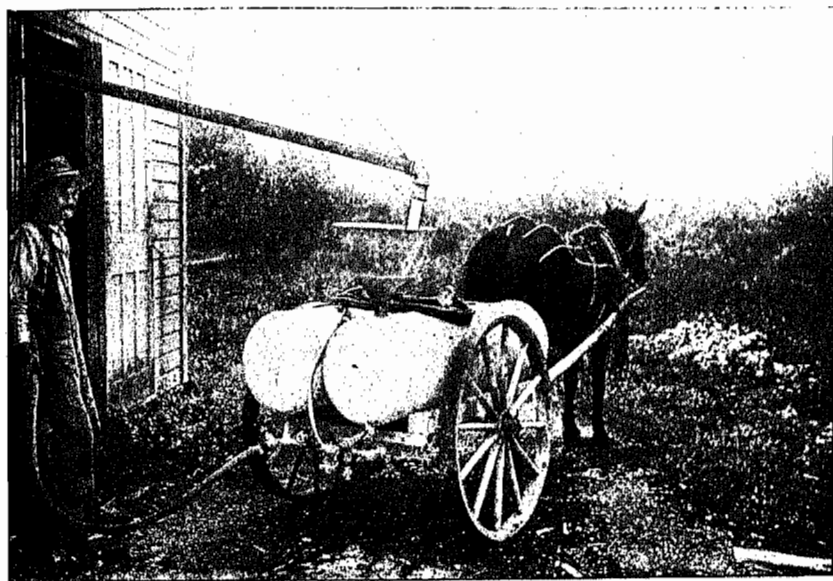


BULLETIN
OF THE
Agricultural Experiment Station
OF THE
UNIVERSITY OF TENNESSEE



NUMBER 99

APRIL, 1913

SUGGESTIONS ON PREPARATION AND
USE OF SPRAY FORMULAS

BY

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KNOXVILLE, TENNESSEE

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

SUGGESTIONS ON PREPARATION AND USE OF SPRAY FORMULAS

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 permanently 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 Tennessee Experi-

ment Station has prepared a bulletin upon the eradication of the ticks by pasture rotation methods, which may be had on application.

Beneficial insects

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.

Birds

Birds as factors in insect control should be recognized. It is not uncommon to find large numbers of birds doing effective work in controlling insect outbreaks.

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.

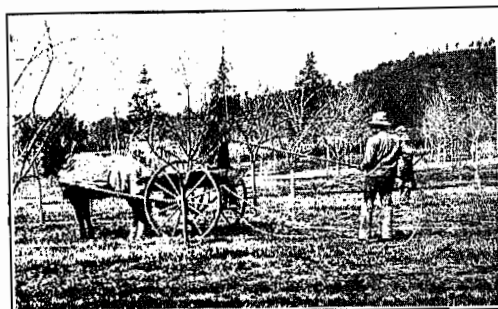


FIG. 1. THOROUGH AND TIMELY SPRAYING PAYS

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 State Entomologist for identification and remedial suggestion. Specimens should be accompanied by pieces of plants upon which they feed, and if possible some samples of the character of the damage done.

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 applied while there is dew on the leaves.

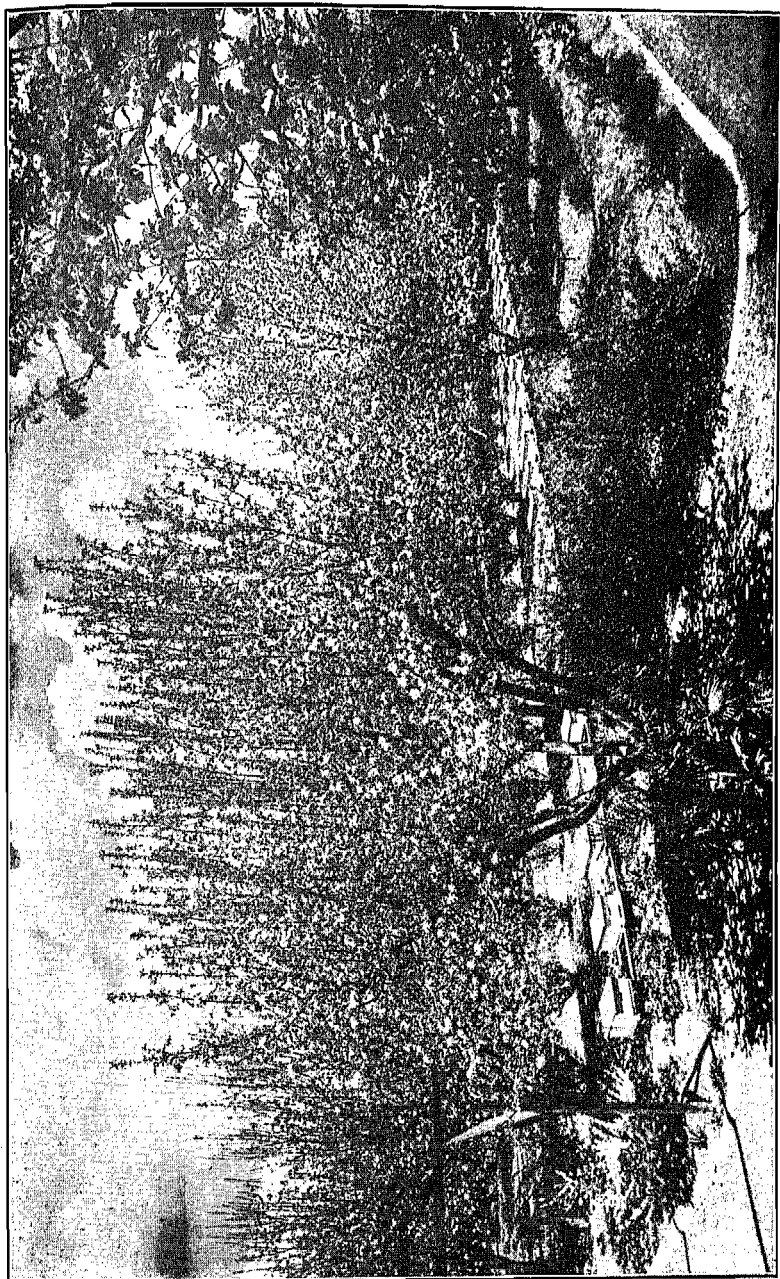


FIG. 2. NEVER SPRAY WHEN TREES ARE IN BLOOM; FLOWERS AND BEES WILL BE INJURED; BOTH ARE NECESSARY FOR A FRUIT CROP.

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 Parish 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. Arsenate of lead, also conveys as a powder in which case it is dusted on at full strength.

3a. Arsenate of Lead

Arsenate of lead	2 to 5 pounds
Water	50 gallons

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

3b. Arsenate of lime

White arsenic	1 pound
Lime	2 pounds
Water	3 gallons

Boil together for fully 40 minutes after the boiling point is reached. As a precaution against danger of burning of foliage, slake an additional pound of lime, add to it three or four gallons of water, and add to the boiled mixture. Strain and dilute to from 200 to 250 gallons for hardy vegetation such as potatoes. Do not use at all on stone fruits or on cucurbits. Dilute to 300 to 400 gallons for tender vegetation.

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, scale, squash bugs, etc.)

7. Kerosene Emulsion

Kerosene (coal oil)	2 gallons
Soap	$\frac{1}{2}$ 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	"	"	"	"	$10\frac{1}{2}$	"	"
"	20	"	"	"	"	7	"	"
"	25	"	"	"	"	5	"	"
"	30	"	"	"	"	4	"	"
"	40	"	"	"	"	2	"	"
"	50	"	"	"	"	1	"	"

How to make an oil 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 Prof. 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 $22\frac{1}{2}$ inches long, as shown in Fig. 3 (a). 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 (c). 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.

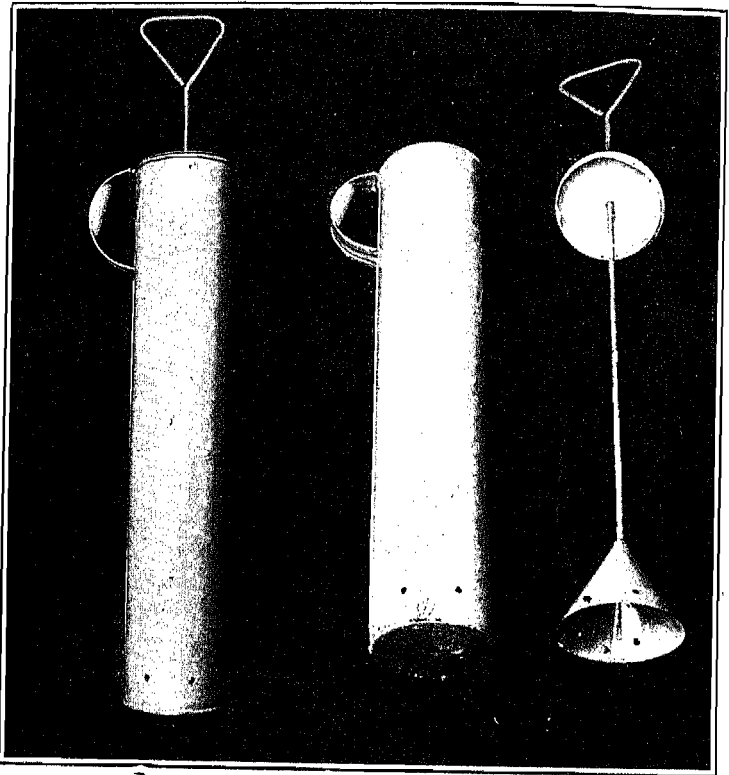


FIG 3

A.

B.

C.

AN EMULSIFIER

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	$\frac{1}{2}$ 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.



FIG. 4. THE EXCESS OF LIME LEAVES THE TREES WHITE

9. THE LIME-SULPHUR SOLUTIONS.

The sprays made from lime and sulphur may be divided into three heads, iz., the home-boiled, factory-boiled and self-boiled. The first two act both as fungicides and insecticides; the last only as a fungicide. All the lime-sulphur solutions have efficiency and cheapness which commend them highly.

Home-boiled Lime-sulphur Solution

Home boiled lime-sulphur may be made after many different formulas. The one which we have used with best success is made from
 21 lbs. stone lime (burnt lime).
 18 lbs. flour of sulphur.
 50 gallons water.

Into the boiler, a kettle or tray, (a barrel, or tank if steam is to be used) place five or six gallons of water; into this add the sulphur which has been passed through a flour sieve; then the lime, small quantity at a time. Fire should now be started under the boiler. After all the

lime has been added and the slacking has finished, add water to keep to a good boiling consistency and boil vigorously for 40 to 60 minutes. The solution is now ready to be thinned and strained carefully into the spray tank or barrel; sufficient water being added to make 50 gallons of spray.

This spray is for winter, late fall or early spring use. Never use while leaves or buds are opening. Never put this solution into a copper tank or sprayer, for its action upon copper is rapid and will soon ruin a receptacle of this metal.

This winter spray is for San José scale, and leaf-curl. The above is known as home-boiled solution.

Factory-boiled Lime-sulphur Solution

A very similar solution can be obtained in concentrated form from factories, and is then known as the factory-boiled. This is usually diluted with from 10 to 12 parts of water to make the winter spray. In barrel lots this sells for about \$10.00 per barrel, making the cost about the same as that made at home. There are many grades, the best of which are about as efficient as the home-boiled solution. If good lime cannot be obtained and the proper care given to making the solution, preference should be given to factory-boiled solution.

9a. The Self-boiled Lime-Sulphur Solution

The experiments with the self-boiled lime-sulphur solution for several years in different states have given results which highly commend this spray for the troubles which have heretofore been met with difficulty. All credit is due Mr. W. M. Scott, formerly Pathologist, Bureau of Plant Industry, Washington, D. C., for his preliminary experiments in 1907 and 1908. The following formula is from Bulletin 174, Bureau of Plant Industry, U. S. Department of Agriculture. The formula giving the best results is:—

8 lbs. flour of sulphur
8 lbs. fresh lime (burnt)
50 gals. water



FIG. 5. MAKING THE SELF-BOILED
LIME-SULPHUR SOLUTION

In making this mixture best results can be obtained by making a larger quantity—say four times this amount, as follows: To 8 or 10 gallons of water in a barrel add 32 pounds of fresh stone lime (the quicker acting lime the better); when the slacking begins add 32 pounds of fine sulphur which has been run through a sieve to break up all lumps. As the lime continues to slack, water may be added to keep it from drying. The mixture should be constantly stirred until the slacking is over, when more water is added to stop the cooking. Strain and dilute to make 200 gallons of spray. Only a small amount of soluble sulphur should be present; the desired solution is a mechanical mixture of lime and sulphur. In straining the spray the coarse parts of the lime are to be taken out but the sulphur worked through the sieve.

How and When to Use this Spray.

The self-boiled lime-sulphur solution should be applied in the form of a fine spray by a pump equipped with a good agitator. The time for applying will be governed by the disease to be treated. The number of applications may be one, two, three or four times, according to conditions and objects sought.

In place of the self-boiled lime-sulphur solution made at home the commercial concentrated solution may be diluted for summer use. With peach this should be used experimentally. With apple the following reduction gives good results.

Hydrometer Reading in Baume Degrees of the Concentrated Lime-Sulphur Solution	Gallons of Water to Add to One Gallon of the Commercial Concentrated Lime-Sulphur Solution
35	45
34	43½
33	41¼
32	40
31	37½
30	36¼
29	34¼
28	32¼
27	31
26	29½
25	27¼

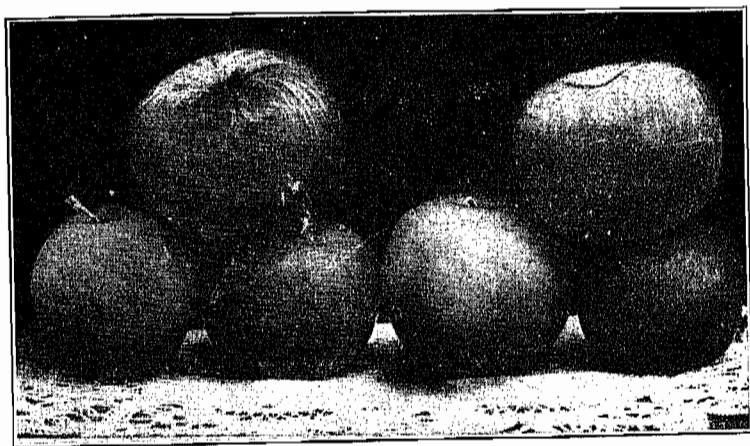


FIG. 6. APPLES FREE FROM BLEMISHES, BECAUSE THEY WERE SPRAYED WITH
LIME-SULPHUR SOLUTION

Deming County, Salem, Ohio

9b. Solution Sulphur Compound

Quicklime (burnt lime)	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 solution. Many of these patent "scalecides" 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. We have tested some fifty of these patent remedies at varying strengths.

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 thoroughly spraying. If all parts of the trees cannot be covered at the first spraying repeat the process soon.

9c. Soluble Sulphur Compound

Fill the spray tank or barrel about two-thirds full of water. Then add the Soluble Sulphur Compound. If agitator is then started while you are filling the remainder of the tank, the Soluble Sulphur Compound will be dissolved very quickly in either hot or cold water.

If Arsenate of Lead is Used in connection with the Soluble Sulphur Compound, it should be added last.

Use 10 pounds of the dry Soluble Sulphur Compound to each 50 gallons of water, for the control of San José Scale, Oyster Shell Bark Louse, Pear Psylla, Peach Leaf Curl, and other sucking insects or fungus diseases, when trees are dormant.

When trees are in foliage, for the control of Apple Scab and the larvae of sucking insects, use $1\frac{1}{2}$ to 2 pounds of Soluble Sulphur Compound to 50 gallons of water.

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.

10b. "Black Leaf 40"

"Black leaf 40"	$\frac{1}{2}$ to 1 pint
Water	100 gallons

"Black Leaf 40" is a solution of nicotine sulphate, guaranteed under the National Insecticide Act to contain 40% nicotine. It is highly recommended as a spray for soft bodied sucking insects.

"Black Leaf 40" used alone or diluted according to directions neither burns nor stains orchard-foliage or fruit; nor does it clog the spray nozzles.

"Black Leaf 40" is effective as a spray for plant lice, thrips, leaf hoppers, etc., in orchard or garden.

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 close 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 (Strong)

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 (Weak)

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.

18b. Sodium Cyanide

Sodium cyanide is now being used as substitute for potassium Cyanide—advantages being that it is cheaper and less poisonous to man.

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 in to 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. A trade name for carbon bisulphide is Fuma.

The above is a dosage at ordinary temperature at 60 to 70 degrees Fahrenheit. At much lower temperature a much heavier dose will be required. At higher temperature one-half to three-fourths the amount will suffice.

19a. Carbon Tetrachloride

2 pounds to each 100 cubic feet.

This fumigant is non explosive and may be used in place of carbon misulphide, where there is possible danger of fire. It is slower in its action than carbon bisulphide.

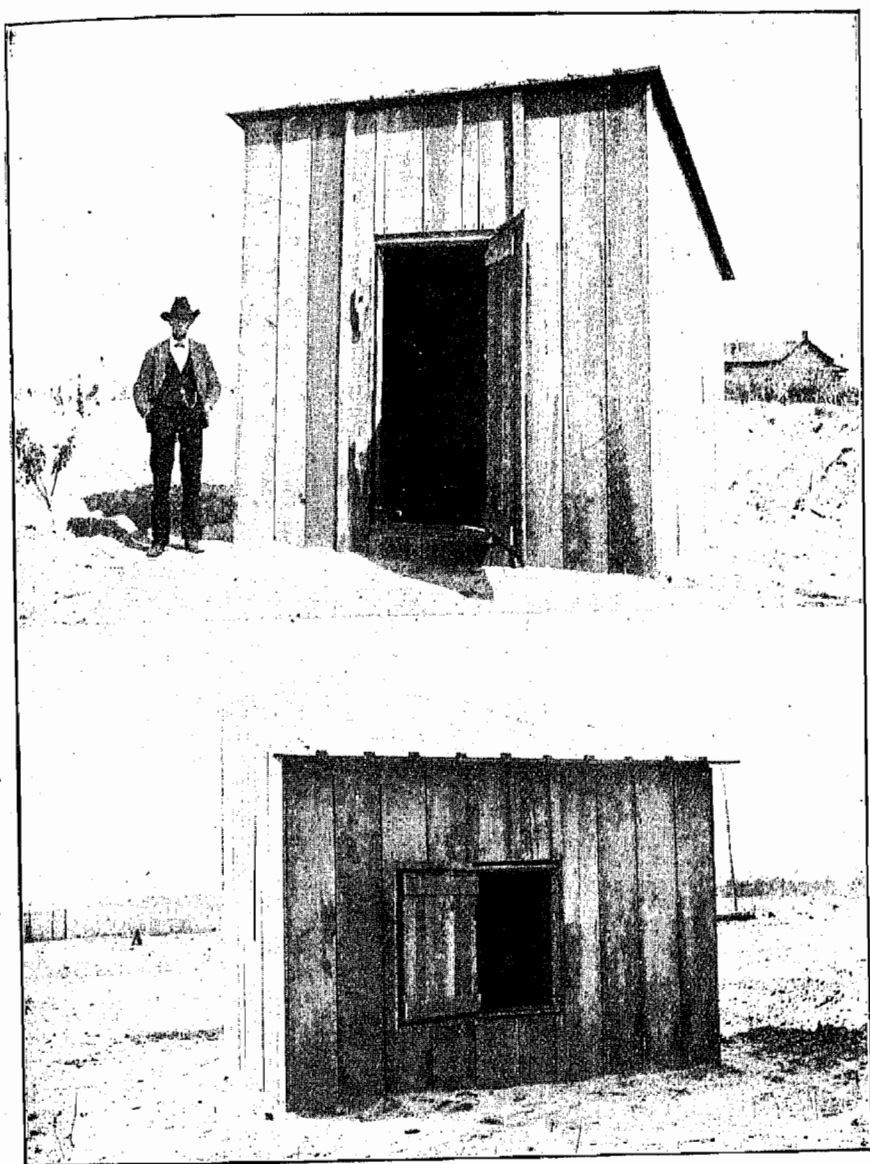


FIG. 7. AN INEXPENSIVE FUMIGATOR, FRONT AND REAR VIEWS

20. Sulphur

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

21. Nikoteen

Nikoteen	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. Self-boiled Lime-Sulphur Solution**

Stone lime (burnt lime)	8 pounds
Sulphur (flour)	8 pounds
Water	50 gallons

22a. Regular Bordeaux Mixture

Copper sulphate (blue stone)	5 pounds
Quicklime (burnt lime)	5 pounds
Water	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 burnt lime in another vessel. When ready to use the Bordeaux mixture, add each of the above-mentioned solutions to two separate barrels, each diluted to make 25 gallons. 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. This solution may be used on foliage not especially sensitive to copper.

22b. Strong Bordeaux Mixture

Copper sulphate (blue stone)	6 pounds
Quicklime (burnt lime)	4 pounds
Water	50 gallons

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

22c. Weak Bordeaux Mixture

Copper sulphate	2 pounds
Quicklime	2½ pounds
Water	50 gallons

Make according to the foregoing suggestion

23. Soda Bordeaux Mixture

(For very late spraying.)

Copper sulphate	4 pounds
Commercial Caustic Soda	1½ pounds
Water to make	50 gallons

Dissolve and mix the copper sulphate and lye and dilute this solution with the water before using. This mixture is used instead of the ordinary Bordeaux, when a fungicide is needed within six weeks of the time the fruit is to be gathered, as it will not seriously spot it.

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. Copper Sulphate Solution

Copper Sulphate	4 pounds
Water to make	50 gallons

For use before the buds open, the above solution is fully as effectual as Bordeaux mixture, and is easier to prepare and apply. The weaker solution should be used upon the peach, although no injury would be done upon any kind of fruit tree, while in a dormant condition, if the stronger solution should be used, but it should not be applied to any plant after the buds have opened.

26. Potassium Sulphide Solution (Liver of Sulphur)

Potassium sulphide	1 ounce
Hot water	2 to 3 gallons

Use as soon as it is cool.

27. Formalin Solution (For Oat and Wheat Smut)

Formalin (40% formaldehyde gas)	1 pint
Water	50 gallons

Soak the grain in this mixture for one hour and a half, spread out to become partially dry before sowing.

27a. Formalin Solution (For Potato Scab)

Formalin	16 ounces
Water	30 gallons

Before cutting potatoes for planting, place them in a sack and soak them two hours in the above mixture.

28. Corrosive Sublimate Solution (For Potato Scab)

Corrosive sublimate	2 ounces
Water	15 gallons

Dissolve the corrosive sublimate in 2 gallons of hot water and dilute to make 15 gallons. Soak potatoes in solution for 1½ hours before cutting them.

28a. Corrosive Sublime Solution (For Cabbage seed)

Corrosive sublimate	1 part
Water	1000 parts

Soak seed in this solution for 15 minutes. Black rot may be introduced on cabbage seed. It is advisable to soak seed as above.

29. Eau Celeste Solution

Copper sulphate	2 pounds
Ammonia	1 quart
Water	50 gallons

SPRAYING TO KILL WEEDS

In Lawns, Parks, Pastures, Hay and Grain Crops.

Spraying with the herbicides given can be used to destroy such weeds as mustard, dandelion, oxeye daisy, white-top, thistle, carrot, parsnip, elders, poison-ivy, ragweed, and all broad-leaved weeds. These sprays will leave narrow-leaved crops such as blue grass, timothy, red-top, and other grasses, including the growing cereal grains—wheat, oats, rye, etc., without injury if properly adapted in strength and time of application.

The time of applying the sprays has to be adjusted to the condition of the crop and the relative development of the weeds. The first spraying should be made not later than the beginning of the

bloom, and repeated applications should be made as new leaves are developed, provided the condition of the host crop will permit it. In grain fields, the best results with a single spraying will be obtained on most weeds by applying the spray just as the crop is ready to occupy the land.

Timothy and other grass meadows should be sprayed just before the grass begins heading out.

There are several solutions which may be used but in general common salt and iron sulphate solutions are found most satisfactory. They are effective in killing the more common weeds and are not dangerous to stock in pastures in which they may be used.

HERBICIDES

30. Common Salt Solution

Common salt	150 pounds
Water	50 gallons

Should be applied at the rate of 50 to 75 gallons per acre sprayed. Useful for killing Canada thistle, dandelion, poison-ivy, yarrow, horse nettle, etc.

31. Iron Sulphate Solution

Iron sulphate (copperas)	100 pounds
Water	52 gallons

Should be applied at the rate of 50 to 75 gallons per acre. Good to kill mustard, ragweed, white-top, yarrow, and other broad-leaved weeds in field of growing grain or timothy.

32. Formula for Brilliant Whitewash

Half a bushel of unslaked lime, slake with warm water, cover it during the process to keep the steam, strain the liquid through a fine sieve strainer; add a peck of salt previously well dissolved in warm water; three pounds of ground rice boiled to a thin paste and stir in boiling hot; half a pound of powdered Spanish whiting and a pound of glue which has been previously dissolved over a slow fire. Add five gallons of hot water to the mixture, stir well and let it stand for a few days, cover up to protect from dirt. It should be put on hot. Coloring matter may be put in to make it of any shade, Spanish brown, yellow ochre, or common clay, etc.

It is well to always strain before using in order to prevent any gritty substance from getting into the valves of the sprayer and interfering with its proper operation. With whitewash thin and smooth no difficulty will be experienced.

TREATMENT

Apple.—For codling moth, canker worm, fall web worm, tent caterpillar and tussock moth use arsenate of lead or Paris green. For fungous diseases, use the strong Bordeaux mixture or self-boiled lime sulphur solution.

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

For San José scale use lime-sulphur solution, either formula under 9.

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 clubroot, 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.

Cauliflower.—Same as cabbage.

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, or arsenate of lead, 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, or "Black leaf 40."

Muskmelon.—Same treatment as for the cucumber.

Nectarine.—Same treatment as for the peach.

Nursery stock.—For the San José scale, burn when infested; fumigate with hydrocyanic acid gas.

For the aphid, use 15 per cent kerosene emulsion.

For fungous diseases, use the Bordeaux mixture, or self-boiled lime-sulphur.

Oats.—For the smut, use formalin.

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

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.

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. Use self-boiled lime-sulphur solution instead of Bordeaux.

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 lime-sulphur solution.

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.

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

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

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

For the fungous diseases use Bordeaux mixture.

Raspberry.—Same treatment as for the blackberry.

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

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

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

For the slug, use hellebore, Paris green, tobacco or "Black leaf 40."

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.

Wheat.—For smut use formalin.

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.

COTTON BOLL WEEVIL QUARANTINE FOR TENNESSEE.

Pursuant to the recommendations of the Association of Cotton States Entomologists held in Atlanta December 5 and 6, and in Washington, D. C., December 29, 1911, the following restrictions are made on the shipment of the following articles coming from any State partially infested with the Mexican cotton boll weevil (*Anthonomus grandis*):

1. Seed cotton
2. Cotton seed
3. Seed-cotton sacks.
4. Cotton-seed sacks.
5. Cotton pickers sacks, any of which have been used within eight months for any of the purposes indicated.
6. Cotton-seed hulls between Aug. 1, and December 31.
7. Spanish moss and corn in shucks between Oct. 1, and June 30.
8. Living weevil or weevil stages or weevil work in possession of any person outside of the infested territory except a qualified entomologist.
9. Household goods containing any of the foregoing, during the period of quarantine applied to each.

There are no restrictions placed upon the following items at any season:

1. Baled cotton, flat or compressed.
2. Linters and loose cotton lint.
3. Cotton-seed meal, cake and oil.
4. Corn shelled or in the ear, with shuck removed, oats or any other seed except cotton seed.
5. Cotton seed shown by affidavit to have been sacked continuously for nine months or more.
6. Cotton seed for planting purposes after fumigation with carbon dioxide by a competent entomologist.
7. Hay.
8. Empty freight cars.

The principal object of the Association of Cotton States Entomologists is to secure uniformity of State laws in regard to the cotton boll weevil quarantine.

The cotton boll weevil has not as yet been found in Tennessee. Its nearest approach is in De Soto County Mississippi. The distance between the last dispersion line, made in November by the U. S. Bureau of Entomology, to Memphis is ten miles.

SPRAYING APPARATUS

The only satisfactory way to apply a spray is by means of a spray pump fitted with a good nozzle. Both of which should be especially selected for the work at hand. If you have no sprayer one should be purchased. Before buying, consult catalogues of the different leading firms dealing in spray machinery. The following-named manufacturers will gladly furnish catalogues:

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.
Bateman Manufacturing Co., Grenloch, N. J.
The Bean Spray Pump Co., Berea, Ohio.
E. C. Brown Co., Rochester, N. Y.
Dust Sprayer Sales Co., Kansas City, Mo.
Friend Manufacturing Co., Gasport, N. Y.
Fritzhenry-Guptill Co., Cambridge, Mass.
The Hardie Manufacturing Co., Portland, Ore.
Leggett & Bros., 301 Pearl St, New York, N. Y.
Niagara Sprayer Co., Middleport, N. Y.
Wallace Machinery Co., Champaign, Ill.
Ballou Manufacturing Co., Belding, Mich.