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How to control injurious insects and noxious plant diseases

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How to Control Injurious Insects and Noxious Plant Diseases.

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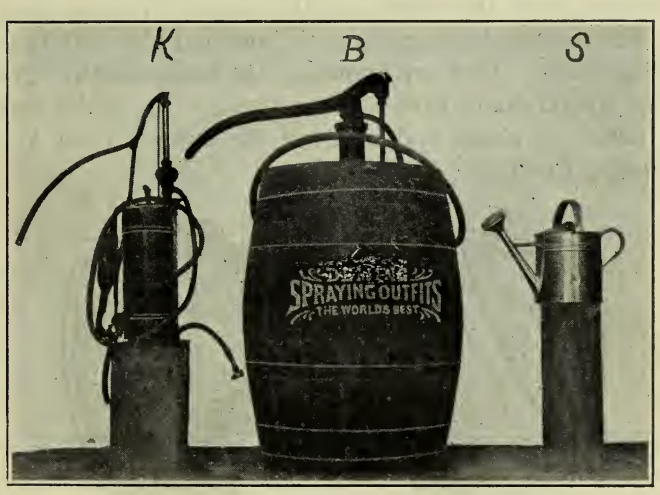

FIGURE 1—SPRAYING MACHINES.
S, hand sprinkler; K, knapsack; B, barrel sprayer.

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THE CONTROL OF INJURIOUS INSECTS AND PLANT DISEASES.

Introduction.—There is, in this State, a steadily increasing demand for information concerning methods of spraying and materials to use in combating injurious insects and noxious plant diseases. This bulletin is prepared in response to such a demand and is an attempt to set forth in a simple, plain way the preparation and use of a few of the leading insecticides and fungicides.

INJURIOUS INSECTS.

The two great groups of insect pests.—There are many kinds of insects that pester the farmer and fruit grower and all of them, taken together, may be divided into two great groups dependant upon the kind of mouth parts they have and the manner in which they attack plants. The insects of one group have jaws and bite off bits of plants and swallow them. They are known as the *biting insects.* The members of the second group have a bill or sucking tube which they insert into the tissues of plants and suck out the juices. These are known as the *sucking insects.*

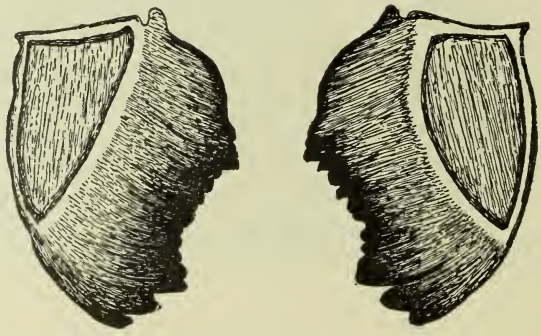

FIG. 2—THE BITING JAWS OF A GRASSHOPPER.

Insects that bite.—The grasshopper is a familiar example of the first class of insects, for it has biting mouth parts, composed of two pairs of jaws, one of which is hard and black and easily seen with the eye (Fig. 2). With these jaws the grasshopper bites off pieces of leaves, stems, etc., and swallows them much as a cow or horse would do. Very many insect pests have biting mouth parts like the grasshopper and eat parts of plants. For example, the caterpillars, or "worms," on cotton, tomatoes, cabbage, etc., the June bugs, fig-eaters, potato bugs, etc. All such insects are known as the *biting* insects.

How to fight the biting insects.—It is plain that an insect that persistently bites off pieces of leaves and swallows them stands a relatively high chance of being killed by putting some poisonous substance upon the leaves before they are eaten. After one determines that the pest causing the trouble bites and eats the plant, it will become necessary to decide what poison is best to use and how and when it is best applied.

Insects that suck the plants.—The squash bug, and the terrapin bug are examples of the other class of insects that suck the juices from plants, but do not bite off pieces of the plants and swallow them. If we look closely at a large squash bug we will find projecting from the under side of its head a long, slender beak. The same kind of a beak may be found on the head of a "terrapin bug," on the little green and black plant lice, and on the "stink" bugs. This little beak forms a tube which is forced into a leaf or stem and serves as a pipe through which to draw the sap into the mouth (Fig. 3).

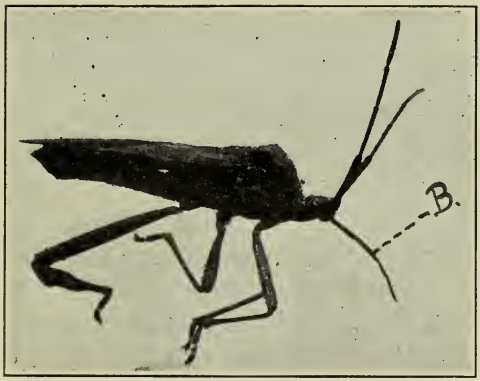

FIG. 3—A BUG WITH SUCKING TUBE.

How to fight sucking insects.—Since these insects draw their food from the inside of a plant, it is evident that no amount of poison placed on the leaves or stems of those plants would affect the insects because the latter would not get any of the poison. Such insects may be killed by putting something like oil, tobacco, soap, or sulphur on their bodies. We usually speak of this method of killing insects as the *contact* method.

Importance of knowing the kind of insect causing the trouble.—It is absolutely necessary to know what kind of an insect is causing the injury,—whether it is a biting or sucking insect. So this is the first

point to determine. If the pest is a biting insect then some poison sprayed upon the plant attacked will usually be the best remedy. If the pest is a sucking insect, then something must be used that can be sprayed upon the body of the insects to kill them.

SUBSTANCES FOR KILLING BITING INSECTS.

Paris green.—Probably Paris green is one of the best known poisons for biting insects. It is rather expensive, difficult to buy unadulterated and is quite liable to burn the foliage of plants if applied too strong.

It can be applied dry as follows:

1 pound of Paris green,
25 pounds of slaked lime or flour.

The two should be thoroughly mixed and may be sifted on the plants from a thin muslin sack, preferably in the morning while the dew is yet on.

Paris green may also be applied in water which we believe is a better method than the dry one for most plants. Quick lime is added to prevent burning of the foliage and the poison is used in the following proportions:

1 pound of Paris green
200 to 300 gallons of water
3 pounds quick lime.

Slake this lime in a little water and add the Paris green. Stir thoroughly and then add the proper amount of water,—for potatoes 200 gallons of water, and for peach, 300 gallons.

Arsenate of lead.—This is a combination of arsenic and acetate of lead and is better than Paris green because it sticks to the foliage better, will not burn the leaves, and remains in suspension longer. It can be made as follows:

11 ounces acetate of lead (white sugar of lead)
4 ounces arsenate of soda
50 gallons water.

Dissolve the acetate of lead in 4 quarts of water and the arsenate of soda in 2 quarts of water. Pour them together, mix thoroughly and then dilute with 50 gallons of water. It is then ready to use at once.

Arsenate of lead can be bought ready prepared and is very convenient to use. It should be used at the rate of 4 to 6 pounds of the rasenate of lead to 100 gallons of water.

Arsenite of lime.—White arsenic is cheap, easy to get, and is not often adulterated. Therefore, when it is combined with lime or sal soda to prevent burning of the foliage, it is a most satisfactory insecticide.

It may be prepared as follows:

1 pound white arsenic
4 pounds quick lime
4 gallons water.

Boil the lime and arsenic together in the water for half an hour and then dilute with 200 gallons of water for spraying.

Arsenite of lime may also be prepared according to the Kedzie formula which consists in boiling *two pounds of white arsenic* and *eight pounds of sal soda* in **two gallons of water** for 15 or 20 minutes, or until the arsenic and soda are dissolved. This constitutes a *stock solution* which may be kept in a sealed jug for a long time. When ready to spray slack two pounds of quick lime, take one pint of the stock solution and mix them both with 40 gallons of water.

Carbon Bisulphide for grain insects.—Stored corn, peas, beans, etc., are often attacked by weevils and the tiny caterpillars of the small Angumois grain moth. These insects can be killed by fumigating the grain with carbon bisulphide, a heavy liquid that quickly evaporates when exposed to the air and forms a heavy gas that settles downward amongst the grain and kills all insect life.

The bins or receptacles holding the grain must first be made as tight as possible, the tighter the better. If made sufficiently tight, a pound of the liquid to every 100 bushels of grain would be sufficient. Usually more than this is needed. The liquid may be poured directly on to the grain, or it may be placed in shallow dishes which are set on top of the grain and allowed to stand for 36 to 48 hours while the openings of the bin are all tightly closed. The gas is highly inflammable and fire in no form should be brought near the place being fumigated. A lighted match, cigar, lantern or candle should not be brought near the grain until the bin or receptacle has been opened and thoroughly aired.

In treating seed corn or peas it is best to pour the liquid in shallow dishes to evaporate because it might destroy the germinating power of the seed if poured directly on the grain.

A very good way to keep seed peas is to store them in a tight barrel leaving about three inches of unfilled space at the top. Then about three times during the storage season pour a half teacupful of carbon

bisulphide in a shallow tin dish and set it on top of the peas, cover with a heavy sack or blanket and allow it to stand 48 hours. Tight, empty dry goods boxes serve equally as well and will do nicely for storing seed corn. The best success with corn will be obtained by removing the shucks before it is stored. The gas from the carbon bisulphide will reach the weevils more surely.

SUBSTANCES FOR KILLING SUCKING INSECTS.

As already explained, some substance is used for sucking insects that when applied to their bodies will kill them by contact.

Oil emulsion.—Perhaps the best substance for combating sucking insects is an emulsion of kerosene oil and soap which may be made after the following formula:

2 lbs. hard or soft soap
4 gallons of soft water
8 gallons of kerosene oil.

Place the soap (if hard soap is used it should be shaved in fine pieces) in the water over a fire and heat until it is thoroughly dissolved. Pour the oil into the barrel in which the spray pump is sitting, and when the water and soap are boiling hot pour them into the barrel with the oil. Pump the mixture vigorously back into itself by directing the hose into the barrel after the cap of the nozzle has been removed. Direct the stream from the hose downward so that all the mass will be agitated. It will probably take ten or fifteen minutes of vigorous pumping to make a creamy, white emulsion. When the emulsion is obtained add enough water, to make 80 gallons of mixture. This will give a ten per cent. solution, which is a safe one for summer use. When water is poured into the emulsion it may not mix readily. In this case, direct the hose into the barrel again, and pump back into the mixture as was done at first. If, for any reason, the soap and oil fail to emulsify, the whole batch might as well be thrown away and another attempt made. Care must be taken to use rain water or some soft water.

This emulsion may be made of sour milk if desired at the rate of 1 gallon of the milk to 2 gallons of kerosene oil. After these are thoroughly mixed they should be diluted with 17 gallons of water. This is a good remedy for plant lice.

Whale-oil soap.—This soap can be obtained from large dealers in cities and can be ordered by the home merchants. It is a splendid remedy for plant lice and should be used at the rate of one pound to 5 or 6 gallons of water. The soap will have to be dissolved in hot water.

Tobacco Solution.—This is a wash or solution made by boiling one pound of tobacco leaves in 4 gallons of water for one-half an hour. If any of the water boils away, add enough, when through boiling, to make 4 gallons.

This solution will be improved by adding one-fourth of a pound of whale-oil soap.

Lime-salt-sulphur wash for scale insects.—This is a wash composed of lime, salt and sulphur in the following proportions:

20 lbs. Quick lime,
15 lbs. Sulphur,
10 lbs. Salt,
45 gals. Water.

Only the very best quality of quick lime should be used. Two iron kettles should be procured, each holding at least 20 gallons, but the more they hold the better. The 20 pounds of lime should be slaked in three or four gallons of hot water in one of the kettles. When the lime is nearly slacked, but before it quits boiling, add the fifteen pounds of sulphur and enough hot water to make a thin paste of the lime and sulphur. Stir the whole vigorously until they are thoroughly mixed, and then boil actively for 45 minutes. After the lime and sulphur have *actually boiled* 45 *minutes* add the ten pounds of salt, and boil vigorously 15 minutes more. It will become necessary during the boiling to add a little hot water now and then to keep the Mixture thin. When through boiling add enough hot water to make 45 gallons, strain through a gunny sack, and apply hot.

Two of the kettles spoken of above are intended to furnish a cooking outfit for a small orchard, say of a thousand trees. If one has a large orchard and is obliged to make this mixture on a large scale, it will be more economical to buy a boiler of 15 or 20 horse power. A discarded threshing engine that is capable of standing a pressure of 5 or 6 pounds of steam will answer admirably. The boiler should be connected with half a dozen barrels, or more, if desired. Some of the barrels may be used for cooking the wash and some for heating the water. In this way two or three wagons, each carrying a 45-gallon barrel spray pump, may be kept at work with no loss of time. It will be found most satisfactory to have the barrels mounted on a platform three or four feet high. Of course the mixture is made in the same manner and in the same proportion as when the kettles are used.

Persian Insect Powder, Buhach, or Pyrethrum for Mosquitoes and Flies.—Buhach is a powder made by pulverizing the blossoms of a

plant now grown largely in California. When it can be obtained fresh at the drug store it is a splendid remedy for ridding the house of flies and mosquitoes. To do this, close all the windows and doors at night and sprinkle the powder about the window casements, on the tables and throughout the room. In the morning the dead and stupefied flies should be swept up and burned, else the latter might revive. Buhach is not poisonous and is perfectly harmless to human beings.

Buhach, or pyrethrum is also good for lice on cattle, horses, and hogs. It should be thoroughly dusted all over the animals.

Oil and Sulphur for cattle ticks and lice.—To rid cattle of ticks they should be smeared with a mixture of 1 gallon of kerosene oil, 1 gallon of cottonseed oil, and 1 pound of sulphur. The mixture may be applied with a brush or mop.

This mixture is also a good remedy for lice on cattle.

The kerosene emulsion already described is a good remedy for lice on cattle and hogs.

Ordinarily, kerosene oil may be used alone for lice. It should be sprayed upon the cattle in a fine mist or it may be applied with a rag. Care should be taken not to use so much that the hair will come off.

Lice on hogs.—The most satisfactory method for keeping hogs free from lice is to build a wallowing vat about 14 inches deep and large enough for one or two or three hogs as desired. It should be built of concrete with sloping sides and be kept filled with water to the depth of 8 inches. The ground around the vat for a little distance should be covered with concrete to prevent the formation of a mudhole. The vat should also be built beneath a shed for protection from the hot sun and rain. At necessary intervals a gallon of crude petrolium should be poured over the surface of the water in the vat. In wallowing the hogs will get enough oil on them to kill all the lice and, in this way, will keep free from these pests without any worry or trouble.

NOXIOUS PLANT DISEASES.

Corn, cotton, tomatoes, and other farm crops are affected with certain diseases as distinct and hurtful as the diseases that attack our farm animals. Occasionally whole fields of cotton are destroyed by disease and the rusts on oats and wheat cause an immense amount of damage every year. There is hardly a patch of cotton that will not show here and there a diseased plant. These plants may be recognized by their pale yellow leaves, wilted appearance, or loss of leaves, or perhaps death. In nearly every cornfield some stalks may be found with blackened, "smutty" ears. Such stalks are diseased and will not pro-

duce perfect ears of corn and perhaps none at all. Pear trees are almost sure, sooner or later, to become affected with the disease known as *blight*. The leaves droop and turn black, then the branches shrivel and die. Finally the whole tree gives up trying to grow and dies. There is hardly a fruit tree when left to itself, that does not become affected with some disease.

Mold on bread and cheese.—If we were to place a piece of bread or cheese in a dish and keep them in a moist place where they would not dry out they would soon become covered with mold. The mold might be white, blue, or even yellow in color. If the mold is allowed to go on growing, the bread or cheese will decay and finally disappear entirely.

These white and blue molds are two different kinds of very simple, low plants that live upon such substances as bread, cheese, apples, dead leaves, wood, etc. The molds live upon the food material that they find in the bread, cheese, and apples and finally devour, as it were, the latter entirely. When the bread has been used up the mold will have no more food and it too will dry up and die.

Whenever apples, sweet potatoes, cabbage, or other vegetables begin to decay we may be almost sure that some mold is at work upon them. Botanists call these molds and many other similar, low plants that cause the sickness, decay, and often death of other plants, *fungi*. The singular of this name is *fungus*.

How a fungus begins.—Each one of the molds that we saw on the apples, bread, or cheese was made up of a great number of tiny, round threads hardly large enough to be seen with the unaided eye. Moreover, some of these threads, as the mold grows older, bear on their ends, very small round bodies known as *spores*. These spores serve as seeds for the mold because, when they are full grown, they may fall upon other pieces of moist bread and will then germinate, much like a seed, grow and produce the white threads that form another mold. This is the way then that molds or fungi begin. Moreover, these spores are small and light and are blown by the wind, or borne on the water, or are carried by insects from one place to another. In this way fungi are scattered all over an orchard or field of corn, cotton or oats.

Plant diseases are catching.—If an apple lying in a box becomes affected with a fungus the spores that are finally produced may fall upon another bruised apple lying close by. The juice of the bruised spot furnishes enough moisture so that the tiny spores germinate and produce a fungus upon the second apple that finally causes it to decay. If the plums on one tree in an orchard are affected with the fungus

that causes the brown rot of plums the spores from this tree will be blown to another tree. Here they will germinate and cause these plums to rot and so on through the whole orchard, perhaps. The same thing is true of corn smut, oat smut, etc. In other words, plant diseases are "catching" like measles, small pox and other diseases.

One way to prevent plant diseases.—It is evident that one way to prevent the growth of that fungus in the box of apples is to pick out the sick or decaying apples and destroy them. When this is done, no more spores will be produced to fall upon other apples and start the mold. Much the same thing is true of pear blight and a disease known as the black knot of plums. If we go at once to the pear trees and plum trees and cut out all the diseased limbs and burn them we can often stop or check the disease.

Again, the fungus causing the decay of the apples entered the fruit at a bruised spot or where the skin was broken. It could not enter a healthy, unbroken skin. This is often true of diseases of fruit trees. When a tree becomes bruised or the bark torn off, spores enter the wound and cause disease. So we can prevent some diseases by careful treatment of fruit and trees so that they will not be bruised and the skin or bark broken.

Spraying to prevent plant diseases.—There are certain diseases that will attack perfectly sound and healthy fruit and trees. These must be prevented by spraying the trees and fruit with some substance that will kill the spores and threads of the fungi. The substance most widely used for spraying plants to prevent disease is a mixture of quick lime, copper sulphate, and water known as *Bordeaux*.

Reasons for spraying.—Sometimes spraying is the only way to prevent the total loss of a crop of fruit. Again, spraying, if done properly and thoroughly, will prevent scabby, knotty, rough fruit. Any fruit grower who wishes to get good prices for his fruit must send smooth, perfect fruit to market. Such fruit, often obtained only by spraying, brings a higher price and gives the grower a reputation for producing a fine product. In the long run his income will be greatly increased.

Treating seed to prevent disease.—Oats are very often affected with a disease known as smut. The heads of the oats become black and are covered with a dry, smutty powder. The grains are usually entirely destroyed by this fungus. The smutty powder is nothing less than great numbers of the fungus spores massed tgether on the heads. These exist over winter sticking to the seed oats. If seeds

carrying spores are sown in the spring the spores will germinate and attack the young growing plants finally causing smut. If, on the other hand, the seeds are thoroughly sprinkled with a solution of formalin the spores will be killed and the smut prevented.

Selecting healthy plants and seed.—There is also another way to prevent disease from destroying farm crops. Cotton, for example, is subject to a disease known as wilt. In South Carolina, especially, the wilt disease often destroys whole fields of cotton. But where this disease is present in a field of cotton there are usually some individual plants that are not affected but that grow well and produce good, healthy seed. Evidently such plants are able, for some reason, to resist the wilt disease. Moreover, it has been found that if the seed from these healthy plants are gathered and planted the next season they produce plants that are not subject to the wilt. This teaches us that we may obtain strong, vigorous plants by planting seed that we have selected from healthy plants the year before. This same principle is true of other plants and very likely of all plants.

SUBSTANCES FOR PREVENTING PLANT DISEASES.

Standard Bordeaux Mixture.—This is the best general fungicide known and is made according to the folowing formula:

6 lbs. copper sulphate (bluestone),
4 lbs. quick lime,
50 gallons of water.

The copper sulphate is suspended in a sack in a barrel containing 25 gallons of water and allowed to remain over night, or until entirely dissolved. The lime is slaked with just enough water to make a thin paste. It is then poured into a barrel containing 25 gallons of water and thoroughly stirred. The two solutions of copper sulphate and lime are then poured together making 50 gallons of mixture which is ready to use at once. This solution is now used mostly to spray peach trees before they bloom to prevent peach leaf curl. It is also used on apple and pear trees and on grape vines before blooming.

General Bordeaux Mixture.—The standard Bordeaux is too strong with copper sulphate to be used with safety on most of our fruit trees when in leaf. It has, therefore, been modified for general use and the following formula is most universally used now for general spraying:

5 lbs. copper sulphate,
5 lbs. quick lime,
50 gallons of water.

It is made exactly as described for the standard Bordeaux mixture.

Peach Bordeaux.—Even the general Bordeaux is a little too strong for *peach* and *plum* trees. It is liable to injure the leaves. Therefore, for peaches and plums, the copper sulphate is lessened and the lime is increased as shown in the following formula:

3 lbs. of copper sulphate (bluestone),
6 lbs. quick lime,
50 gallons of water.

It is made as described for the standard Bordeaux.

Test for Bordeaux.—It sometimes happens that the copper sulphate and lime do not combine just as they should and the mixture becomes unsafe to use. When just right it will be a brilliant sky blue color. Sometimes, however, the mixture has a greenish caste which indicates that it is not right and is not safe to apply.

To be absolutely sure that the Bordeaux mixture is in proper condition get a small bottle of a 10 per cent. solution of *yellow prussiate of potash* from your druggist and pour a few drops into the solution of lime and copper sulphate. If the yellow drops turn reddish-brown the Bordeaux is not right and lime should be added until when the prussiate of potash strikes the solution it will retain its yellow color and not change to a reddish-brown.

Formalin for oat smut.—The spores causing oat smut adhere to the seed and are sown with them in the field. If the seed oats are treated with a solution of formalin before they are sown the disease can be very largely prevented. Formalin can be bought in a liquid form in a 40 per cent. solution under the name of Formaldehyde.

Treatment of seed.—Select a tight floor in a barn, granary, or house, sweep it clean and wait until the dust settles. Then put down a layer of seed oats, say one and one-half inches thick, make a dilute solution of formalin by putting 1 pint of the 40 per cent. solution in 45 gallons of water. With a hand sprinkling pot thoroughly sprinkle the layer of oats and shovel them over until every seed is moistened by the formalin. Put down another layer of oats, sprinkle and shovel over again. Perhaps 3 or 4 layers may be treated in this one pile but when the oats get deeper than 5 or 6 inches it will be best to remove them and begin a new pile. After a lot of oats is treated they should be covered with a sheet to keep off the dust and stirred occasionally to prevent heating and facilitate drying. When dry they are ready to be sown.

Formalin for potato scab.—Scab on Irish potatoes may be prevented by soaking the seed potatoes for two hours in a solution of formalin made by mixing 1 pint of the 40 per cent. formaldehyde with 30 gallons of water.

30 gallons of the solution is sufficient for 15 or 20 bushels of potatoes. If only a few bushels of potatoes are to be treated, a less amount of solution can be made by using lesser amounts of formaldehyde and water and preserving the same proportions.. After treating the potatoes they should not be put in infested sacks nor planted on ground that has borne scabby potatoes.

Pear blight and its treatment.—Pear trees are subject to one of the most fatal diseases affecting any plant. This disease is known as *fire blight, pear blight,* etc. It generally begins by attacking the ends of the branches, the leaves of which turn black, shrivel and die and the tree looks as though fire had scorched the ends of the twigs. If left undisturbed, the disease works along down the branches, attacking the larger ones and then the trunk until, finally, the whole tree becomes affected and succumbs.

The disease is due to a minute germ (Bacillus) that is carried from tree to tree by insects and probably other agencies. There is no known specific remedy for the blight but there are certain palliative remedies which will hold the disease in check, and if persistently practiced may stamp it out.

The first and main preventive is the removal of all blighted branches. This should be done in the late fall and winter because at this time the growth of the germ has stopped and its location in the branches can be more surely determined. In removing the diseased twigs, one should cut far enough below the dead portion to be perfectly sure that all the germs and affected wood are taken away. Before cutting off another twig, the cutting instruments should be dipped in a poison solution made by adding one teaspoonful of corrosive sublimate to two gallons of water. This solution should be made in a wooden bucket and carried about with the pruner. Every time a branch is cut off, the knife or shears should be immersed in the solution in order that any germs sticking to the instruments may be killed and not carried to another branch of the tree or to different trees. If this practice is persistently followed in an intelligent manner every winter the disease may be greatly checked if not stamped out. All of the removed branches should be completely burned.

Another precaution to be taken is to remove all water sprouts as close as possible to the tree trunk so that the wounds made in cutting them off may quickly and effectually heal over.

Lastly, the pear trees should be kept from making too great a growth. Trees that grow fast become tender, succulent, and sappy and afford a splendid place for the germs to increase and thrive. Trees that are well cultivated and heavily fertilized make too rapid a growth and blight worse. Therefore, we believe that pear trees should be left in the sod and not given too much cultivation or forced to grow fast.