two kinds of the same material is a chemical problem which we will not attempt to explain. It is enough to say that by manipulation of the chemicals used, two stable compounds are produced with distinct amounts of arsenic in each. They are known under various names as acid and as neutral, or non-acid, arsenates of lead; but all of these names are misleading to the fruit grower, because of the suggested presence of an acid of some kind, which is not the case.
In our work at the Oregon Experiment Station, we now designate them as lead hydrogen arsenate and basic arsenate. The principal difference between the two is that chemically pure lead hydrogen arsenate contains approximately 33 per cent, and basic arsenate of lead contains approximately 25 per cent arsenic oxide, the active killing agent. In comparing the two kinds, we have found that the lead hydrogen arsenate is superior in many ways to the basic form. The main point in favor of the latter is the fact that it can be added to lime-sulfur with less decomposition and supposed loss of efficiency than in the case of the other.

No one has yet demonstrated that there is a loss of efficiency in a combination of the lead hydrogen arsenate, although it is well known that there is a greater apparent chemical decomposition. Experiments conducted at Corvallis during the past summer show that the latter is quicker acting than the basic and that it is also much more finely divided than the basic form and will stand in suspension much longer. Our work also showed that in combination with lime-sulfur and in strengths containing equal percentages of arsenic oxide, the lead hydrogen arsenate was as efficient, or more efficient, than the basic. (This does not mean that the former combination is recommended for orchard practice.)

Considerable experimental work yet remains to be done with both of these sprays in order to determine their limitations. But except in cases where provided otherwise, the lead hydrogen arsenate is recommended when used without lime-sulfur.

Originally all arsenates of lead were sold in paste form, but now several manufacturers are producing and selling the lead hydrogen arsenate in powdered form as well. We have used the powdered basic form in some experiments with satisfactory results, but its great tendency to settle may make its use prohibitive in this form.

FUNGICIDES.

The term fungicide is applied to those substances which will prevent the growth of fungi on plants. The fungi are a group of plants of low order, many of them living as parasites on the higher or flowering plants, among which are included all our agricultural crops. These parasitic fungi are usually minute and the details of the form can be made out only by a mi-
crosscopic examination. The grower usually sees merely the effect of the fungus upon the plant or the characters which make up the symptoms of the disease.

Fungi reproduce by means of small microscopic bodies known as spores, which, generally speaking, answer the purpose of seeds for the fungous plant. These spores may be disseminated by the wind, washed about by the rain, or carried about by birds and insects. Spraying for fungous diseases, in general, must be preventive rather than curative. One must cover the tree with some substance which will prevent the growth of the minute spores and so prevent them from entering the plant.

**Bordeaux Mixture.** Bordeaux mixture has long been the principal spray used as a preventive of fungous diseases of plants, and while other sprays, notably the lime-sulfur mixtures, give promise of largely supplanting it for special purposes, it still remains the most important orchard fungicide.

Bordeaux for winter use may be made as follows:

- Copper sulfate .................. 6 lbs.
- Quick lime ....................... 6 lbs.
- Water .......................... 50 gallons

This is known as the 6-6-50 formula. It should be used only upon dormant or nearly dormant trees. Another formula frequently used is the 5-5-50 formula. When the trees are in leaf the following 4-4-50 formula is used on certain fruits:

- Copper sulfate .................. 4 lbs.
- Quick lime ....................... 4 lbs.
- Water .......................... 50 gallons

A weaker formula known as the 3-6-50 formula, is sometimes used on plants of tender foliage.

It is of great importance that Bordeaux be properly made. The mixture must be made fresh each time it is used. The ingredients, however, may be stored in the form of stock solutions. Always use wooden or earthen vessels for preparing Bordeaux or for storing the stock solution of blue stone.

When large quantities of Bordeaux mixture are required, it is most convenient to have stock solutions made up containing one or two pounds per gallon of the respective ingredients. Take a fifty gallon barrel of water and suspend near the top a coarse sack containing fifty pounds of crystalized or granu-
lated commercial copper sulfate (blue-stone). It will dis-
solve in a few hours. It is convenient to arrange this the night
before the spraying is to be done. In another barrel place 50
pounds of lime freshly slaked. For this purpose choose clean
stone lime of the best quality. Slaking should be done care-
fully. Water should be added a little at a time so that slaking
will take place rapidly. The process should be watched care-
fully and the mixture stirred constantly while the slaking is
going on, adding water as needed to prevent “burning.” Lime
should never be allowed to become dry while slaking or it will
“burn,” nor should it become entirely submerged in water.
The mixing can be conveniently done with a hoe. When thor-
oughly slaked, make up to fifty gallons with water.

If small quantities only of stock solution are needed any
quantity can be made in the above mentioned proportions.

These stock solutions can be kept for a considerable time
if water is added to replace that lost by evaporation. They
should be kept covered to prevent dilution by rains. Made up
in this way, each gallon of stock solution represents one pound
of ingredients. Each should be stirred very thoroughly before
any is taken out. If desired, the stock solutions may be made
up by using double the quantity of blue-stone or lime. If this
is done, each gallon will represent 2 lbs. of substance.

In making up the mixture from these stock solutions both
the copper sulfate and the lime should be diluted before being
mixed. Have two dilution barrels or tanks. If the 6-6-50 for-
mula is to be made, and the spray tank holds 100 gallons, take
twelve gallons of copper sulphate stock solution (if it repre-
sents one pound to the gallon) and dilute to make fifty gallons
in one barrel, then take twelve gallons of the lime paste and
dilute in the same manner in another barrel. The lime paste
should be run through a fine strainer.

For convenience, it is well to have a platform built high
enough to permit the liquids to flow from the dilution tanks
into the spray cart. Allow the two diluted solutions to run to-
gether through a twenty-mesh copper wire strainer into the
spray tank, mix well and apply at once.

It is always best to test the mixture, before applying,
with potassium ferrocyanide. Buy ten cents worth of potas-
sium ferrocyanide at the druggist’s and dissolve in the least
possible amount of water. Label the bottle poison. Take out
a cupful of the well-stirred mixture and allow a drop or two of the potassium ferrocyanide to fall into it. If the drop turns yellow or brown on striking the mixture it will be necessary to add more lime. Add lime till no discoloration is seen when the test is made. If this precaution is not taken, the spray may injure the foliage.

Use a good pump that gives strong constant pressure; have good nozzles that give a fine, mist-like spray and cover the tree thoroughly.

Always rinse the spray tank, hose, and rod with water, after using. Use only brass rods and connections, as Bordeaux mixture will gradually attack iron.

Resin Bordeaux. On certain plants, especially those having very smooth surfaces, Bordeaux is not found to adhere well. It is found desirable, therefore, to add a "sticker." This can be conveniently made after the following formula:

Resin .................................................. 2 lbs.
Sodium carbonate (Sal soda) ............. 1 lb.
Water ............................. 1 gallon

Boil together, in the open, in an iron kettle until of a clear brown color. This will take from one to one-and-one-half hours. Add this amount to 100 gallons of ordinary Bordeaux mixture. This increases the spreading qualities and also has a tendency to make the spray adhere longer to the tree.

Self-Boiled Lime Sulfur. This mixture, introduced and perfected by Scott of the department of agriculture, is especially desirable for use on peach foliage. The experience in most sections of the country has been that Bordeaux mixture and most other fungicides are unsafe to use on peach and other tender foliage. This fact has led to the perfection of the self-boiled lime-sulfur, which is made from a mixture of lime and sulfur, and which has proved to be very satisfactory for use on the peach foliage. In Oregon, this spray is especially recommended for use against brown rot and fruit spot of peach and cherry. The formula recommended is as follows:

Lime ................................. 8 lbs.
Sulfur ............................... 8 lbs.
Water .......................... 50 gallons

The preparation of the mixture as described by Scott in Bureau of Plant Industry, Bulletin 174, is as follows:

"The mixture used in our experiments during the past sea-
son was composed of 8 pounds of fresh stone lime and 8 pounds of sulfur (either flowers or flour may be used) to fifty gallons of water. The mixture can best be prepared in rather large quantities, say enough for 200 gallons at a time, making the formula 32 pounds of lime and 32 pounds of sulfur, to be cooked with a small quantity of water (8 or 10 gallons) and then diluted to 200 gallons.

“The lime should be placed in a barrel and enough water almost to cover it poured on. As soon as the lime begins to slake the sulfur should be added, after first running it through a sieve to break up the lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted, and applied.

“The stage at which cold water should be poured on to stop the cooking, varies with different limes. Some limes are so sluggish in slaking that it is difficult to obtain enough heat from them to cook the mixture at all, while other limes become intensely hot on slaking, and care must be taken not to allow the boiling to proceed too far. If the mixture is allowed to remain hot fifteen to twenty minutes after the slaking is completed, the sulfur gradually goes into solution, combining with the lime to form sulfides, which are injurious to peach foliage. It is very important, therefore, especially with hot lime, to cool the mixture quickly by adding a few buckets of water as soon as the lumps of lime have slaked down. The intense heat, violent boiling and constant stirring result in a uniform mixture of finely divided sulfur and lime, with only a very small percentage of the sulfur in solution. The mixture should be strained to take out the coarse particles of lime, but the sulfur should be carefully worked through the strainer.”

This mixture is in effect a mechanical mixture of lime and sulfur with the sulfur as the active ingredient. A proprietary mixture known as “atomic sulfur” is replacing it to some extent for spraying peaches and doubtless will come into quite general use on account of the convenience of preparation.

Atomic Sulfur. This is a commercial product that has been recently perfected largely as a substitute for the self-
boiled lime-sulfur. It consists essentially of pure sulfur which has been subjected to a special process mixed with certain organic materials with the result that the sulfur is in a very finely divided form. It is marketed in paste form and must be diluted with water before being used.

This mixture has not been tested thoroughly under Oregon conditions, but from all available reports it evidently has good fungicidal value and is especially recommended by those who have used it, as a substitute for self-boiled lime-sulfur or flowers of sulfur, for brown rot and mildew of peaches and mildew of apple, grape, etc.

As a remedy for apple scab, it would seem to be in the experimental stage and growers are advised to proceed with caution till the results of experiments which will be conducted during the season of 1914 can be obtained and made public.

One of the chief objections to this spray is the relatively high cost.

Iron Sulfide. This mixture is used primarily for mildew. When used as a dormant spray it should be combined with lime-sulfur and is prepared in the following manner:

In order to prepare 100 gallons of spray, put in the spray tank the usual amount of lime-sulfur for the winter strength; then add 15 quarts more. Partly fill the spray tank with water; add 15 pounds of iron sulfate dissolved in 10 or 15 gallons of water. This should be added slowly and with constant stirring. It will cause a black substance to be thrown down. Fill the spray tank to 100 gallons and apply the mixture to the trees. The tank should be equipped with a good agitator where this mixture is used.

If this mixture is to be used as a summer spray proceed as follows:

Partly fill a barrel with water, dissolve in this 10 pounds of iron sulfate, then add with constant stirring, 10 quarts of undiluted lime-sulfur. Fill this barrel with water, allow the black precipitate to settle and then pour off the discolored liquid. Fill with water and thoroughly stir the sediment, allow it to settle again and pour off the liquid. Repeat this until the liquid is perfectly clear. Use the sediment thus prepared in 100 gallons of spray and apply to the trees.

This mixture, which is inconvenient to prepare, is being
rapidly replaced by atomic sulfur. It is discussed here because of the relatively low cost of materials.

_Burgundy Mixture._ This fungicide is designed particularly for use where it is desired to spray with a mixture that will not cause any deposit. It has been successfully used, for example, previous to the fruiting season, on loganberries, as a control for loganberry anthracnose. Its fungicidal value as a control for apple diseases has not been determined, but it has been used without any apparent injury just previous to the picking season. It is made as follows:

3 lbs Sodium carbonate (Sal soda)
2 lbs of copper sulfate
100 gallons of water.

Each chemical should be dissolved separately in 25 to 50 gallons of water, and should then be mixed as in preparing Bordeaux mixture.

COMBINATION SPRAYS.

A combination spray may be defined as a spray that has both fungicidal and insecticidal values to a greater or less degree. During the past few years it has been conclusively demonstrated at this and other experiment stations that the lime-sulfur spray, which has long been known as the most satisfactory winter spray for San Jose scale, has fungicidal qualities nearly or quite equal to those of Bordeaux. It has also been conclusively demonstrated that it may be used in combination with arsenate of lead without materially detracting from the value of either; and that when so used it is at once an efficient contact insecticide, food poison spray, and fungicide. It also has the advantage that when properly diluted it may be used either as a winter or summer spray.

As a winter spray, one application of lime-sulfur each year will do more for the neglected orchard than can be done in any other way by the same expenditure of cash and energy. It not only destroys San Jose scale, but it may also destroy the branch form of woolly aphis, the pear leaf blister mite, the hibernating larvae of the prune twig miner, possibly the hibernating larvae of the bud moth, together with some other insects which may chance to be wintering upon the trees. It is also a good fungicide. It has become the standard remedy for apple scab in most apple growing sections, and when applied to peach trees just before the buds open in the spring, is a preventive of peach leaf curl.
As a summer spray, the results of the past few seasons’ work at the Oregon Experiment Station prove that when properly diluted, it can be used upon the pear with reasonable safety, and that it gives as good results in controlling apple scab as does Bordeaux, which has long been the standard spray for this disease. The results proved further that lime-sulfur spray is much less likely to produce the disastrous “spray injury” to fruit and foliage which is so common and often serious when Bordeaux is used.

Preparation of Lime-Sulfur. The stock solution method of preparing lime-sulfur is now most generally used in this state. A number of brands of commercial solutions which have only to be diluted with water to be ready for use are now offered for sale, and careful experiments extending over several seasons have demonstrated that these sprays are fully equal to the old home-made lime-sulfur spray.

The chief fault to be found with these commercial preparations is that they cost too much. The retail price is $7.00 to $10.00 per barrel of fifty gallons. The lime and sulfur necessary to prepare fifty gallons of stock solution, which can be made equally efficient, costs at present retail prices approximately $3.00 to $4.00. It may be prepared as follows:

Sulfur (best finely ground) one sack, 100 lb.
Lime (best grade, unslaked) ...... 60 lb.
Water sufficient to make ............ 50 gal.

Slake the lime, mix the sulfur into a thin paste with a little water, add it to the lime, add sufficient water to make, all told, sixty gallons; bring it to a boil and boil vigorously for thirty to thirty-five minutes, stirring constantly. The sediment is then allowed to settle, after which the clear, amber-colored liquid is drawn off and may be stored in tanks for future use.

Every grower who expects to prepare his own spray by the stock solution method should provide himself with a Baume acid scale hydrometer. Such an instrument, which should not cost over one dollar, furnishes a very simple and convenient method of testing the strength of the solution. Having thus determined the strength of any commercial or home-made stock solution, it may be diluted for winter or summer use according to the following table:

If stock solution tests 29 degrees for winter spray, use one gallon to ten gallons of water; for summer spray use one
gallon to twenty-nine gallons of water. If stock solution tests 30 degrees, for winter spray use one gallon to twelve gallons of water, or for summer spray one gallon to thirty gallons of water.

Table of Dilutions For Various Stock Solutions.

<table>
<thead>
<tr>
<th>Stock solution</th>
<th>Dilution</th>
<th>Dilution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baume scale</td>
<td>Winter strength</td>
<td>Summer strength</td>
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<tr>
<td>32°</td>
<td>1-15</td>
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<td>22°</td>
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</tbody>
</table>

**MIXED SPRAYS.**

With the increasing number of important pests it has been necessary to make a careful and thorough study of the economy of orchard protection. The time of application of a spray for a fungous disease often coincides with the time of application for some one or more important insect pests. This has led to many experiments in the mixing of insecticides and fungicides to determine the practicability of using one application of mixed sprays in place of separate applications of a suitable fungicide and insecticide.

Considerable success has followed from these experiments and the mixing of a fungicide and an insecticide in combined application is a common orchard practice of considerable value to the fruit grower. Mixed sprays may also apply to insecticides. The great difficulty in mixing sprays arises from the fact that more or less of a chemical change usually takes place in the mixing, which may destroy the killing value of the sprays. The original substances may also be changed so as to liberate some material which will injure the foliage and fruit. Such is apparently the case when lead hydrogen arsenate of lead is mixed with lime-sulfur; free arsenic is said to be liber-
ated and it is thought that the injury which often occurs with
the use of this combination is due to that substance.

Sprays that can be successfully mixed at the present time
are:

Bordeaux mixture and arsenate of lead, arsenite of zinc
or Paris Green.
Lime-sulfur and arsenate of lead or arsenite of zinc.
Lime-sulfur and tobacco sprays.
Arsenate of lead or arsenite of zinc may also be added to
the last mixture when desirable.
Iron sulfate may be mixed with arsenate of lead and Black
Leaf-40 alone or mixed.
Atomic sulfur and arsenate of lead.
Self-boiled lime-sulfur and arsenate of lead.

Other mixtures have been tried and some are worthy of trial,
but it is not advisable yet to recommend them for general use. *The fruit grower is cautioned against using spray mixtures which have not been thoroughly tested.*

**GENERAL NOTES ON SPRAYING**

On the last pages of this circular will be found a spray cal-
endar for the treatment of apples and pears and another for
stone fruits. These calendars are aimed to give in a graphic
way the treatment which an orchard should receive if all the
pests were present. In most orchards, especially orchards
which have received reasonably good treatment in the past,
many of these pests are not present in serious form, conse-
quently it need not be inferred that all of the sprays are neces-
sary in each orchard. As pointed out above, it is necessary
that growers know the insects and diseases well enough so that
they can determine whether they are present in their orchard
or not. If the grower is not familiar with these troubles at the
present time, he should take every opportunity to become fa-
miliar with them. In the meantime, he should have his or-
chard inspected once or twice each year by the county fruit
inspector or some other competent person.

In addition to the spray calendars, it is considered advis-
able to give some general notes on treatment under special con-
ditions and for young orchards. These will be taken up under
each crop.
APPLE.

Treatment of Young Orchard. If young trees are passed upon by a competent inspector before planting, it is not necessary to spray them for scale insects until the second year after they are set out. If they are then given a thorough treatment with lime-sulfur, they will probably not need further treatment until they are five or six years old. The trees should be carefully watched, however, and if any indication of scale is found in the meantime, the infested trees and those immediately surrounding them should be sprayed. Whenever leaf feeding caterpillars or aphids become troublesome, spray with arsenate of lead or Black Leaf-40, respectively, as given in the calendar.

Young trees would not need to be sprayed for scab unless this disease became so abundant as to cause considerable defoliation; then one or two sprayings, as outlined in the calendar, should be given.

Where mildew is found developing on young trees, it is often possible to control it by cutting out the affected twigs, removing them from the orchard and burning. If it is abundant, however, use atomic sulfur, 4 lbs. to 100 gallons, as the buds are opening, or it may be applied whenever the mildew is found to be developing seriously.

In regard to anthracnose in a young orchard, the trees would not need regular protection except in cases where they are planted in the immediate vicinity of older infested orchards, in which case they should be sprayed in the middle of September.

Bearing Orchard. In regard to spraying for San Jose scale, one thorough application with lime-sulfur every other year will be sufficient under normal conditions. It is possible, although it has not been fully demonstrated, that where lime-sulfur is regularly used for apple scab these sprays will control the scale. Under these conditions, if the trees are carefully watched, a special application for scale may be unnecessary except under special conditions. If the brown aphis is not a serious pest and is not found to be present every year, the early spring application of Black Leaf-40 may be omitted.

In regard to spraying a bearing orchard for apple tree anthracnose, the practice will depend upon the severity of the disease in each particular orchard. At least one spraying
should be given each year in infested districts as a matter of general orchard practice. Where the disease is serious, it is desirable to make more than one application in order to clean the trees up in the shortest possible time. The times for spraying are given in the calendar.

PEAR.

In general, the recommendations for spraying pears against San Jose scale and codling-moth, are the same as given for apple. The first calyx spray for codling-moth, while not necessary in all cases, is especially desirable in controlling leaf feeding caterpillars.

For the pear, no fall spraying is necessary, unless the bud moth is present. Under ordinary conditions, anthracnose does not develop on pear as a serious disease and spraying for it need not be a general practice.

PEACH.

Treatment for Young Orchard. Young peach trees should be protected from peach leaf curl and California peach blight. Consequently, fall and spring spraying should become a regular practice as soon as the trees are set out. While Bordeaux mixture is considered better than lime-sulfur for the control of peach leaf curl in the spring, the latter has the advantage of controlling San Jose scale, peach twig borer, etc., and should be used in preference to Bordeaux mixture where insect pests are troublesome.

If a peach orchard is sprayed regularly in the fall for California peach blight from the time it is set out, no sprayings during May should ever be necessary for this disease.

PLUM AND PRUNE.

In general, a regular dormant spray as recommended in the calendar, should be applied for the control of scale and the twig miner.

In the case of the shot hole borer, it has been demonstrated that this insect apparently does not attack healthy trees; therefore, combative measures are not included.

It is becoming more and more necessary that growers in Western Oregon spray for brown rot. As recommended in the calendar, the three sprays for brown rot on prunes are advised wherever any trouble has been experienced in the past with this disease. The department of plant pathology is at
the present time conducting experiments to determine the
sprays to use and the least number of applications necessary
to control the disease.

CHERRY.

Ordinarily the cherry need not be given a dormant appli-
cation of spray unless it is found that scale insects, aphids, or
red spider, are especially troublesome. Whenever cherry slugs
become troublesome, spray with arsenate of lead, 2-50. In
the case of the shot hole borer, it has been demonstrated that
this insect apparently does not attack healthy trees; conse-
quently, combative measures are not included.

Brown rot and the shot hole fungus are the only serious
fungous diseases which attack the cherry. If these diseases
become abundant, follow directions given in the calendar.
**SPRAY CALENDAR FOR APPLES AND PEARs.**

<table>
<thead>
<tr>
<th>What to Spray for</th>
<th>Condition of tree or relative time</th>
<th>What to Use</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moss, Lichens, <em><strong>Insects</strong></em></td>
<td>Just as tips of leaves are emerging.</td>
<td>Lime-sulfur 1-12 plus, Black Leaf-40 1-1200.</td>
<td>The time indicated is the best time to apply the clean-up spray as this will destroy more insect pests than if applied during the winter. No so-called dormant spray need be given where this method is used. Slight injury may occur to the tips of the first leaves, but this is not serious. Dilute the lime-sulfur and add Black Leaf-40, 1 pint to each 150 gals. of the diluted spray.</td>
</tr>
<tr>
<td>Pear Leaf, Blister Mite, Red Spider</td>
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<tr>
<td>Scab, First Application</td>
<td>When the blossoms buds have separated in show pink.</td>
<td>Bordeaux, 5-5-50, or Lime-sulfur 1-30.</td>
<td>If leaf eating insects or green fruit worms are present, add arsenate of lead, 2 lbs. to 50 gals. of diluted spray in a paste form.</td>
</tr>
<tr>
<td>Scab, second application Codling-moth calyx spray Tent and other leaf-eating caterpillars. Slugs on pears.</td>
<td>After petals fall and before calyx lobes close.</td>
<td>Lime-sulfur 1-85 plus arsenate of lead 2-50 paste (basic)</td>
<td>If scab does not occur in a district lime-sulfur is not necessary. This spray should be applied with considerable force so as to get the poison into the inner calyx cup.</td>
</tr>
<tr>
<td>Apple Powdery Mildew</td>
<td></td>
<td>Add 1 lb. dissolved iron sulfate to each 50 gallons of diluted lime-sulfur or use Atomic sulfur 4 lbs. to 100 gallons.</td>
<td>It is not necessary to wash the iron sulfide in districts where Lime-sulfur can be safely used. Repeat this application at intervals of three weeks during the summer if necessary.</td>
</tr>
<tr>
<td>Bud Weevils</td>
<td>When the insects become abundant.</td>
<td>Bands of some sticky substance. (Tangle-foot, printer’s ink, etc.)</td>
<td>These insects cannot fly, and if the bands are such that they cannot crawl over or under them, there is little danger of their getting into the trees. Bands of cloth should be put around the trees and the tangle-foot or ink placed on the bands.</td>
</tr>
</tbody>
</table>

**SPRING**
## SPRAY CALENDAR FOR APPLES AND PEARS. (Continued).

<table>
<thead>
<tr>
<th>What to spray for</th>
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<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPRING</strong></td>
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</tr>
<tr>
<td>Apple Tingis</td>
<td>When the insects become abundant.</td>
<td>Black Leaf-40 1-1000 plus whale oil soap 1 lb. to 100 gal. of spray.</td>
<td>These insects are not as easily killed as plant lice and it is necessary to use a stronger spray.</td>
</tr>
<tr>
<td>Apple Leaf Hopper</td>
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<tr>
<td>Scab, third application</td>
<td>Ten days after second application.</td>
<td>Lime-sulfur 1-35 or try atomic sulfur, 12 lbs. to 100 gals.</td>
<td>If rains continue in early June give fourth application 10 to 15 days after 3rd. The use of atomic sulfur is advised only in an experimental way.</td>
</tr>
<tr>
<td><strong>SUMMER</strong></td>
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<tr>
<td>Codling-moth, second application.</td>
<td>East of Cascade Mts. 2 to 4 weeks after first application.</td>
<td>Arsenate of lead 2 lb. to 50 gal. of water, if paste. 1 lb. to 50 gal. of water, if powder.</td>
<td>The codling-moth apparently does not deposit its eggs until the evening temperatures reach 60°F or above. The larvae appear a week to 10 days later, and the spray should be applied before the first ones hatch. If anthracnose is serious, mix the arsenate of lead with Bordeaux 3-4-50.</td>
</tr>
<tr>
<td>Slugs on pear</td>
<td>West of Cascades about 6 weeks after first application.</td>
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<tr>
<td>Seldom cause damage on trees sprayed for codling-moth.</td>
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<tr>
<td><strong>FALL</strong></td>
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<tr>
<td>Bud Moth. Anthracnose. Codling-moth.</td>
<td>First to fifteenth of September.</td>
<td>Bordeaux mixture 4-4-50 and arsenate of lead 2-50 paste, or 1-50 powder.</td>
<td>This is the best time of year to kill the bud moth, and many codling-moth larvae may also be destroyed. If anthracnose is present, it is advisable to use combination spray. Where anthracnose is severe the Bordeaux should not be omitted.</td>
</tr>
<tr>
<td><strong>WINTER</strong></td>
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<tr>
<td>Anthracnose.</td>
<td>After fruit is picked.</td>
<td>Bordeaux mixture, 6-6-50.</td>
<td>If anthracnose is not serious and summer applications as above have been given, this application could be omitted. Where anthracnose is severe, this application should not be omitted, and if summer applications have not been made make 2 sprayings 15 days apart.</td>
</tr>
<tr>
<td>No winter spraying is necessary if spring applications are made as recommended above. Fence rows should be cleaned up and all dead wood and prunings should be burned.</td>
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</table>
# SPRAY CALENDAR FOR STONE FRUITS.

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Peach leaf curl</strong>&lt;br&gt;scale&lt;br&gt;mites&lt;br&gt;Peach twig miner&lt;br&gt;aphis&lt;br&gt;Moss lichens&lt;br&gt;Red spider</td>
<td>As the buds are swelling in the spring.</td>
<td>Lime-sulfur 1-12 plus&lt;br&gt;Bla-k Leaf-40, 1-1200.</td>
<td>If leaf curl, moss and lichen are the only troubles, use Bordeaux 5-5-50. If curl has been especially serious in previous years, and insect pests are present, use Bordeaux late in February and lime sulfur plus Black Leaf-40 as buds are swelling. If aphids and red spiders are not present, omit Black Leaf-40.</td>
</tr>
<tr>
<td><strong>Peaches</strong>&lt;br&gt;<strong>Prunes</strong>&lt;br&gt;<strong>Plums</strong>&lt;br&gt;<strong>Cherry</strong></td>
<td><strong>California</strong> peach blight and fruit spot. Also attacks apricots and almonds.</td>
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<td></td>
<td>About first week in May.</td>
<td>Self-boiled lime-sulfur 9-8-50, or atomic sulfur 10 lbs. to 100 gals.</td>
<td>Repeat last week in May. If disease is especially serious, make an application in the middle of May and delay the last spraying till the first week in June. If fall spraying has been given, these sprayings should be unnecessary.</td>
</tr>
<tr>
<td><strong>Peach Tree Borer.</strong></td>
<td>First of June.</td>
<td>Asphaltum.</td>
<td>Ordinary paving asphaltum should be used and can be applied with a paint brush. Apply from base of tree to 12 or 14 inches up the trunk.</td>
</tr>
<tr>
<td><strong>Caterpillars</strong>&lt;br&gt;and Bud Meth on all fruits.</td>
<td>As soon as they appear after the leaves are out.</td>
<td>Arsenate of lead, 1-50 powdered, or 2-50 paste.</td>
<td>Not necessary to make this application if insects do not appear.</td>
</tr>
<tr>
<td><strong>Bud Weevils</strong> (on prune grafts principally).</td>
<td>When they begin to appear.</td>
<td>Tree tanglefoot or some sticky substance.</td>
<td>These insects cannot fly, therefore any sticky substance placed on bands about the trunks should keep them out of the trees. Tree tanglefoot is probably the most efficient material to use. Bugs in trees when bands are put on can be shaken from the tree by jarring.</td>
</tr>
<tr>
<td><strong>Cherry Shot</strong>&lt;br&gt;hole fungus.</td>
<td>One month after blossoming.</td>
<td>Bordeaux 3-4-50 Atomic sulfur 10 lbs. to 100 gallons, or self-boiled lime-sulfur, 10-10-50.</td>
<td>Repeat as soon as the fruit is picked, if weather conditions are favorable to the development of the disease.</td>
</tr>
<tr>
<td>What to spray for</td>
<td>Condition of tree or relative time.</td>
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<td>Remarks.</td>
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<tr>
<td>Brown Rot (peach, plum, apricot, cherry)</td>
<td>First application one month after petals fall; 2nd 3 weeks to 1 month later. Third, two weeks before ripening of fruit.</td>
<td>Self-boiled lime-sulfur, 8-8-50, or atomic sulfur 10 lbs. to 100 gals.</td>
<td>Bordeaux and commercial lime-sulfur are unsafe on peach foliage.</td>
</tr>
<tr>
<td>Brown Rot of Prune.</td>
<td>Spray first about 1 week after petals fall; 2nd, about middle of June; 3rd, last week in Sept.</td>
<td>Bordeaux 4-4-50 or atomic sulfur 10 lbs. to 100 gals.</td>
<td>Lime-sulfur is injurious to prunes. Bordeaux can be used safely, but does not adhere readily to fruit. A trial of Resin Bordeaux in comparison with atomic sulfur is suggested. Burgundy mixture may be used in last application.</td>
</tr>
<tr>
<td>California peach blight and fruit spot.</td>
<td>Last week in October or before rains begin.</td>
<td>Bordeaux, 6-6-50.</td>
<td>This is the most important application for California peach blight. Fall spraying should become regular orchard practice in all sections where this disease occurs. After the disease is once under control, fall spraying should be sufficient and the spring applications for this disease may be dispensed with.</td>
</tr>
</tbody>
</table>