

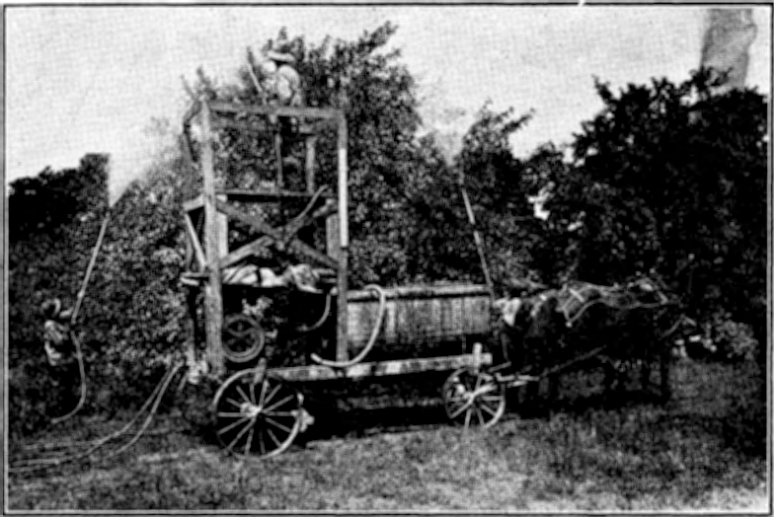
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Orchard spray calendar  
Circular no. 168, rev. 1942



# ORCHARD SPRAY CALENDAR



Power Sprayer with Tower.

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## ORCHARD SPRAY CALENDAR

### PRACTICAL SPRAYING SUGGESTIONS

1. Weigh, measure, mix, and use spray materials according to directions.
2. Efficient spraying consists of a thorough application of the right materials at the right time.
3. Know what insects and diseases you hope to control, what spray materials to use, and when and how to apply the materials for the best control.
4. Buy needed spray materials well in advance of the time for applying the sprays. Delays in securing materials may result in serious crop losses.
5. A good spray pump, nozzles, rods, cut-off, and hose are essential to first-class work. Test equipment before starting to spray.
6. Protect hands and face when using lime sulphur sprays. Wear leather gloves and apply vaseline to both hands and face.
7. In most cases it will be cheaper for the grower to buy dormant spray materials ready for dilution. Manufactured products will be more uniform and therefore less likely to injure trees than home mixed materials.
8. Do not spray while weather is cold enough to freeze spray materials before they have time to dry.
9. Clean and flush spray tank thoroughly after each spray application.

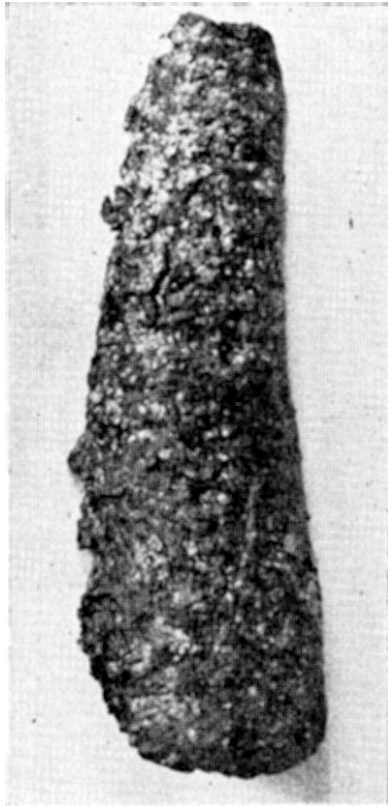
### WINTER OR DORMANT SPRAYS

During the winter while there is no foliage on the trees, concentrated, corrosive or oil sprays may be safely applied to destroy scale insects, and for the purpose of controlling peach leaf curl disease.

San Jose scale is the most important scale pest. A rather high concentration of spray material is required to kill this insect. Such concentrations are not safe during the summer, but may be applied during the winter when the temperature is above 60 degrees F., or early in the spring before leaves have developed.

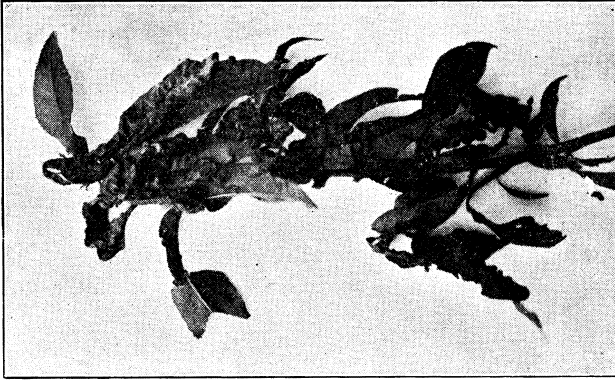
Commercial lime sulphur (33° B.) mixed at the rate of one gallon in eight gallons of spray is effective as a control for both scale and peach leaf curl. If dry lime sulphur is used, four pounds of powder is equivalent to one gallon of liquid. Thus, the mixture to use would be four pounds of dry lime sulphur in eight gallons of spray.

Oil sprays are effective for the control of scale insects. There are many different types of commercial oil sprays available for use. Follow closely the directions given regarding the use of the brand purchased.



**Fig. 1. San Jose Scale.**

Apple, pear, peach, and plum trees are susceptible to scale attack. While the insect is very destructive, and although sprays must be applied for its control when found on trees, regular annual dormant sprays are not required except in commercial orchards where infestation is general. Learn to identify the insect and spray when it appears.



**Fig. 2. Peach Leaf Curl.**

Peach leaf curl disease is prevalent throughout the state. There is no way to determine whether the disease is present or not except by having observed it on the trees during the previous growing season. If the disease was observed during the growing season, apply a Bordeaux or lime sulphur spray sometime during the winter prior to the second week in February. Mix the lime sulphur the same strength as recommended for San Jose scale. A 4-4-50 Bordeaux mixture combined with a prepared oil may be used to control both curl and scale. Lime sulphur and oil cannot be mixed.

### SUMMER SPRAYS

Sprays are applied to trees and fruit during the summer for the control of insects and diseases. Repeated applications must be made in order: (1) to cover new growth, (2) to replace material washed away by rains and lost or weakened by oxidation, (3) to have a protective covering upon foliage and fruit when insects or diseases may be expected in greatest numbers.

### SPECIAL PEST CONTROL RECOMMENDATIONS

#### Apples

*Canker Worm.* Very soon after the winter buds unfold, canker worms may attack the foliage. Sometimes present in considerable numbers, they are very voracious and quickly defoliate the trees unless the foliage has been protected by poisonous sprays. They are easily controlled by arsenate of lead sprays. This insect is also very destructive to plum foliage.

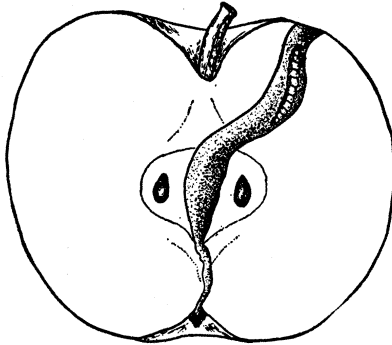


Fig. 3. Codling Moth Injury. Showing larva or worm in the apple.

*Codling Moth.* The codling moth or apple worm is the most serious insect pest of apples in Oklahoma. The adult is a moth. Eggs usually hatch two to four weeks after apple blossom time. Worms enter the fruit and frequently cause it to drop. These worms develop rapidly to the adult stage, and eggs are deposited for a second generation of worms which appear seven to nine weeks after apple blossom time. With higher temperatures, the growth and development of the worms are accelerated and generations follow one after another until cold weather. Unfortunately, there is considerable overlapping of generations, since eggs are deposited by the



spring adults over a long period of time. During the summer and fall this results in a more or less continuous worm infestation.

To effectively control the codling moth, it is very desirable to ascertain the time when the first brood hatches. Many growers are now using bait traps in their orchards. These traps consist of pans or kettles suspended in the upper portions of the apple trees filled with a fermenting compound. The adult moths, upon emergence, are attracted to these bait traps. By examining the traps every day or two during the probable period of emergence, it is possible to determine when the greatest emergence is taking place. It then becomes necessary to check temperatures at dusk. Eggs are deposited in numbers only when the temperature at dusk is above 62 degrees F. The eggs hatch in seven or eight days. Therefore, the intelligent orchardist can determine rather closely when worms will appear, and protect the fruit by applying spray material before that time.

A lead arsenate spray should be applied when from three-fourths to seven-eighths of the petals have fallen, and completed before the sepals have closed over the calyx cups. This spray is necessary because many worms enter the fruit through the calyx cup and unless spray material is applied before the sepals close, it is impossible to place poison in the calyx cup.

Other sprays must be applied during the growing season at regular intervals for the control of this insect.

The banding of producing trees is a desirable supplemental method to control the codling moth. Chemically treated tree bands made of strips of single faced corrugated paper, cut two inches wide, and which have been dipped in a solution of beta-naphthol dissolved in oil, are wrapped tightly around the trunk of the tree. The dissolved chemical is toxic to the insect larvae, but does not harm the tree when properly used.

*Young trees with smooth bark should not be banded.* In banding old trees, the trunk and lower limbs are scraped to remove all loose bark. This scraping should extend up about 10 feet. A special tool for scraping, such as box scraper, or even a short handled hoe, is desirable.

The chemically treated band is then placed tightly around the tree trunk and fastened with large headed roofing nails or special wire staples. Care must be taken to fit the band into the depressions of the trunk.

The bands should be in place by June 1. The bands slowly lose toxicity; therefore, they should not be made up or placed on the trees more than a week before the above date.

When the larvae, after leaving the apple, search for a place to spin cocoons, they find the paper band and spin up in the corrugations and in the grooves of the paper held tightly against the tree. If the bands are properly made, the worms will be killed within a few days. By autumn the bands have lost most of their toxicity and do not kill all of the larvae. These, however, are affected by the chemical and usually die during hibernation. The bands are serviceable only one season, and should be taken off the trees early in November and burned.

The codling moth attacks pears as well as apples, and where pears are a commercial crop the same control measures should be practiced as on apples.

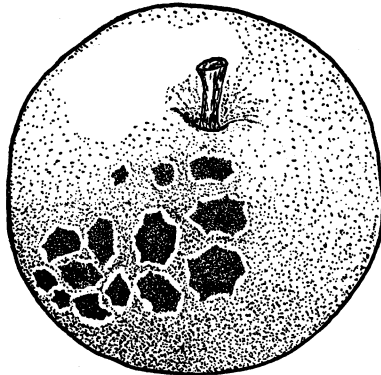


Fig. 4. Apple Scab.

*Apple Scab.* This is a disease which is sometimes destructive, particularly on such varieties as Delicious and Wine-sap. It attacks the trees in the early spring while the weather is still cool. It affects both foliage and fruit. Scab is not difficult to control if a fungicidal spray such as lime sulphur or Bordeaux mixture is applied just after the blooming period.

*Apple Blotch.* This is a very serious disease of apples in Oklahoma, being particularly destructive to such varieties as Ben Davis, Gano, Arkansas Black, and Missouri Pippin. It does not appear until early summer when the temperature becomes high. It is controlled by spraying with Bordeaux mixture, starting two or three weeks after the blooming period.

*Flat-Headed Borer.* The flat-headed apple tree borer is prevalent in many orchards and causes considerable damage to young trees. This insect also attacks peaches, plums, cherries, and other trees. It is especially destructive to newly set trees, or to trees which have been weakened by drouth, winter injury, or other cause. Healthy vigorous trees are relatively free from attack. Every effort should be made to keep young trees in a healthy, vigorous growing condition. This can be accomplished by good cultivation, destruction of grass and weeds around the trees, mulching, if necessary, and fertilization with nitrate of soda, sulphate of ammonia, or some other nitrogenous compound.

Low headed trees are less likely to be attacked than high headed trees.

Wrapping paper wound around the trunks of young trees, beginning three inches below the surface of the soil and extending up to the branches, gives protection from the borers. Apply this paper by the first of May and leave on the trees until September.

*Cedar Apple Rust.* Spores of this disease, which infect apple trees, are produced on the cedar trees during rainy periods and are blown by the wind to apple trees, where they cause infection on the leaves and fruit. Severe infection usually does not occur unless cedar trees are within a mile of the orchard. Infection will be more severe when the cedar trees are located near the orchard. This disease is very difficult and expensive to control by spraying. The easiest means of control is the destruction of the cedars.

Where cedar trees are so common that their destruction is impractical, avoid planting susceptible varieties such as Jonathan or Winter Banana.

*Fire Blight.* This disease is more common on pears than apples. When outbreaks are prevalent, however, it is desirable to protect such susceptible apple varieties as Jonathan with a 2½-4-50 Bordeaux spray applied while the trees are in full bloom.

#### Pears

*Fire Blight.* This bacterial disease affects the growing twigs of pears and apples, causing them to turn black and die, hence the name fire blight. Outbreaks can be checked by keeping pear trees from making too much growth by sod culture, and after severe outbreaks by cutting out the diseased branches and burning them.

After severe outbreaks of fire blight disease on either apples or pears, it may be necessary to remove overwintering cankers. In order to locate these cankers examine the trees during the dormant season and carefully remove and burn all affected bark, disinfecting the wound and tools with bichloride of mercury. If the area of wood thus exposed is more than three or four inches across protect with a coat of liquidified asphalt applied two or three weeks after the cankers have been removed and the wound sterilized with bichloride of mercury.

#### **Peaches and Plums**

*Curculio.* The peach worm or curculio is sometimes destructive in Oklahoma orchards. This pest can easily be controlled by arsenate of lead sprays. If there was no fruit the previous year, curculio sprays may be omitted.

*Borers.* Peach borers are prevalent in the state and sometimes are very destructive to both peach and plum trees, especially when the orchard is planted in a sandy type of soil. The borer is found in the trunk of the tree near the surface of the soil. This insect can be effectively controlled by the use of paradichlorobenzene or ethylene dichloride emulsion.

*Brown Rot.* Brown rot is the disease most frequently found on Oklahoma peaches, particularly upon such varieties as Early Wheeler, Carmen, and Champion. J. H. Hale and Elberta are usually not seriously affected by brown rot. When prevalent, it can be controlled by the application of such mild fungicides as self-boiled lime sulfur, dry-mix sulfur lime, atomic sulfur, etc. This disease sometimes attacks the buds and blossoms, making applications of sprays previous to the blooming season desirable, particularly in the eastern part of the state. Lime sulphur applied as a dormant spray will be very helpful in preventing early infestations of brown rot as well as serving as a control for San Jose scale and Peach leaf curl.

*Peach Scab.* Peach Scab causes sooty spots on the fruit, and in severe infestations may cause the fruit to crack. It is worse during wet seasons, and is easily controlled by the sprays applied to control brown rot.

#### **Cherries**

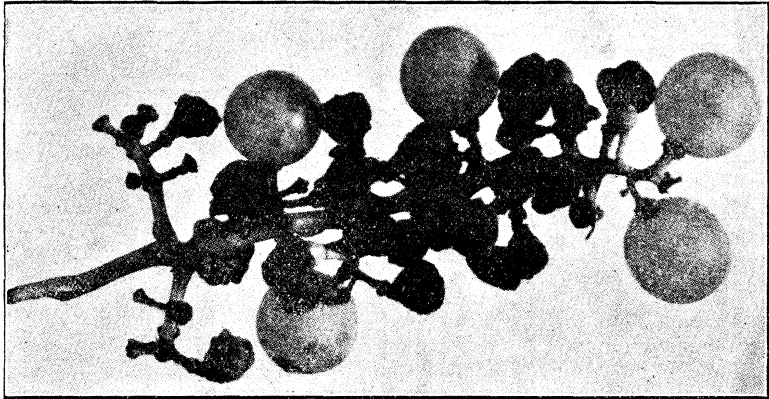
*Curculio.* Cherries are frequently attacked by curculio in much the same manner as peaches. Arsenate of lead sprays are effective for the control of this insect.

*Cherry Leaf Spot.* Cherry leaf spot is a disease usually found prevalent in Oklahoma. Trees are weakened by the loss of foliage during July and August due to the attacks of this

fungous disease. This loss of foliage may be prevented by controlling the disease by the application of dilute Bordeaux sprays.

**Grapes**

*Black Rot.* This disease is very common on grapes in Oklahoma. It affects the young shoots, leaves, and fruit. Sometimes the fruit is completely destroyed. Effective control can be had by timely spraying with Bordeaux mixture.



**Fig. 5. Black Rot of Grapes.**

## SPRAY SCHEDULES

### Apples

Name of Spray and When to Apply	What to Spray For	Materials and Amounts
Dormant. Late winter or early spring.	San Jose Scale, similar scale insects.	One gal. commercial lime sulphur in 8 gals. of spray or oil sprays prepared as directed.
First Summer Spray. When flower buds show pink but before they open. May be omitted in absence of scab and canker worm.	Scab, curculio, canker worm, aphid.	Bordeaux mixture 2½-5-50 plus 1½ lbs. arsenate of lead. If aphids are present add ½ pint nicotine sulphate to 50 gals. spray.
Second Summer Spray. Begin spraying when two-thirds of the petals have fallen.	Scab, curculio, and codling moth.	1¼ gals. commercial lime sulphur and 1½ lbs. arsenate of lead in 50 gals. spray.
Third Summer Spray. Two or three weeks after petals have fallen. Just before codling moth eggs hatch.	Scab, blotch, bitter rot, curculio, and codling moth.	Bordeaux mixture 2-4-50 plus 1½ lbs. arsenate of lead and ½ gal. prepared spray oil.
Fourth Summer Spray. Four weeks after the petals have fallen.	Blotch, bitter rot, black rot, codling moth.	Bordeaux mixture 2-4-50 plus 1 lb. arsenate of lead and ½ gal. prepared spray oil.
Fifth Summer Spray. Eight weeks after the petals have fallen.	Codling moth and leaf hoppers.	One lb. arsenate of lead, 2 lbs. hydrated lime, ¼ pint nicotine sulphate and ½ gal. prepared spray oil in 50 gals. spray.

Sixth and Later Summer Sprays. Apply at three-week intervals, following fifth summer spray, spray to consist of one lb. arsenate of lead, 2 lbs. hydrated lime, ¼ pint nicotine sulphate in 50 gals. of spray applied until within 4 to 6 weeks of harvest.

NOTE 1. This schedule will probably overload fruit with arsenate of lead, and therefore make spray residue removal necessary. This may be accomplished by washing in a 2 percent hydrochloritic acid solution. To avoid the necessity of washing the use of oil and nicotine may be relied upon for control after the fifth summer spray, but the expense of spraying will be greater and there is some danger connected with the use of oil during the summer while the temperature is high.

NOTE 2. All of the above sprays are necessary for best results in the control of insects and diseases. However, fair results may sometimes be procured by application of second summer, third summer and fifth summer sprays, particularly in young orchards not seriously infested with codling moth and when used in connection with bands.

## Pears

If San Jose Scale is present use the dormant spray recommended for apples; otherwise, the *second, third, and fifth summer sprays*, as listed under the spray schedule for apples, will usually control pear pests. Additional sprays may be required for codling moth control.

## Peaches and Plums

Name of Spray and When to Apply	What to Spray For	Materials and Amounts
Dormant Spray. Any time after the leaves drop in the fall and before the buds swell in the spring.	San Jose Scale; peach leaf curl.	One gal. commercial lime sulphur in 8 gals. spray or spray oils mixed as directed. (See Note 2.)
First Summer Spray. Begin spraying when $\frac{1}{4}$ of the petals have fallen.	Curculio.	One lb. arsenate of lead and 3 lbs. hydrated lime in 50 gals. spray.
Second Summer Spray. When the shucks are falling (about 10 days after the petals have fallen).	Curculio, Brown rot; scab.	One lb. arsenate of lead; 3 lbs. hydrated lime and $12\frac{1}{2}$ lbs. dry mixed sulphur lime in 50 gals. spray, or (other sulphur sprays used according to directions).
Third Summer Spray. Two weeks later. (About four weeks after the petals have fallen.)	Brown rot; scab.	$12\frac{1}{2}$ lbs. dry mixed sulphur lime in 50 gals. spray, or (other sulphur sprays used according to directions).
Fourth Summer Spray. Four weeks before the peaches are due to ripen.	Brown rot.	Same application as third summer spray.

NOTE 1. Early peaches sometimes require only two sprays. Use the materials recommended for the *First Summer and Second Summer Sprays*, applying them at the time prescribed.

NOTE 2. If scale is present use prepared spray oil in the fall or spring, but where *leaf curl* was present the previous season, use commercial lime sulphur, one gallon in eight gallons of spray after the leaves have fallen in the fall or before the buds have started to swell in the spring; this will control both scale and peach leaf curl. Bordeaux mixture and prepared spray oil may be used as a combination spray, applied during the dormant season for the control of leaf curl and San Jose scale. *Lime sulphur* and *oil* cannot be mixed.

## Cherries

Name of Spray and When to Apply	What to Spray For	Materials and Amounts
First Summer Spray. Just after blossoms fall.	Curculio; brown rot; leaf diseases.	Bordeaux mixture 1-2-50 plus one lb. arsenate of lead.
Second Summer Spray. As soon as the husks are off the fruit.	Curculio and brown rot.	Same mixture as First Summer Spray.
Third Summer Spray. After fruit is harvested.	Leaf spot.	Bordeaux mixture 1-2-50.

NOTE: Sweet cherries are subject to San Jose scale infestation; sour cherries are not. The *second* and *third Summer Sprays* are sometimes the only ones required. If no serious trouble has been experienced with worms or loss of foliage, these two will be sufficient.

## Grapes

Name of Spray and When to Apply	What to Spray For	Materials and Amounts
First Summer Spray. When shoots have two leaves.	Black rot; anthracnose; and flea beetle.	Bordeaux mixture 3-5-50 and 1½ lbs. arsenate of lead.
Second Summer Spray. Before blossoms open.	Black rot; anthracnose and flea beetle.	Bordeaux mixture 3-5-50 and 1½ lbs. arsenate of lead.
Third Summer Spray. After blossoms fall.	Black rot; anthracnose; curculio.	Bordeaux mixture 4-6-50 and 1½ lbs. arsenate of lead; also add ½ pint of nicotine sulphate if leaf hoppers or aphids are present.
Fourth Summer Spray. Two weeks after third summer spray.	Black rot; anthracnose; curculio; leaf hopper.	Bordeaux mixture 4-6-50 and 1½ lbs. arsenate of lead; also add ½ pint of nicotine sulphate if leaf hoppers or aphids are present.
Fifth Summer Spray. Two weeks after fourth summer spray.	Black rot; anthracnose; curculio; leaf hopper.	Bordeaux mixture 4-6-50 and 1½ lbs. arsenate of lead; also add ½ pint of nicotine sulphate if leaf hoppers or aphids are present.

NOTE 1. The most serious losses in grape growing come from black rot. Other diseases and insects frequently need attention. The complete schedule is necessary for best results in the control of all insects and diseases. However, good results may sometimes be secured from the application of three of the above sprays: i. e. *second summer spray just before blossoms open, third summer spray just after blossoms fall, and fourth summer spray two weeks later.* These sprays are especially important and should never be omitted.



## INSECTICIDES

An insecticide is any material used for the control of insects.

*Arsenate of Lead.* Arsenate of lead is used more than any other poison to control insects with biting mouth parts that attack fruit trees. From one to one and one-half pounds of powdered arsenate of lead in 50 gallons of spray is recommended for most insects with chewing mouth parts.

Arsenate of lead for a spray solution should be mixed in water before it is strained into the spray tank. The agitator in the tank should be in motion when this material is put in and the spray should be applied as soon as possible after the arsenate of lead has been added.

*Nicotine Sulphate (Blackleaf 40).* Nicotine sulphate is the most satisfactory preparation with which to control soft bodied insects with sucking mouth parts, such as plant lice. If nicotine sulphate solution is used alone, use it at the rate of  $\frac{1}{2}$  pint in 50 gallons of spray plus three pounds of soap. The addition of nicotine sulphate to other sprays will increase the cost of the material about one cent per gallon of spray.

*Para-di-chloro-benzene (P. C. Benzine or P. D. B.).* Paradichlorobenzene is used for the control of the peach tree borer. It is a white crystalline substance resembling fine ice cream salt. When exposed to the air at a temperature above 50 degrees Fahrenheit it vaporizes, giving off a heavy poisonous gas that penetrates the borer's tunnels, killing the insect.

The treatment is recommended only for trees four years old or older, although results indicate that trees of any age can be treated without injury if the material is removed two or three weeks after application, and if lesser amounts are used per tree.

Prepare each tree by removing the grass from about the base of the trunk. Having cleared a space six inches wide about the base of the trunk, it is desirable to remove any large amount of gum just above the ground level. Where the borers are working above the ground level it is well to build up a mound of soil slightly higher than the injury and place crystals around the tree on top of this mound, because the gas that is liberated is heavier than air and kills only those insects at or below the point of application. Use only enough paradichlorobenzene to make a narrow closed ring around the tree about an inch from the trunk. One-half to three-fourths of an ounce will be enough to use for each tree. The material is then cov-

ered to a depth of three or four inches with several spadefuls of soil free of trash built in a cone shape, and packed slightly with the back of the spade. Experience indicates that it is not necessary to remove the mounds except in the case of young tender trees as mentioned above.

Do not treat trees when the ground is water soaked or when the temperature is below 50 degrees Fahrenheit. Apply about the first of October in the fall or if the fall application was omitted, apply between April 15 and May 15, when soil temperatures are favorable, the following spring.



Fig. 6. Tree at left being prepared for P. D. B. treatment. Tree in center shows P. D. B. in place. Tree at right shows mound after completing P. D. B. treatment.

*Ethylene Dichloride Emulsion.* This material is a relatively new fumigant that has been used successfully for the control of peach tree borers. The emulsion can be purchased in stock solution form which is made by emulsifying ethylene dichloride with fish-oil soap in percentages varying from 50 to 90 percent. Care should be exercised in diluting the stock solution according to directions given by the manufacturer.

The next table gives the quantity of water to be added to a 50 percent stock emulsion of ethylene dichloride to get 10 gallons of diluted emulsion of the different strengths and the dosages found to be most satisfactory for use on peach trees of various ages.

Age and size of trees	Quantity of water and of stock emulsion to use to get 10 gallons of diluted emulsion		Strength of the diluted emulsion	Dosage of the diluted emulsion for each tree
	Water	50 percent stock emulsion		
	Gallons	Gallons	Percent	
Six years and older (average size and larger trees)	5	5	25	½ pint
Six years and older (small size trees)	6	4	20	½ pint
Four and five years	6	4	20	½ pint
Three years	7	3	15	½ pint
Two years	7	3	15	¼ pint
One year	8½	1½	7½	⅓ pint

Ethylene dichloride emulsion can be applied for the control of the peach borer any time during the fall or spring. Best results will probably be obtained in the fall at the end of the egg-laying period of the peach borer moths, when most of the borers are small.

The emulsion can be applied either by spraying or pouring. The quantity should be regulated rather closely, since applications much in excess of the recommended dosage may cause tree injury. Applications are made by wetting the soil immediately surrounding the tree, and the lower part of the trunk should receive some of the material during treatment. No preparation of the soil before treatment is necessary on loose, level ground. In some cases, however, cupping the soil slightly toward the tree trunk to prevent the liquid from running off, or loosening the soil around the tree sufficiently to permit the liquid to be readily absorbed, will give better results. Several shovelfuls of soil should be placed against the trunk of the tree after treatment to prevent surface loss of the fumigant.

*Oil Sprays.* It is better to buy commercially prepared spray oils than to try to make oil emulsion on the farm. There are a large number of good prepared spray oils on the market. Follow closely the directions given by the manufacturer for mixing and using the brand purchased.

### FUNGICIDES

A fungicide is any material used for the control of fungus diseases.

*Bordeaux Mixture.* Bordeaux mixture is the best fungicide for the control of apple scab, blotch, bitter rot, black rot, cherry leaf spot, and black rot of grapes. The formula for making Bordeaux mixture 3-6-50 will serve to illustrate how the spray is made. The 3-6-50 refers to:

3 pounds of Copper Sulphate (Bluestone)  
6 pounds of Hydrated Lime  
50 gallons of water

*Making Bordeaux Stock Solution Method.* Two stock solutions should be prepared, one of copper sulphate and one of lime at the rate of one pound to a gallon of water. Dissolve 50 pounds of copper sulphate in 50 gallons (use wooden barrels) of water. This is most easily done by placing the copper sulphate in a burlap bag and suspending it in the top of the barrel of water. The bag may be suspended by tying it to a stick which rests across the top of the barrel. Some time is required for the copper sulphate to go into solution, and this process should therefore be started the evening before the day when spraying is to be done. In case it becomes necessary to make a stock solution in a short time hot water will shorten the time required for the copper sulphate to go into solution.

The 50 gallons of solution thus obtained is known as the copper sulphate stock solution. Mix 50 pounds of hydrated lime with 50 gallons of water. This is the stock solution of lime.

To make 50 gallons of 3-6-50 Bordeaux spray put 30 to 35 gallons of water in the spray tank and add through the strainer three gallons of the copper sulphate stock solution. Start the pump and add through the strainer six gallons of the lime stock solution. Add enough water to make 50 gallons. The result is 50 gallons of a 3-6-50 Bordeaux spray. For larger amounts simply use multiples of this formula. For instance, if 100 gallons of Bordeaux mixture are wanted use six gallons of the copper sulphate stock solution and 12 gallons of the lime stock solution diluted as described above and made up to 100 gallons. It is well to remember that the tank should be two-thirds full of water before any solution is added.

When lump or stone lime is used instead of hydrated lime, use two-thirds the amount specified, which in making 50 gallons of 3-6-50 Bordeaux mixture would be four pounds of lump or stone lime. Slake this lime and add it through the strainer.

Bordeaux mixture should be used soon after it is made. The stock solutions, however, may be kept indefinitely if covered to prevent evaporation and to keep out trash. Never make copper sulphate stock solution or Bordeaux mixture in metal containers.

When arsenate of lead is to be used with Bordeaux sprays add it just as the tank becomes full and apply the spray immediately.

*Making Bordeaux Instant Mix Method.* Instant Bordeaux mixture can be made by using the powdered form of copper sulphate which dissolves quickly when added to water, thus eliminating the necessity of making stock solutions. Copper sulphate and lime are used in the same amounts as described under the stock solution method. Fill the spray tank two-thirds full of water and start the agitator. Wash through the strainer three pounds of powdered copper sulphate and allow three or four minutes for it to dissolve. Dissolve through the strainer six pounds of hydrated lime, make up to 50 gallons and a 3-6-50 Bordeaux mixture spray is ready for use.

*Lime Sulfur.* Lime sulfur is both an insecticide and a fungicide prepared by boiling 100 pounds of sulfur and 75 pounds of lime in 50 gallons of water for an hour or longer. It is sold in concentrated form as commercial lime sulfur (33 degrees B).

For many years self-boiled lime sulphur has been recommended and used as a spray for the control of brown rot of stone fruits, especially peaches. This self-boiled lime sulphur has proved to be efficient in the control of this disease, but it is rather difficult to prepare under farm conditions and has therefore never been popular with growers.

*Dry Mix Sulfur Lime.* A spray mixture has been developed which is much easier to make. It is called "dry mix sulfur lime." The ingredients are mixed dry, then diluted with water to make the spray. A large amount of the dry materials may be mixed at one time and kept for future use. This spray has been used at the Oklahoma Experiment Station and has given good results. It has proved to be effective in disease control and has not injured trees or fruit. Many other experiment stations report similar results. One southern station has reported some burning of the foliage after using this spray, but taken all in all it has given such uniformly good results that it is suggested that Oklahoma peach growers give it a thorough trial.

To make the spray, mix 8 pounds of finely ground sulfur (flowers of sulfur is not fine enough), 4 pounds of fresh hydrated lime, and one-half pound of calcium caseinate, or this proportion. This is the right amount to make 50 gallons of spray material. The best way of mixing seems to be with a barrel mixer. This mixer is made by attaching short sections of gas pipe to the ends of a good heavy barrel so that the barrel may be suspended as on an axle, and rotated. A handle should be attached to one end of the axle for the purpose of turning the barrel. A door large enough to admit a scoop shovel is cut in the barrel so the material may be shoveled in and out. Eight or 10 smooth stones about three inches in diameter should be placed in the barrel with the material to be mixed in order to prevent its packing tight and sticking to the sides of the barrel. Turning for about five minutes will insure a good mixture. If the sulfur is lumpy it should be sieved before mixing. One hundred fifty to 200 pounds of the material may be mixed at one time. After mixing, it is a good plan to weigh out enough for each tank of spray material and place it in separate containers.

To dilute this mixture for spraying add enough water to the proper amount of dry mix to make a barrel or tank of spray. For a 50-gallon barrel this will be 12½ pounds and for a 200-gallon spray tank it will be 50 pounds. Enough water should be added to make a thin paste; then pour it through the strainer into the barrel or tank. If it does not pass through the strainer readily, turn the spray nozzle on the strainer screen and force it through. Then fill the tank and add the arsenate of lead just before starting to the orchard, if arsenate of lead is to be used.

Sulfur fine enough to pass through a 200-mesh screen should be used. Ordinary commercial flowers of sulfur is too coarse and should not be used. The hydrated lime should be fresh. Two gallons of skim milk may be substituted for the one-half pound of calcium caseinate.

There are several wettable forms of commercial sulfur on the market which can be used satisfactorily. They consist of finely ground sulfur to which a wetting agent has been added which causes the sulfur to mix evenly with water. They should be mixed and used according to directions.

**PROTECT TREES FROM RABBITS**

Rabbits will injure fruit trees as long as the bark is smooth. The best and cheapest protection in the long run is a collar made of hardware cloth or one inch mesh poultry wire. Place the collars around the trees immediately after transplanting, leaving plenty of room between the wire and the trunk. As the tree grows, enlarge the collar to avoid damaging the trunk.

*Rabbit paint.* The trunk and lower branches of young fruit trees may be protected from rabbit injury by painting with a resin alcohol repellent in the fall before rabbit injury occurs and giving later applications as necessary. Usually one thorough application in the fall is sufficient each year, but where rabbits are very numerous an additional application may be needed in midwinter.

*Method of Preparing Rabbit Paint.* Use resin and alcohol in the proportion of 1 pound of resin to 1 pint of denatured alcohol. Warm the resin over a slow fire just to melting point but do not superheat it. Heat the alcohol to about the temperature of the resin. Do not heat the alcohol over a direct flame, but warm it in a pan or bottle immersed in hot water. Add the heated alcohol to the melted resin and stir to an even consistency. If the resin is too hot the alcohol will bubble and escape. Immediately after mixing place the preparation in a container that can be sealed tightly and keep sealed, except when in use. Keep water out of the preparation, as moisture changes the texture of the paint.

Apply with a brush when bark is dry. Cover bark of trunk and lower limbs as far as rabbits can reach.

## PUMPS AND EQUIPMENT



Fig. 7. Extension Bamboo Spray Rod with Cut-off.

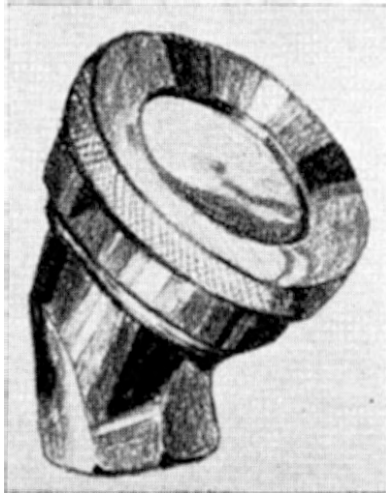


Fig. 8. Angle Disc Spray Nozzle.

*Selecting the Sprayer and Equipment.* To determine the size of the spray pump for the job, figure gallonage requirements for one application and secure pump with sufficient gallons per minute capacity to apply the spray solution in three working days or less. Keep in mind time needed to refill sprayer and allow for emergencies. Convenient water supplies, orchard filling stations, or hauling water to sprayer promotes the most efficient use of portable spray pumps.

Select tanks for portable rigs as large as can be pulled to advantage to save time in refilling. Check up your pump occasionally to determine gallons per minute actually delivered through the nozzles. Spraying into a large open head drum of 50-gallon capacity or larger for a given period, such as one minute, and measuring discharge with gauge stick previously notched in gallons, is helpful for check-up work. Time required to empty the tank also tells you gallons per minute dis-



charge. Many rigs, especially after some use, are found to deliver far less than the rated pump capacity, and need attention to valves, packing, leaks, etc. Sometimes restrictions in pipe lines, and size or condition of hose or fittings, or use of nozzles with too small disks prevent discharge of pump capacity.

The barrel pump is the smallest unit that can be used for efficient spraying in a small orchard. Power outfits are necessary for larger orchards, i. e., five acres or more of mature trees. A good barrel pump equipped with 50 feet of good spray hose, a cut-off and an 8-foot bamboo rod (See Fig. 7) fitted with a disc type of nozzle having a 45 degree angle (See Fig. 8) is the minimum unit with which effective spraying can be done.

Power sprayers are much more satisfactory for efficient work than barrel pumps, regardless of whether the orchard is large or small. In many instances, neighboring fruit growers could purchase a company or partnership power outfit and arrange to spray all of the orchards in the community with this one company-owned sprayer. It is sometimes possible to secure the services of a custom sprayer. Although the cost of a power outfit is high compared to that of a barrel outfit, the results to be expected from the use of these two types will invariably be in favor of the power outfit. These are power outfits of various sizes; and the price is usually based upon the capacity of the outfit. Rubber tires make it possible to move the outfit rapidly from one place to another without damage to the machinery. The tank and pump are sometimes mounted upon an old car or truck chassis.

*Pressure.* Pressure at nozzles of 350 pounds or more on power rigs has given finest break-up of spray fog and most economical coverage. Pressure of 600 pounds or more gives splendid coverage. High pressures are limited only by added power costs and ability of hose and equipment to withstand the higher pressures. With fine fog break-up the higher pressures have given least spray injury and most satisfactory coverage for the gallons applied.

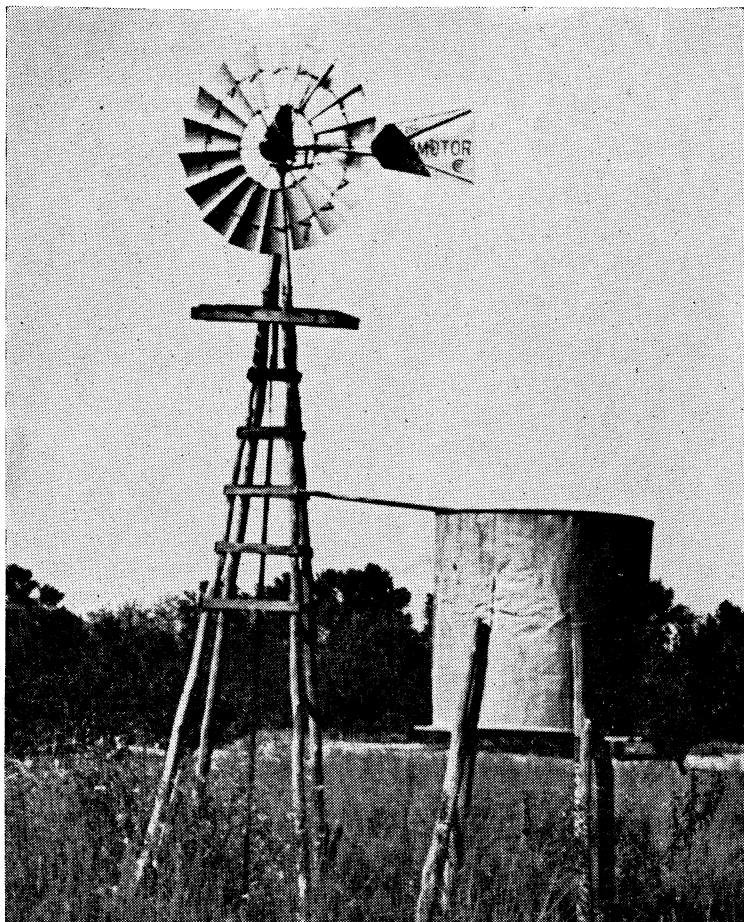


Fig. 9. Overhead Water Supply Tank.

*Water Supply System.* A water supply system, set up so that the sprayer can be filled quickly and so that there will be only a short haul, is necessary. Locate supply tanks in the center of each 20-acre block of orchard. In most cases the water can be pumped at the source of supply into one tank, and piped from there by gravity to supply tanks located at convenient points. All tanks should be set up so that they serve as overhead filling stations with a 4-inch discharge pipe equipped with a gate valve for quickly filling the sprayer.

*Care of the Sprayer.* The proper care of the sprayer does much to increase its useful life. At the end of each day's spraying, water should be pumped through the spray pump, hose, and nozzles to clean out all chemicals. At the close of the spraying season, the pump, hose, and all equipment should be thoroughly cleaned with water and drained. Then the hose, rods, and guns should be taken off the sprayer and looked over carefully, and any needed repairs made. Nozzles should be cleaned and oiled. The pump should be filled with oil and parts apt to corrode should be cleaned and coated with grease before the rig is put away for the winter.

*Method of Spray Application.* The most important factor in getting a spraying job well done is the sprayman himself. He must start each needed application on time, finish on time, and use equipment and methods skillfully so that every part of each tree is thoroughly coated with finely broken spray fog, applied to give safe, uniform coverage. There is no substitute for a skillful, alert, thorough-working sprayman.

Many difficulties are encountered when growers insist on only "spraying with the wind," because often the orchard is not completely sprayed within the necessary time interval for best control of pests. Applications must be completed on time and methods employed that secure prompt complete coverage.

#### **AMOUNT OF SPRAY LIQUID REQUIRED**

It may require as many or even more than eight gallons of spray fluid to cover a mature apple tree when used as a winter spray when no foliage is on the tree and as many as 12 or more when applied as a summer spray when the tree is in partial or full foliage. The amount used under the different conditions varies so much that a trial spray on a few average sized trees in an orchard may be necessary where a correct estimate is desired for an entire orchard. Since all parts of the trees must be covered it follows that some parts may be treated two or three times before others are treated at all. Furthermore, some of the fluid will be wasted because of windy weather, poor ability on the part of the person making the application, or irregularly shaped trees. In any case to be effective, the spray materials applied for the control of orchard pests should be applied carefully to cover every part of the tree, its foliage and fruit, with a thin coat of spray material.





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