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Fungous Diseases, Insect Pests, Fungicides and Insecticides

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SOUTH DAKOTA
AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION
BROOKINGS, S. D.

BULLETIN NO. 35.

MAY 1893.

DEPARTMENTS OF
Horticulture and Forestry, Botany and Entomology.

FUNGOUS DISEASES, INSECT PESTS.
FUNGICIDES AND INSECTICIDES.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

COMMON FUNGOUS AND INSECT FOES OF FARM AND GARDEN.

THOMAS A. WILLIAMS.

I. FUNGOUS DISEASES.

APPLE SCAB.

(*Fusicladium dendriticum*.)

This attacks both leaves and fruits and often also the young twigs. Though the fungus grows on both sides of the leaf it is most conspicuous on the upper surface. It appears as a network of fine greenish brown or blackish filaments and causes the leaves to become discolored, curl up and fall off. On the fruit it produces irregular, dark greenish brown, velvety blotches and while not causing any great amount of decay, hinders growth and deforms the fruit. In very bad cases young fruit shrinks up and falls off.

TREATMENT.—If trees were attacked by “scab” the preceding year, all leaves, rubbish, decayed fruit and the like that is on the ground about them should be raked up and burned. About the time the blossoms fall or as soon thereafter as practicable spray with either of the fungicides *XII, XIII or XIV. The most satisfactory results will be obtained if the operation is repeated at intervals of from two to three weeks (depending on the weather) until the fruit is half grown.

APPLE TWIG BLIGHT.

(*Micrococcus amylovorus*.)

This disease often called “sun scald,” “fire blight,” etc., is due to one of the bacteria. This little organism attacks the young

*Roman numerals refer to formulæ for preparing fungicides and insecticides.

rapidly growing twigs, and no doubt obtains a start wherever the bark of the tree has been broken.

TREATMENT.—As the injury is too deep seated, spraying will do no good except indirectly. Carefully pruning and burning affected parts, if followed up, will usually keep an orchard comparatively free from this disease. The pruning knife should be handled with the utmost caution as the disease may be carried by it from one tree to another.

SPOT DISEASE OF PLUM AND CHERRY.

(*Cylindrosporium padi.*)

This disease is also known as the "shot hole disease" from the peculiar effect it has upon the leaves particularly those of the plum. It appears first as reddish or discolored spots on the leaves. These spots are at first usually less than one-sixteenth of an inch in diameter, but increase in size, often running together forming large irregular areas. Sometimes the diseased part falls out giving the leaf the appearance of having been perforated by several to many large shot, hence the name—shot hole disease. This is more liable to occur in plums and peaches. The diseased leaves after a time turn yellowish and fall prematurely. The common black cherry and some varieties of plums have suffered severely from this disease, here, of late years. The younger shoots and plants suffer most.

TREATMENT.—In this region spraying should begin not later than June 1 and should be continued through the summer at intervals of about three weeks if the disease is very damaging. Use either XII or XIII giving the trees a thorough spraying. The bordeaux mixture is perhaps the better fungicide all things considered.

PLUM AND CHERRY BLIGHT OR MILDEW.

(*Podosphaera tridactyla.*)

This disease attacks the leaves, covering them with a network of fine whitish filaments, and causing them to curl up and fall off; in extreme cases leaving the twigs entirely leafless.

Sand cherries suffer severely from this disease.

TREATMENT.—As this fungus grows almost entirely on the surface of the leaves it is comparatively easy to deal with. Be-

ginning usually in June the trees should be sprayed thoroughly with either XII or XIII. This should be continued throughout the season as often as seems necessary. Nos. XII, XIII and a sulphur mixture sold under the name of "Par Oidium" were tried last season on plums and sand cherries on the Station grounds. The Par Oidium was a failure while both the other treatments were successful. There seems to be but little choice between them so far as efficiency is concerned. Some prefer No. XII.

BLACK KNOT OF PLUM.

(*Plowrightia morbosa*.)

The wild plums and most cultivated varieties, particularly those derived from native forms, suffer considerable damage from this disease. It produces great black, unsightly wart-like growths on the stems and branches, disfiguring them and finally either killing the tree outright or rendering it useless as a bearer of fruit. Cherries are often affected also.

TREATMENT.—The fungus is too deep-seated to be reached by any ordinary fungicide applied to the surface. When but few knots appear they may be cut away and burned and the tree thoroughly washed with No. XIII. Or better the knots may be saturated with linseed oil or painted with a mixture of red oxide of iron in linseed oil. If badly affected, the tree should be cut and burned.

PLUM POCKETS.

(*Exoascus pruni*.)

This fungus attacks the fruit, leaves, and in some cases the young twigs. Last year it was very destructive and promises to be as bad this season. On plums the fruit suffers most while on sand cherries fruit, twigs and leaves are affected. The diseased parts swell up and become more or less distorted; the fruit being often three times its normal size, but hollow and puffed up, hence the name—plum pockets.

TREATMENT.—As the parasite goes through with most of its development within the tissues of the host, spraying alone will not suffice. All the diseased parts should be cut away and

burned. The plants may then be sprayed with XII or XIII to keep the fungus from getting a new start.

SPOT DISEASES OF CURRANT.

(*Septoria ribis* and *Cercospora angulata*.)

These diseases appear usually some time in June. Small brownish spots are formed on the leaves. These are at first roundish or somewhat angular, but often become confluent and are of a grayish color when fully matured. The leaves usually turn yellowish and soon fall off. Both cultivated and wild currants suffer from these fungi. Gooseberries are also attacked but usually less severely.

TREATMENT.—Beginning the first week in June spray with XII or XIII. In very bad years, four or five applications should be made during the season. *Both sides* of the leaves should be thoroughly wet with the spray.

STRAWBERRY LEAF-BLIGHT.

(*Sphaerella fragariae*.)

This is also known as "strawberry rust," "sun scald," "sun-burn," "spot disease," etc. It appears first as brownish or more often red or red-purple, circular spots on the leaf. Very often there are several to many of these spots on a single leaf. As the spots grow older they become white in the center, the border remaining red, purplish or brownish. They are usually $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in diameter at maturity.

TREATMENT.—A thorough application of No. XII just before the disease makes its appearance (usually in June) will be sufficient in most cases. In moist seasons cutting the leaves close to the ground by running a mowing machine over the bed, and burning as soon as dry is recommended as a preventative for the next season. In dry weather this method should be used with caution, if used at all.

POTATO SCAB.

(*Oospora scabies*.)

This disease is too well known to need much description. The scabby areas on the surface of the potato are familiar to all. The disease is due to a very minute fungus. The damage has

been considerable in some parts of the state the last few years. Beets are subject to the same disease.

TREATMENT.—In the first place “scabby” seed should not be planted, and soil that has previously produced diseased potatoes or beets should not be planted to either until several seasons have passed. If diseased seed must be planted or if potatoes are to be kept free from scab, all seed should be treated with XIII or better with XV. The seed should be soaked about one and a half hours in either of the fungicides before planting.

II. INSECT PESTS.

CODLIN MOTH.

(*Carpocapsa pomonella*.)

This insect infests the fruit of the apple. The mature insect is a small, ashy-gray and brown moth, about three-fourths of an inch from tip to tip of the expanded wings. The eggs are laid singly in the blossom ends of the young apples. After about a week the larva hatches and eats its way into the core. It makes its presence known by pushing its castings out of the hole by which it entered or by making a new one at the side of the apple. The insect passes the winter in the pupal state, often in apple barrels in the cellar. It is without doubt the most serious insect pest of the apple.

TREATMENT.—Destroy all wormy fruit as soon as it falls to the ground. A thorough application of either IX or X just after the young fruit has “set” but before it has become heavy enough to droop, or the calyx end to turn down, will reduce the wormy apples to a very small per cent. Two thorough applications will suffice; one at the falling of the blossoms and the other ten days or two weeks later.

GOOSEBERRY AND CURRANT SPAN-WORM.

(*Eufitchia ribearia*.)

Here in the Dakotas, this insect is probably the worst pest that the grower of these small fruits has to contend with. The

mature insect is a moth pale yellowish in color with several dusky spots arranged in one or two irregular bands extending across the wings. The caterpillar, when full grown, measures an inch or more in length. It is whitish with yellow, black, pink and purple markings. It usually appears about the last of May or the first of June.

TREATMENT.—As the fruit is often so nearly ready to pick when the pest is hardest at work, it is not advisable to use the arsenical mixtures. No. XI used either as the dry powder or in water will prove an effective remedy if used very strong.

CABBAGE WORMS.

(*Pieris rapae*, *P. protodice* and *Plusia brassicae*.)

Several different caterpillars are injurious to cabbage; the one of most importance with us being the "Imported Cabbage Worm." The adult insect is a common white butterfly, with a few black spots on the wings. The larvae are about one and a half inches long, greenish with yellow and black markings.

TREATMENT.—As the cabbage is a food plant the arsenical mixtures cannot be used. Nos. IV or XI either dry or in water have been used with success. Where the caterpillars can be reached by it hot water is an effective remedy. It should be at 130° to 140° Fahr. when it touches the insect. If put into the sprinkler when *boiling* and applied immediately, it will be at about the proper temperature.

POTATO BEETLES.

(*Doryphora 10-lineata* and *Epicauta* spp.)

The first of these insects is the "Colorado potato beetle," and is readily recognized by its yellowish color and the ten longitudinal black stripes on its wings. The eggs are orange-yellow and are deposited in clusters on the under side of the leaves. The larvae are reddish with a double row of black spots along the back when fully developed. The other beetles feeding on the potato are the common black "blister beetle" and the "striped blister beetle." The former is more common here. They can be distinguished from the "Colorado potato beetle"

by their more slender, cylindrical bodies and longer antennae; the commoner form is also black in color.

TREATMENT.—All the potato beetles can be held in subjection by the use of IX or X. Application should be made as soon as the insects appear in the spring and should be repeated as often as necessary. As there is more than one brood of the “Colorado potato beetle” more than one application will usually be necessary.

PLANT LICE.

(*Aphididae.*)

These little insects are very injurious to some of our common trees and garden stuffs. They are usually rather small either winged or wingless, and vary greatly in color; being generally green, reddish brown or black. They get their nourishment by sucking up the juices of the plant upon which they live. Many of them cause curling and twisting of leaves and twigs. Some are covered more or less with a waxy or cottony secretion which serves as a protection. Some of our most injurious species are those found on cabbage, apple, plum and cherry, willow and cottonwood, boxelder, elm, ash, etc.

TREATMENT.—As these insects feed by sucking and not by chewing, poisonous mixture; are of no avail but insecticides must be used that kill by contact with the body of the insect. Nos. I, II, VI, VII, and VIII may be used in fighting these pests. For hardy trees and shrubs and most other out of door plants the kerosene emulsions are perhaps most to be preferred. For cabbage lice a strong soap suds is preferable. In conservatories the various soap and tobacco remedies are more often used.

COTTONWOOD AND WILLOW LEAF-BEETLES.

(*Lina scripta* and *L. lapponica.*)

These insects are without doubt the worst insect enemies of our cottonwoods, willows and poplars. The striped or spotted beetles and their disgusting larvae are familiar to all who have tried to grow these trees.

TREATMENT.—These insects feed by biting and chewing up the green pulp of the leaves, and so may be successfully check-

ed by the use of poisons. Thorough applications of either IX or X just as the larvae begin their depredations will be successful. As the insects are several brooded the trees should be closely watched and again treated if the larvae reappear.

LARGE WILLOW SAWFLY.

(*Cimbex americana.*)

This is the worst enemy of the willows. The adult insect is a large dark colored bee-like insect usually with more or less prominent white spots along the abdomen, particularly in the case of the female. The larvae are great, cylindrical, yellowish-white worms.

TREATMENT.—They are easily killed by the use of either IX or X. The spraying should be done just after the larvae are hatched. If there are only a few trees hand picking will suffice.

ASH SAWFLY.

(*Monophadnus bardus.*)

The adult of this insect is a “four winged fly about one third of an inch in length, in color black, with thorax above and in front dull orange or honey red.” The larva are yellowish-green about an inch in length.

TREATMENT.—The same remedies given for the large willow sawfly are applicable to this and in fact to all sawflies, except where the character of the plant prohibits their use.

ASH TREE SPHINX.

(*Daremma undulosa.*)

The adult of this insect is a large moth, gray with whitish and blackish mottlings. The larvae of this moth as well as those of all the sphingids, may be at once recognized by the “horn” borne at the posterior end of the body. The larvae of the ash sphinx is greenish with variously colored markings along the sides.

TREATMENT.—When trees are small and but few in number hand-picking may be resorted to. Spraying with IX or X as soon as the eggs have hatched and the young larvae have begun

work, will keep them in check. This will apply to all the sphingids.

EMPEROR MOTH.

(*Attacus cecropia.*)

This insect is well known through the state as the worst enemy of the box elder. It is not limited to this tree, however, but feeds greedily upon nearly all of our common trees. It is at once recognized by its large size as a moth and caterpillar, and by its conspicuous cocoons which remain on the trees all winter.

TREATMENT.—The cocoons may be picked off the trees during the winter and destroyed. Kerosene may be poured on the cocoons while on the tree as described in bulletin No. 13 from this station. After the larvae have begun their work the trees may be sprayed with IX or X. Here in Dakota the common sapsucker kills and eats many of the pupae during the winter.

AMERICAN SILKWORM MOTH.

(*Telea polyphemus.*)

This insect is very like the preceding, being nearly as large, but differs in being lighter colored and the cocoon being rounded at the end. The larvae is also shorter and more compactly built. Its habits are very similar to those of the cecropia. Here on the station grounds it seems to be partial to the birches, while the cecropia prefers the box elder.

TREATMENT.—The remedies given for cecropia are also applicable to this insect.

PREPARATION AND APPLICATION OF FUNGICIDES AND INSECTICIDES.

LEE C. CORBETT.

In the use of insecticides we must recognize two laws. First that certain mixtures are designed to kill by contact. These are used to destroy the sucking insects, such as plant lice, which are not affected by the poisonous sprays. The second class of insecticides are those containing some poisonous ingredient which, when thrown upon the foliage and tender parts of the infested plants, kills by being eaten by the mischief-makers. Those of this class are useful only for the treatment of plants suffering injury from insects which eat the foliage.

The following list is selected with reference to the value and ease of both preparation and application.

INSECTICIDES.

The following insecticides are those which kill by contact. The essential principle of any mixture of this class must be a volatile oil of considerable penetrating power in order that it shall act upon the body of the insect, or it shall be a heavy substance capable of forming a coating over the body of the insect and thus prevent the power of respiration. In any case the material used, while sufficient to act upon the body of the insect must not be injurious to the delicate tissues of the plant.

I. KEROSENE EMULSION.—Soft soap, 1 quart, or hard soap, $\frac{1}{4}$ pound; 2 quarts hot water; 1 pint of kerosene. Stir until thoroughly mixed; then dilute with water, using one part of the emulsion to three or four of water. The most satisfactory way of making an emulsion is to use a force pump for mixing; pumping the mixture back into the receptacle several times.

Another method is to use hard soap, $\frac{1}{4}$ pound; boiling water, 1 gallon; kerosene, 2 gallons. Churn or pump the ingredients

thoroughly for fifteen minutes. Dilute ten times when using.

II. KEROSENE AND MILK EMULSION.—Sour milk, 1 gallon; kerosene oil, 2 gallons; warm to blood heat and mix thoroughly. Dilute 10 times with water and use as a dip or spray.

III. LYE WASH.—1 Pound concentrated lye, or potash $1\frac{1}{4}$ pounds to three gallons water. This may be applied to branches of trees with brush as a remedy for bark lice.

IV. PYRETHRUM (Buhach.)—Used dry by dusting upon or beneath the plants. In Alcohol:—Put one part of pyrethrum (buhach) and four parts alcohol, by weight, in any tight vessel. Shake occasionally, and after eight days filter. Apply with an atomizer. Excellent for green-house pests. For some plants it needs to be diluted a little. Another good way is to dissolve about four ounces of powder in 1 gill of alcohol, and 12 gallons of water.

V. QUASSIA.—The following is for plant-lice. Boil 4 ounces quassia chips 10 minutes in a gallon of water; strain off the chips and stir in as it cools 4 ounces of soft water. Use syringe or brush in applying and ten or fifteen minutes later give the plant a good syringing with clean water.

VI. SOAP AND TOBACCO.—Dissolve 8 pounds of the best soft soap in 12 gallons of rain water, and when cold, add 1 gallon of strong tobacco liquor.

VII. TOBACCO AS COARSE DUST OR "TOBACCO FERTILIZER." Strewn under melons and squash plants.

VIII.—TOBACCO TEA.—Used as a spray for plant lice, is made by steeping stems or leaves in water for a couple of hours.

POISONOUS INSECTICIDES.

Insecticides of this class kill by being taken into the system of insects for which they are used. Arsenic and its compounds form the active agent of most of such insecticides.

IX. PARIS GREEN.—As a spray use 1 pound to 200 gallons of water. Keep well stirred so that the poison shall be held in suspension. If this is neglected the green will settle to the

bottom of the vessel, as it is not soluble in water, and the result will be that the spray will contain little poison at first and too much towards the last. In spraying stone fruits use the mixture more dilute. 1 pound of poison to 300 gallons of water.

X. LONDON PURPLE.—This poison should be used same as Paris green. 1 pound to 200 gallons of water. It should never be used upon peach trees, because the foliage is very susceptible to injury from the arsenites.

XI. WHITE HELLEBORE—Used as a spray. 1 ounce of the poison to 3 gallons of water. When applied it is seldom mixed with anything. A little flour, however, makes it more adhesive.

FUNGICIDES.

At the present time the use of fungicides is quite as important as the use of insecticides in the culture of fruits and vegetables.

XII. AMMONICAL CARBONATE OF COPPER—The stock solution is made by adding 5 ounces of carbonate of copper, to 3 pints of ammonia (26°), this may be kept any length of time in a bottle with a glass stopper. For use dilute with 45 gallons of water.

XIII. BORDEAUX MIXTURE.—Dissolve 6 pounds of copper sulphate in a wooden or earthen vessel. In another tub or vessel shake 4 pounds of *fresh* lime; add enough water to reduce it to the consistency of a thick whitewash. Pour this slowly into the vessel containing the copper-sulphate solution, using a coarse gunny sack stretched across the top of the vessel for a strainer. Dilute to 45 gallons before applying to plants of any kind.

XIV. MODIFIED EAU CELESTE.—Dissolve 4 pounds of copper sulphate in 10 gallons of water, and stir in 5 pounds of sal soda; then add 3 pints of strong aqua ammonia; dilute to 45 gallons.

XV. MERCURIC CHLORIDE (corrosive sublimate) made by "dissolving 2 ounces of the chloride in 2 gallons of water and letting it stand several hours, or over night and diluted to 22 gallons." Corrosive sublimate is very poisonous and should be

used with caution. In preparing and applying the mixture always use a wooden or earthen vessel.

XVI. COMBINATION OF INSECTICIDE AND FUNGICIDE.—The only safe combination of this character, is that of Bordeaux mixture with Paris green or London purple. The combination of these mixtures results in no injury to the foliage of the plants treated, and yet each retains its value to the extent of being as good as when used separately. The great value of the combination is in lessening the cost of treatment, for we save the cost of one application. In preparing the mixture use the formula for Bordeaux mixture given under No. XIII and add to it Paris green or London purple at the rate of 1 pound to each 200 gallons of the mixture. While using keep the mixture well stirred.

APPLYING INSECTICIDES AND FUNGICIDES.

To obtain best results from the use of sprays for preventing injury to our trees and fruits from insects and fungi, it is necessary that the spray be fine, evenly distributed and applied with force. A force pump with a capacity sufficient to give 25 or 30 pounds pressure, with brass cylinder and plunger, will be found to be best and most economical. The brass is not readily acted upon by the chemicals used, and although the first cost of a pump of this class is a little more than that of a cast-iron pump, in the long run, as usual, the best is the cheapest.

The most convenient receptacle for the spraying solution, and the one most easily obtained and mounted is a common oil barrel. Mount this upon a sled, the runners of which are made from plank 2x6 or 8 in. and a little longer than the barrel. The width of the sled should not greatly exceed that of the bulge of the barrel. The beams should be made of 2x6 in. plank and hollowed out to make a saddle to receive the barrel. To make the barrel fast to the sled pass a band of hoop-iron over either end and fasten it securely to the runners. When completed we shall have a cask laying horizontally upon a plank sled, to which it is securely fastened. Mount the pump upon the rear end of the barrel, with the handle parallel with the long axis of

the barrel. At the front end and on the top side of the barrel remove a portion of one or two of the staves between the second and third hoops leaving an opening 6 in. wide through which the liquid may be poured. To prevent loss of the mixture the opening should be covered with a piece of burlap or oil-cloth. Tack one edge to the barrel having the rest loose to admit of its being turned back to allow the full opening to be used in filling the barrel.

The length of hose needed will depend upon the character and height of the plants to be sprayed. In general, however, from eight to ten feet will be ample, if the nozzle used is suited to throw a fine spray a long distance. If the nozzle has to be carried into the tree on a pole in order to do the required work, the length of the hose must be increased correspondingly.

The nozzle is the all-important attachment of the spraying apparatus.

A nozzle that will throw a fine spray a long distance, and one that will not clog by any fine particles of lime or dirt which might get into the spraying mixture, is what is wanted. Such a nozzle will facilitate the work of spraying more than most any other invention. I believe that such an one has recently been placed upon the market.

For spraying large forest, fruit, or street trees the barrel, as before described, instead of being mounted upon runners, may be placed upon a wagon. This will be found to be most convenient where the trees are at some distance from each other, or in long rows far enough apart to admit the team and wagon.