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# The Control of Insects, Fungi, and other Pests

University of Tennessee Agricultural Experiment Station

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THE CONTROL OF INSECTS, FUNGI AND  
OTHER PESTS

BY

GORDON M. BENTLEY

KNOXVILLE, TENNESSEE

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Bulletins of this Station will be sent, upon application, free of charge, to any farmer in the State

# THE CONTROL OF INSECTS, FUNGI AND OTHER PESTS

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This bulletin has been prepared in response to the numerous requests and urgent demand from all parts of the State for general information on the control of insects, fungi and other pests. It consists of a compilation of suggestions on the preparation and use of various insecticidal and fungicidal formulas.

Many people believe that insects and fungi are controlled only by applications of chemical preparations, and give little attention to the prevention of attacks by cultivation, drainage, planting and rotation, based upon a knowledge of the habits and life histories of the pests. This impression has led us to give the suggestions below regarding preventive measures.

## PREVENTIVES

**In general** While much may be accomplished in the control of insects and fungous diseases by the use of insecticides and fungicides, more attention should be given to the prevention of the introduction of crop pests by judicious legislation, to the selection of resistant plants, to the elimination of weeds and worthless plants which harbor pests or act as intermediary hosts and are often of the same family as those under cultivation, to judicious rotation of crops, and to better drainage, cultivation and fertilization.

**Cultural methods** Cultural methods of overcoming attack and injury by pests are based upon a knowledge of their habits and life histories. Simple rotations, season of planting, the use of trap plants, fall plowing, early planting, and many other average operations of the farm, if done with an intelligent knowledge of the habits and development of the pests to be controlled, will often of themselves prove decidedly efficient. One of the most important points to be considered in this connection is the manner of hibernation, which often suggests cultural methods.

**Rotation** The succession of the same or similar crops on the same land has proved disastrous in more ways than by the reduction of soil fertility. Its encouragement of the increase of insects and fungi has become notorious. The corn root worm, boll worm (or corn ear worm), Hessian fly, and many other pests are more or less affected by crop rotation, and their control by this method should be carefully studied.

In sections affected with contagious diseases of live stock pasture rotation is essential. In the control of stomach and intestinal worms in sheep, hogs and cattle intelligent rotation covering definite periods, based upon longevity and life history of the pests, is now recognized as the most available and economical plan.

The fever cattle tick, infesting several counties of Tennessee and responsible for the national quarantine of the area infested, may be perma-

nently eradicated by positive rotation. It has been found that if cattle and horses are removed from a pasture during the summer months it becomes free from ticks. During the winter if infested cattle are run upon a corn-field or other cultivated field upon which no animals have been during the summer all the ticks will drop off, after which the animals may be placed upon the pasture that was freed of ticks during the previous summer. The Experiment Station has prepared a bulletin upon the eradication of the ticks by pasture rotation methods, which may be had on application.

#### Parasites

While it may seem anomalous, probably the greatest factors in the control of insects, at least, are other insects and fungous diseases which are parasitic within or upon them. Such are truly friends of the producer, but they can not be brought thoroughly under his control until insect life is better understood. Unable to identify these friends or to understand their operations, man too often treats them as enemies or minimizes their mission.

#### Insecticides and fungicides

Insecticides are substances which kill insects. Fungicides are substances which destroy fungous diseases. When insects and fungous diseases prevail upon the same plants insecticides and fungicides may be combined and the two results gained from one application.

Variable results have been obtained from the use of insecticides and fungicides, due largely to climatic conditions and to the quality, age and preparation of the ingredients used and the combinations made. A knowledge of the pest being treated and the nature of the plant infested is an important consideration.

For remedial treatment, insects are divided, according to their manner of feeding, into biting and sucking groups. Hence, in the economic application of insecticides a knowledge of the mouth parts of insects is essential. To obtain this one has only to notice carefully the damage being done or study the insect and observe whether its mouth is provided with jaws for biting (chewing) or a beak for sucking. Until a distinct familiarity with insect anatomy and general classification is procured it may be better to send specimens to the Station for identification and remedial suggestion. Specimens should be accompanied by pieces of plants upon which they feed and if possible some examples of the character of the damage done.

#### How to make an emulsion

In the making of an emulsion it is essential that the oil when added to the water be thoroughly agitated in order that a thorough mixing of the ingredients be obtained. This may be accomplished by turning the nozzle of the force pump into the mixture and forcing the solution through. The heat, however, is injurious to the valves of the pump. A jet of steam, if handy, could be used with good results. A simple device for making a perfect emulsion is one originated by H. A. Morgan, mentioned in Bulletin No. 48 (second series) of the Louisiana Agricultural Experiment Station, Baton Rouge, La.

It consists of a tin cylindrical vessel, 18 inches long and 4 inches in diameter, and a plunger or piston 22½ inches long, as shown in Fig. 1. About one inch from the lower end of the cylinder is a row of seven holes

each  $\frac{1}{4}$  inch in diameter. In the center of the bottom of the cylinder is a single opening  $\frac{1}{2}$  inch in diameter. The plunger consists of a  $\frac{1}{4}$ -inch iron rod with tin cone  $3\frac{1}{2}$  inches high and of a circumference that will permit it to fit nicely within the cylinder, as shown in Fig. 3. This is firmly soldered on one end of the rod and a handle is fitted on the other. A row of five holes, each  $\frac{1}{4}$  inch in diameter, is made  $\frac{1}{2}$  inch from the base of the cone. In the base is an opening  $\frac{1}{2}$  inch in diameter. The openings at the base of the cylinder and at the base of the cone may be increased in number and lessened in diameter. This hastens the operation of emulsifying but increases the labor. The above-described implement can be made by any tinsmith, and should not cost more than 35 or 40 cents.

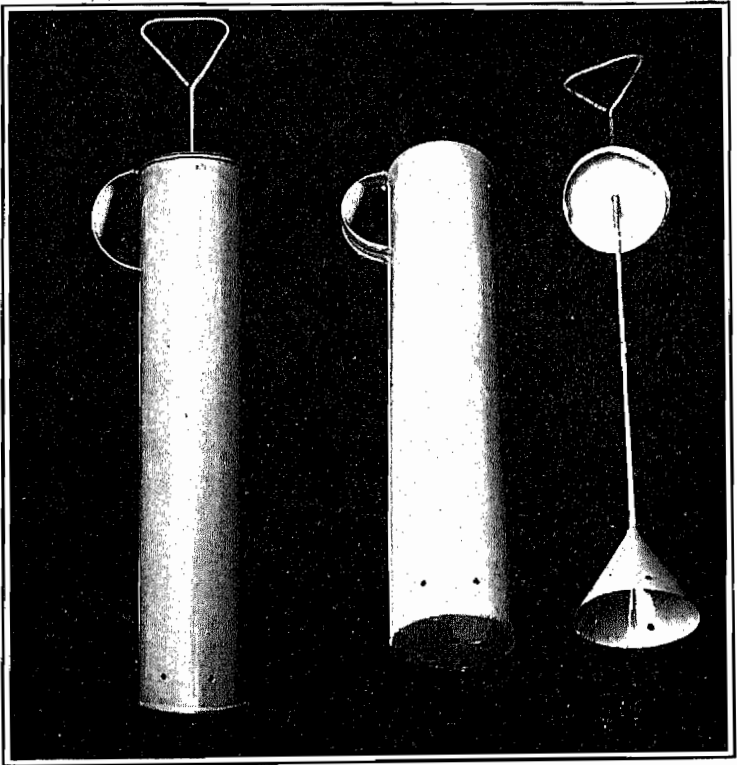


FIG. 1

FIG. 2

FIG. 3

### INSECTICIDES FOR BITING INSECTS

#### 1. Paris Green (dry)

Paris green	1 pound
Flour or	
Land plaster or	
Slaked lime	20 to 50 pounds

These should be mixed thoroughly. The best results will be obtained if the solution is applied while there is dew on the leaves.

**1a. Paris Green (wet)**

Paris green	1 pound
Quicklime	1 to 2 pounds
Water	200 to 300 gallons

Slake the lime in part of the water; then add the Paris green slowly. Vary the strength according to the tenderness of the foliage. For tender growing peach and the like use 300 gallons of water.

**2. London Purple**

London purple	1 pound
Quicklime	2 to 3 pounds
Water	60 to 200 gallons

London purple is somewhat cheaper than Paris green, but its strength is variable and its use is therefore not to be recommended.

**3. Arsenate of Lead**

Acetate of lead (sugar of lead)	12 ounces
Arsenate of soda	4 ounces
Water	50 gallons

Put the arsenate of soda into a wooden bucket with 2 quarts of water. Put the acetate of lead into another bucket with 4 quarts of water. When these two are dissolved, mix well with the water and spray.

Arsenate of lead will not burn foliage, it mixes more readily and is held in suspension longer than Paris green. Prepared arsenate of lead is much more convenient. This comes in the form of a thick paste, which can be readily reduced to the proper strength.

**3a. Arsenate of Lead**

Arsenate of lead	8 to 12 pounds
Water	200 gallons

Arsenate of lead is also used with the Bordeaux mixture instead of the Paris green.

**4. Hellebore**

White hellebore	1 ounce
Water	2 gallons

The hellebore may be used without reducing.

**5. Resin Lime Mixture**

Pulverized resin	5 pounds
Concentrated lye	1 pound
Fish or animal oil	1 pint
Water	5 gallons

Place the oil, resin and 1 gallon of hot water in a kettle and heat till the resin softens; then add the lye and stir thoroughly; add 4 gallons of the hot water and boil till a little will mix with cold water and make a clear amber-colored solution. Add water to make 5 gallons. Keep this as a stock solution. For use take—

Water	16 gallons
Milk of lime	3 gallons
Paris green	$\frac{1}{4}$ pound
Stock solution	1 gallon

The object of this preparation is to obtain an adhesive material which will cause the poison to adhere to smooth leaves, like those of cabbage and cauliflower.

### 6. Green Arsenoid

This is an arsenical poison which is used by some persons instead of Paris green. It seems to remain in suspension longer than Paris green; yet its use is not general.

### INSECTICIDES FOR SUCKING INSECTS

(Insects like plant lice, scales, squash bugs, etc.)

#### 7. Kerosene Emulsion

Kerosene (coal oil)	2 gallons
Soap	½ pound
Water (soft)	1 gallon

Dissolve the soap in water by boiling, remove from the fire, add kerosene, mix vigorously until all forms a creamy mass and emulsion. Dilute according to the per cent wanted.

For 10 per cent oil emulsion add	17	gallons of water
" 15 " " " " " "	10½	" "
" 20 " " " " " "	7	" "
" 25 " " " " " "	5	" "
" 30 " " " " " "	4	" "
" 40 " " " " " "	2	" "
" 50 " " " " " "	1	" "

#### 7a. Treatment for Ticks, Horn Flies, Stable Flies, Etc.

Cotton-seed oil (fish oil may be substituted)	1 gallon
Sulphur	1 pound
Carbonate of potash	1 pound
Concentrated lye	3 ounces
Beeswax	½ pound
Zenoleum	1 pint
Water	3 gallons

Heat the cotton-seed oil, sulphur, potash and beeswax until the beeswax is melted, then add 3 gallons of cotton-seed oil or fish oil. To this add 1 pint of zenoleum or crude carbolic acid. Before applying this wash to cattle or horses dilute with equal parts of water, thoroughly mixing it to form a good emulsion.

#### 8. Whale Oil Soap Solution

Whale oil soap	1½ to 2 pounds
Hot water	1 gallon

Use this solution for late winter spray.

#### 8a. Whale Oil Soap Solution

Whale oil soap	¼ pound
Hot water	1 gallon

Use for summer spray.

#### 9. Boiled Lime-Sulphur Wash

Quicklime	21 pounds
Sulphur (flowers or flour)	18 pounds
Water	50 gallons



Slake lime in about 5 gallons of hot water; add the sulphur that has been made into a thick paste with water; boil, stirring frequently, for one hour; dilute all to make 50 gallons. While boiling add water from time to time to keep the solution thin enough to boil readily. Apply this wash while it is hot.

#### 9a. Unboiled Lime-Sulphur Wash

Quicklime	20 pounds
Sulphur (flowers or flour)	15 pounds
Sal soda	10 pounds
Water	50 gallons

Put a few pails of water into a wooden barrel; add the lime, sulphur and soda; stir frequently; let it remain from 20 to 30 minutes. Dilute to make 50 gallons.

The lime-sulphur wash from the standpoint of cheapness, accessibility and efficiency is the best spray now known for the San Jose scale. Numerous patent remedies for the scale are upon the market. There is a place for a few of these which have given good results, for they are convenient, and when there are only a few trees to spray it does not always pay to take time to make the lime-sulphur wash. Many of these patent "scale-cides" are ineffective when used according to the directions given on the packages. If their strength is increased sufficiently to make an effective spray the cost is increased to from ten to fifteen times what the lime-sulphur wash costs. The Station has tested some fifteen of these patent remedies at varying strengths. The most satisfactory results were obtained from Pratt's Scalecide, Kiloscale and Con-sol.

The time for applying the lime-sulphur wash is while the trees are dormant, as in the late fall, winter or early spring. Prune the trees before spraying and do thorough spraying. If all parts of the trees cannot be covered at the first spraying repeat the process soon.

#### 10. Tobacco Infusion

Tobacco (waste or stems).	1 pound
Boiling water	4 gallons

Add hot water to tobacco when cold; strain, and add 1 pound of whale oil soap or 2 pounds of soft soap to each 50 gallons of tobacco infusion.

#### 10a. Tobacco Dust

Tobacco is effective against the root aphid when used freely upon the roots.

#### 11. Carbolic Acid Emulsion

Soap	1 pound
Carbolic acid (crude)	1 pint
Water	1 gallon

Dissolve the soap in hot water, add carbolic acid, and churn vigorously until an emulsion is formed. Dilute with 30 parts of water.

#### 12. Pyrethrum Powder (Insect Powder)

For spraying use—

Pyrethrum powder	1 ounce
Water	3 gallons

**12a. Pyrethrum Powder (Insect Powder)**

For dusting—

Mix thoroughly 1 part by weight of pyrethrum with 4 parts of flour. Keep in a closed vessel for 24 hours before using.

**13. Lye Sulphur**

Sulphur (flowers)	20 pounds
Caustic soda	10 pounds

This spray is especially good for red spider. To the sulphur mixed with water to make a paste add the caustic soda. Add cold water to prevent burning. When cool add water to make 20 gallons. This gives the stock solution. For use add 50 gallons of water to 2 gallons of this stock solution.

**14. Sulphur**

Dry flowers of sulphur dusted upon moist leaves is an effective remedy for plant lice.

**COMBINED INSECTICIDES AND FUNGICIDES****15. Bordeaux Mixture and Paris Green**

Copper sulphate	4 pounds
Quicklime	6 pounds
Paris green	4 to 5 ounces
Water	40 to 50 gallons

**15a. Bordeaux Mixture and Arsenate of Lead**

Copper sulphate	4 pounds
Quicklime	6 pounds
Arsenate of lead	1½ pound
Water	50 gallons

**15b. Bordeaux Mixture and Arsenate of Lime**

Copper sulphate	4 pounds
Quicklime	6 pounds
Arsenate of lime	1½ quart
Water	50 gallons

**16. Ivory Soap**

Ivory soap	1 pound
Water	15 gallons

Dissolve the soap in hot water and apply when warm.

**17. Bait for Cutworms**

Bran or middlings	40 pounds
Paris green	1 to 2 pounds

Add enough molasses to sweeten well; mix with water to make a thick mash. Spread around on the ground late in the evening. Keep fowls from this.

**FOR FUMIGATING****18. Hydrocyanic Acid Gas**

Potassium cyanide	1 ounce
Sulphuric acid	2 ounces
Water	4 ounces

This charge is for 100 cubic feet.

For one or two-year-old apple, pear, plum and peach. Allow fumigation to continue for 40 minutes.

### 18a. Hydrocyanic Acid Gas

Potassium cyanide	$\frac{2}{3}$ ounce
Sulphuric acid	$1\frac{1}{2}$ ounce
Water	3 ounces

This charge is for 100 cubic feet.

For June buds, roses and budding and grafting wood. Allow fumigation to continue for 30 minutes.

Hydrocyanic acid gas is lighter than air, highly penetrating, and a deadly poison. The enclosure in which this gas is used should be perfectly air-tight. Care should be taken to get the right chemicals for this fumigating, the cyanide to be fused 98 per cent, the sulphuric acid to be the best commercial, specific gravity 1.83. For more detail upon fumigation see Bulletin No. 2 of the Tennessee State Board of Entomology, on The Fumigation of Nursery Stock.

### 19. Carbon Bisulphide

1 pound to 100 bushels of grain.

Leave in tightly closed bin for 24 hours.

$1\frac{1}{2}$  tablespoonful may be used for every 100 pounds.

The bisulphide may be thrown upon the grain or it may be put into shallow dishes and set upon the grain. The gas is much heavier than air and sinks down through the grain, killing any insects that may be there.

**Caution.**—Carbon bisulphide is highly inflammable. Do not approach the enclosure containing this gas with a lantern, a lighted pipe or a cigar. When fumigation is over let the bin thoroughly ventilate.

### 20. Sulphur

Burn 6 ounces of sulphur in a space of 1000 cubic feet. Keep closed for at least 12 hours.

### 21. Nikoteen

Nikoteen	$\frac{1}{7}$ ounce
Water	5 ounces

Place this upon a hot steam pipe and let it vaporize at night. The amount given above is sufficient for a space of 1000 cubic feet.

## FUNGICIDES

### 22. Bordeaux Mixture

Copper sulphate	4 pounds
Quicklime	6 pounds
Water	40 to 50 gallons

Dissolve the copper sulphate by suspending it in a bran bag or gunny sack in a wooden vessel containing 4 or 5 gallons of water. Slake good quicklime in another vessel. When ready to use the Bordeaux mixture, add each of the above-mentioned solutions to two separate barrels, each containing 25 gallons of water. These two solutions may now be added by pouring one into the other and thoroughly mixing. The result is 50 gallons of the Bordeaux mixture ready for use.

Separately the sulphate and the lime solutions may be kept for some time, but when these are mixed the solution should be used.

#### 22a. Weak Bordeaux Mixture

Copper sulphate	2 pounds
Quicklime	2½ pounds
Water	50 gallons

Make according to the foregoing suggestion.

#### 23. Potassium Sulphide (Liver of Sulphur)

Potassium sulphide	1 ounce
Hot water	2 gallons

Use as soon as it is cool.

#### 24. Ammoniacal Copper Carbonate Solution

Copper carbonate	6 ounces
Ammonia	3 pints
Water	40 to 50 gallons

Dissolve copper carbonate in the ammonia. This may be kept in a jar or bottle tightly corked. When ready for use dilute with water.

#### 25. Formalin

Formalin	1 pint
Water	30 gallons

#### 26. Corrosive Sublimate Solution

Corrosive sublimate	2½ ounces
Hot water	2 gallons

#### 27. Eau Celeste Solution

Copper sulphate	2 pounds
Ammonia	1 quart
Water	50 gallons

### TREATMENT

**Apple.**—For codling moth, canker worm, fall web worm, tent caterpillar, Tussock moth and fungous diseases, use the strong Bordeaux mixture.

For oyster-shell scale and scurfy scale, use 15 per cent kerosene emulsion.

For San Jose scale use lime-sulphur wash, either formula 9 or 9a.

**Apricot.**—Same treatment as for peach and plum.

**Asparagus.**—For beetle, spray with arsenate of lead after you have stopped cutting; during the spring pyrethrum powder may be dusted on the larvae.

For rust, spray during July and August with the Bordeaux mixture.

**Bean.**—For rust or anthracnose, spray with the Bordeaux mixture every ten days.

**Blackberry.**—For fungous attacks, use Bordeaux mixture or copper sulphate solution before the buds open.

For insect attacks, use Bordeaux mixture and Paris green or Bordeaux and arsenate of lead, just before the flowers open and just after the bloom has fallen.

**Cabbage.**—For club root, rotate crop or lime the soil at the rate of 35 to 50 bushels per acre.

For lice, use 10 per cent kerosene emulsion.

For cabbage worms, use Paris green when the plants are young; when the plants begin to head use hellebore.

For Harlequin bug, use a trap crop; when this is thickly infested spray with pure kerosene.

**Celery.**—For rust and blight, use Bordeaux every ten days or two weeks.

**Cherry.**—Same treatment as for plum.

**Chrysanthemum.**—For blight, use Bordeaux mixture. Repeat every ten days or two weeks.

**Corn.**—For wire worms, rotate crops and practice fall plowing.

For the weevil in the bins, fumigate with the carbon bisulphide.

For red spider, use the lye-sulphur wash.

**Cotton.**—For red spider, use the lye-sulphur wash.

For lice, use 10 per cent kerosene emulsion.

For the caterpillar, use Paris green, either wet or dry.

**Cucumber.**—For the blight, use Bordeaux mixture.

For the beetle, use Bordeaux mixture and the arsenate of lead or Paris green.

For lice, use 10 per cent kerosene emulsion.

**Currant.**—For the worm, use Bordeaux mixture and the arsenate of lead before fruit is nearly grown. After this time use hellebore.

**Dewberry.**—Same treatment as for the blackberry.

**Elm.**—For the beetle, use arsenate of lead.

**Gooseberry.**—Same treatment as for the currant.

**Grape.**—For rot and mildew or anthracnose, use Bordeaux mixture.

For the aphid, use 15 per cent kerosene emulsion.

For the flea beetle, use Paris green or arsenate of lead.

For fungous diseases, use the Bordeaux mixture.

For the root worm, use arsenate of lead at the rate of 4 pounds to 50 gallons of water.

**Greenhouse.**—For the thrips, use nikoteen, 1-7 ounce; water, 5 ounces. See formula No. 21.

For the white fly, use hydrocyanic acid gas according to formula No. 18, diluted to from 1-10 to 1-20 that strength, according to the tenderness of the plants and the condition of the house.

**Lettuce.**—For the aphid, use the tobacco infusion.

**Muskmelon.**—Same treatment as for the cucumber.

**Nectarine.**—Same treatment as for the peach.

**Nursery stock.**—For the San Jose scale, burn if badly infested; if slightly, use hydrocyanic acid gas.

For the aphid, use 15 per cent kerosene emulsion.

For fungous diseases, use the Bordeaux mixture.

**Oats.**—For the smut, use formalin.

**Onion.**—For the root maggot, use carbon bisulphide in the ground.

**Peach.**—Same treatment as for the plum. The foliage is very tender,

and consequently liable to burn with Paris green or the poorly made Bordeaux. Arsenate of lead is better.

**Plum.**—For black knot, prune and burn. Spray before the buds open, with Bordeaux mixture.

For brown rot, thin fruit and spray early with the Bordeaux mixture.

For the leaf blight, shot-hole fungous, use weak Bordeaux.

For the curculio, use Paris green or arsenate of lead. The jarring method is also practiced successfully.

For the scale insects, notice treatments for the apple.

**Quince.**—For the scale, same treatments as for the apple.

For the fungous diseases use Bordeaux mixture.

**Pear.**—For the pear blight, cut out below the affected region and burn.

For the psylla, use 15 per cent kerosene emulsion.

For scale and fungus, same as treatment on apple.

**Potato (Irish).**—For the scab, use formalin or corrosive sublimate.

For the beetle, use Bordeaux and arsenate of lead or Paris green.

**Raspberry.**—Same treatment as for the blackberry.

**Rose.**—For the mildew, use sulphide of potassium.

For the aphid, use the 15 per cent kerosene emulsion.

For the chaffer, use arsenate at the rate of 4 pounds to 50 gallons or water.

For the slug, use hellebore, Paris green or tobacco.

**Strawberry.**—For the fungous diseases, use the Bordeaux mixture.

**Tobacco.**—For the horn worm, use arsenate of lead or Paris green.

For the cut worms, use poison mash or arsenate of lead on clover.

For the cigarette beetle, use carbon bisulphide.

**Tomato.**—For the rot, use Bordeaux mixture, and repeat every ten days or two weeks if necessary.

**Watermelon.**—Same treatment as for the cucumber.

### SUGGESTIONS

All chemicals used in spraying should be kept correctly labeled and out of reach of children.

Never spray when the trees are in bloom. This will kill the bees which are necessary for fertilizing the flowers. Spray just before the buds open or just after the bloom has fallen.

Never put the lime-sulphur wash in a copper sprayer. The action of the chemical is very rapid upon the copper and will shortly destroy a copper sprayer. For spraying this wash use galvanized iron or a wooden receptacle.

In spraying, great pains should be taken to cover all parts of the tree, shrub or plant. If a heavy rain immediately follows your application of the spray the process should be repeated. Do not spray when the foliage is wet.

In all the formulas which require quicklime, the best stone lime freshly burned should be used. Air-slaked lime will not answer.

When hydrocyanic acid gas is used, fully fifteen minutes should be allowed for ventilating the enclosure after the fumigation is over. This

gas being a deadly poison, all precautions against breathing it should be taken.

It is difficult to keep quicklime if the atmosphere is at all moist. Under these conditions the lime should be slaked with water while it is yet fresh. When slaked it may be kept for months if a little water is kept over it. In this form use  $2\frac{1}{2}$  to 3 pounds to each pound called for in the formulas.

Bordeaux mixture should be applied several times, once before the buds break, once after the bloom falls, then after a lapse of ten days or two weeks. A fourth application can be made a week later. With some fungous diseases the Bordeaux can be profitably used every ten days to two weeks. If the lime-sulphur wash has been used the first application of the Bordeaux may be omitted.

*Information about insects and insect pests and fungous diseases will be gladly furnished if specimens of insects and their work be sent to us. Place specimens in a box, wrap neatly and put your name and address somewhere upon the package. In an accompanying letter tell us all you have noticed about the insect or disease, its first appearance, rapidity of increase, extent of destruction, etc.*

#### AVOID ACCIDENTAL INTRODUCTION OF THE MEXICAN COTTON BOLL WEEVIL

Mr. W. D. Hunter, in charge of the boll weevil investigation for the U. S. Department of Agriculture, Bureau of Entomology, has announced that the cotton boll weevil will in all probability spread over the entire cotton area of the United States. At the present rate of natural spread it will be a number of years before the cotton growers of Tennessee will be troubled by this pest unless it is accidentally introduced through imported infested cotton seed, hulls or other media in which it may be hibernating. The State Board of Entomology, in order to guard against such introduction and to protect the cotton interests of the State, issued under the Act creating a State Entomologist and Plant Pathologist, approved April 17, 1905, Senate Bill 442, the following Regulation:

"11. In accordance with Sec. 9 of the Law, and in order to prevent the importation of the Mexican cotton boll weevil into Tennessee from the State of Texas and the infested portion of Louisiana, a quarantine is hereby declared against the following counties of the State of Texas:

Anderson	Comanche	Harris	Llano	San Augustine
Angelina	Cook	Harrison	Madison	San Jacinto
Aransas	Coryell	Hays	Marion	San Patricio
Atascosa	Dallas	Henderson	Matagorda	San Saba
Austin	Delta	Hidalgo	McLellan	Shelby
Bastrop	Denton	Hill	McMullen	Smith
Bee	DeWitt	Hood	Milam	Somervell
Bell	Duval	Hopkins	Mills	Starr
Bexar	Eastland	Houston	Montague	Stephens
Blanco	Ellis	Hunt	Montgomery	Tarrant
Bosque	Erath	Jack	Morris	Titus
Bowie	Falls	Jackson	Nacogdoches	Travis
Brazoria	Fannin	Jasper	Navarro	Trinity
Brazos	Fayette	Jefferson	Nueces	Tyler
Brown	Fort Bend	Johnson	Newton	Upshur
Burleson	Franklin	Karnes	Orange	Van Zandt
Burnet	Freestone	Kaufman	Palo Pinto	Victoria
Caldwell	Galveston	Kent	Panola	Walker
Calhoun	Gillespie	Kendall	Parker	Waller
Cameron	Goliad	Lamar	Polk	Washington

Camp	Gonzales	Jamparas	Rains	Wharnton
Cass	Grayson	Javaca	Red River	Williamson
Chambers	Gregg	Lee	Refugio	Wilson
Cherokee	Grimes	Leon	Roberson	Wise
Collin	Guadalupe	Liberty	Rockwell	Wood
Colorado	Hamilton	Limestone	Tusk	
Cornal	Hardin	Live Oak	Sabine	

and the following parishes of Louisiana: Bossier, Caddo, Calcasieu, Cameron, De Soto, Grant, Sabine, St. Landry, and Vernon, Red River, Natchitoches, and Rapides Parishes lying west of the Red River.

"(a) No cotton lint, (loose, baled, flat, or compressed), cotton seed, seed cotton, cotton-seed hulls, seed-cotton or cotton-seed sacks (which have been used), or corn in the shuck, shall be shipped into Tennessee from the infested counties of Texas and parishes of Louisiana, as above enumerated.

"(b) Shipments of household goods from the infested areas of Texas and Louisiana shall not be admitted into Tennessee unless accompanied by an affidavit attached to the waybill, to the effect that the shipment contains no cotton lint, cotton seed, seed cotton, cotton-seed hulls, seed-cotton or cotton-seed sacks, or corn in the shuck.

"(c) It shall be unlawful for anyone in Tennessee to have in his possession live Mexican cotton boll weevils. The public is urged to recognize the danger of introducing unwittingly live boll weevils for inspection, observation, or experiment."

The Department of Entomology will be glad to identify cotton insects and to assist in every way in protecting the cotton interests from the accidental introduction of the boll weevil.

### SPRAYING APPARATUS

The only satisfactory way to apply a spray is by means of a spray pump fitted with a good nozzle, either a Vermorel, Mistry or Bordeaux, according to the kind of spray you are applying. If you have no pump one should be purchased. Before buying, consult catalogues of the different leading firms dealing in spray machinery. The following-named manufacturers may be relied upon:

- Field Force Pump Co., Elmira, N. Y.
- Goulds Manufacturing Co., Seneca Falls, N. Y.
- Morrill & Morley, Benton Harbor, Mich.
- Deming Pump Co., Salem, Ohio.
- Spray Motor Co., Buffalo, N. Y.
- Wm. Stahl, Quincy, Ill.
- F. E. Myers Pump Co., Ashland, Ohio.