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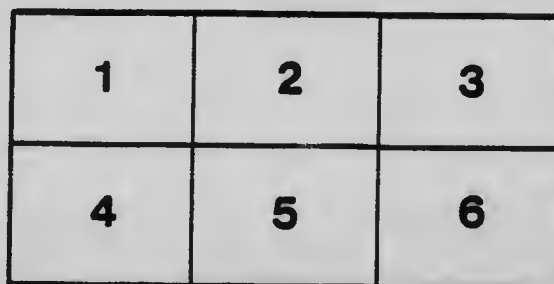
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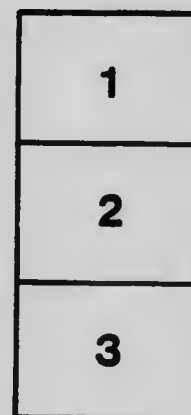
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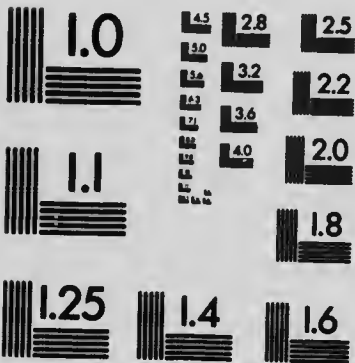
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RECEIVED

JUL 22 1918

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BULLETIN No. 42

— THE —

PROTECTION OF PLANTS

— BY —

GEORGES MAHEUX

Provincial Entomologist



Hand-power sprayer in operation

Published by order of the Hon. Jos.-Ed. Caron, Minister of Agriculture, Province of Quebec.

JULY 1918

Let us have specimens of insects or diseases injurious to your crops. Living insect pests are preferable for study; give them sufficiently of their ordinary food to allow them to eat *en route*. As soon as you notice a serious invasion of your crops by such enemies, advise us immediately.

Your letters or parcels should be mailed to:

The Entomologist,
Department of Agriculture, QUEBEC.

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THE PROTECTION OF PLANTS.

I.—INSECTS INJURIOUS TO ALL CROPS.

White grubs.

Large, whitish, curled grubs, with a light brown head, living in the soil during three years and feeding on the roots of all kinds of plants. They are to be found in large numbers especially in vegetable gardens that were in sod the previous year. Potatoes and corn are more liable to be their victims.

CONTROL.—Deep plowing, frequent weeding, appropriate rotation. Hogs and chickens, if allowed to run in the newly ploughed area, will destroy large numbers of grubs. These are preventive measures; we do not know, as yet, of any direct remedy.

Cutworms.

Dark-colored caterpillars hiding in the soil during daytime and which, at night, cut the stems of young plants near the ground. Other species are continually living underground, while others climb on the plants.

CONTROL.—Spreading a poisoned bait on the ground, around the plants, is the best remedy (page 19).

Wireworms.

Long, slender and hard worms, of a brownish color, eating off the roots of many plants, especially potatoes, carrots, turnips and onions. These legumes are often worked throughout.

CONTROL.—Same as for white grubs; they are however more difficult to check.

Blister Beetles.

Black or grey beetles particularly injurious to vegetables. They are often seen in large numbers feeding on the leaves of potatoes; sometimes they also damage ornamental shrubs; caragana, spirea, etc.

CONTROL.—Spray with arsenate of lead (page 18). at the very outbreak of the first attack.

Grasshoppers.

Swarms of these voracious insects often destroy field crops; they are sometimes troublesome to vegetables and very seldom to fruit trees.

CONTROL.—Poison bran mash spread, early in the morning, in infested fields (page 19).

Plant Lice.

These small soft-bodied insects work considerable damage on almost all cultivated plants, especially cabbages, peas, cucumbers, potatoes, apple trees, currants, flowers. They lie under the surface of the leaf, most of the time. They plunge their beak into the tissue of the plants and suck their juice while they secrete a sweet mixture called honeydew of which they are sometimes covered. They vary in color from green or pink to black.

CONTROL.—Spray with nicotine sulphate (page 20) taking care that the liquid reaches the lower part of the foliage. Kerosene emulsion (page 21), may be used if the first mixture cannot be procured. If only a limited number of plants required to be treated it will be advisable to sprinkle (powder) fine tobacco dust on them while still wet with dew. Indoor and greenhouse flowers, under a glass bell in which a piece of blotting paper, saturated with nicotine or tobacco juice, is allowed to burn, will soon be freed of this pest.

Slugs.

Sticky snails which adhere to vegetables and even penetrate the tubers, potatoes, turnips, celery.

CONTROL.—Spread powder lime in the garden: this substance sticks to the slug and kills it rapidly.

Flea-Beetles.

Very small beetles that riddle the leaves of potato, cucumber and tomato plants and cause very serious damage in certain years. They jump quickly when disturbed.

CONTROL.—Bordeaux mixture combined with arsenate of lead or Paris green, used as a spray, when required.

II.—INSECTS AND DISEASES INJURIOUS TO VEGETABLES.

Asparagus.

INSECTS.—Asparatus beetles: two species, one yellow and blue, the other red and black, eat the foliage during the whole summer. Larvae and beetles cooperate to this destruction.

DISEASES.—A kind of rust especially injurious to the stem.

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Asparagus Beetle

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- CONTROL.**—1. Planting resistant varieties, is the best preventive against diseases, as spraying with Bordeaux mixture is not recommendable for this plant.
2. Arsenate of lead may be used to destroy insect pests (page 18).
 3. Sprinkling with lime, instead of spraying gives good results when the plants are wet: larvae coming in contact with this substance are quickly destroyed.



Asparagus
beetle

Beet-Spinach.

INSECTS.—Beet fly the tiny whitish grub of which bores passage in the leaves of these two legumes; leaves become white-spotted; eggs are laid under the leaves. Blister beetles, white grubs, wireworms (see chapter I).

DISEASES.—Leaf spots or brown circular areas.

- CONTROL.**—1. Hand pick and burn white-spotted leaves or simply faded and containing larvae; poisoned sprays are of no avail.



Blister Beetle

2. In case of disease, spray with Bordeaux mixture (page 23), every 10 days dating from the appearance of the first symptoms.
3. For blister beetles, white grubs and wireworms, refer to chapter I.

Corn.

INSECTS.—A green or brown caterpillar is sometimes injurious to cobs; it is $\frac{1}{2}$ inch long and is often so numerous as to necessitate control.

Corn fly: feeds on young plants often causing their death.

DISEASE.—Smut affecting all parts of the plant and covering them with a white membrane which opens later to scatter masses of spores or germs.

- CONTROL.**—1. Sow to a small depth in a suitable and well prepared ground to prevent the attacks of the fly.



Corn ear
worm.

2. To control the caterpillar sprinkle the ears several times with a mixture formed of one part of sulphur and three parts of arsenate of lead, both under powder shape.
3. All parts infested by smut should be cut and burnt before the breaking of the membranes, otherwise the germs will soon spread all over

Carrot-Parsnip.

INSECTS.—Carrot rust-fly, insect very injurious to these vegetables and sometimes to celery plants. A small yellowish grub bores in the root and causes the plant to turn yellow and die. Large quantities of these two vegetables are

destroyed in this way. Some cabbage caterpillars also eat off the leaves of parsnips and do great damage.

DISEASES.—Bacterial wilt, rhizoctonia.

CONTROL.—1. Damages by the fly will be prevented by delaying seeding.



Carrot
Rust-fly

2. Sow a few beds, one week apart; as a rule, only the first one will be injured.
3. To control the destructive work of the fly, spray with kerosene emulsion (page 21).
4. For caterpillars: spray with arsenate of lead (page 18), as often as considered necessary.

Celery.

INSECTS.—Celery-caterpillar, velvet like, green and black, with two retractile horns, feeding on celery, carrots and parsnips. Carrot rust-fly.

DISEASES.—Early and late leaf-blight. The rust damages twigs and makes them lose their commercial value, white stems being the best and commanding the highest prices.

CONTROL.—1. To control leaf-blight, spray with Bordeaux mixture (page 23) every 10 days until fully ripe.



Celery Caterpillar

2. To prevent rust, fit a paper cone around the stalk, from root to leaves or fix plants between boards.
3. Caterpillars are big, very conspicuous and very seldom found in large numbers; they are hand picked and afterwards destroyed. For large crops, where this pest would be in large number, use arsenate of lead (page 18) or poisoned Bordeaux mixture (page 25).

Cabbage-Turnip-Cauliflower.

The same insects and diseases damage these three legumes indifferently; consequently they are grouped together.

INSECTS.—The cabbage-maggot is one of the most serious pests of the cabbage plant. The female fly lays its eggs near or on the young plant; the little grubs produced bore through the soil and feed on the roots, thus causing much damage; the attack usually takes place immediately after plantation. Cabbage worm, a green caterpillar eating leaves throughout the summer. Cut-worms, plant lice, flea-beetle, zebra caterpillar, cabbage looper, plusia, etc.

DISEASES.—Club root, swelling of the roots, black nervation, black leg, etc.

CONTROL.— 1. Before sowing, disinfect seeds with corrosive sublimate, using 1 tablet to 1 pint of water, for 10 minutes.



Cabbage Worm



Cabbage-Maggot and disk of paper



Cabbage Leopard

2. When possible, select a soil free from diseases and use well rotten manure.
3. When transplanting cabbages or cauliflowers, place a disk of tarred paper, 2 or 3 inches in diameter, around each plant; the center will be slit like a star the ends of which, will first be raised to allow the root to go through and then well fixed around the stem; the disk shall rest well flat on the ground. This is the best means to prevent the cabbage-maggot from laying eggs near the plants and to make its destruction work nil; its use should be widespread,
4. To destroy chewing insects, spray with arsenate lead (page 18) mixed with sticker (page 18), until heads are about half formed; after that date pick by hand or use following remedy.
5. Cabbage and cauliflower sprays may be replaced by this preparation; mix thoroughly, 1 part of fresh pyrethrum powder with 3 parts of ordinary flour and leave for 24 hours in a closed receptacle; then sprinkle on plants.
6. Destroy all vegetable matters left on the field after the crop.

Pumpkin-Squash.

INSECTS.—Most of the insects injurious to cucumbers and the squash-bug: brown in color, with a bad smell, 3-4 inch long and laying eggs under the leaves.

DISEASES.—Plants are injured by wilt when 6 to 8 inches high and afterwards throughout the summer.

CONTROL.—1. Spray with Bordeaux mixture (page 23) every 10 days after the disease has shown for the first time.

2. Hand picking, early in the morning, will control bugs. One may also use shingles as traps wherein bugs hid at night; an early inspection of these traps in the morning will enable us to disclose and kill these pests. Should bugs grow too numerous (which is rather unlikely in this Province), kerosene emulsion (page 21), would have to be employed.



Squash-bug

Cucumber.

INSECTS.—Cucumber striped-beetle, a small insect attacking the leaves of young plants; often found in so large numbers as to injure other vegetables during summer. Aphis.

DISEASES.—Anthraenose particularly injuring leaves and stalks. Mildew, damaging leaves and killing them in wet summer seasons.

CONTROL.—1. Insect pests will be destroyed by spraying with arsenate of lead (page 18).



Striped Cucumber beetle.

2. For diseases, use Bordeaux mixture (page 23) every 10 days after first symptoms have been noticed.

3. To fight both insects and diseases, use a combined spray or poisoned Bordeaux mixture (page 25).

Lettuce.

INSECTS.—Cutworms, aphid, cabbage looper.

DISEASES.—Wilt making leaves to fade suddenly. Leaf blight.

CONTROL.—1. As no poison must be used on lettuce, hand picking is the only remedy against caterpillars.



Cutworm and its work

2. Abundant sprays with pure water will chase insect pests.

3. Transplanting is the only means to check diseases. The rapid growth and low price of this legume would not repay for the use of a fungicide.

Melon-Musk Melon-Water Melon.

INSECTS.—The same as for the cucumber.

DISEASE.—Leaf affection often causing the death of the melon.

CONTROL.—1. Arsenate of lead (page 18) or poisoned Bordeaux mixture to kill insect pests; repeat as often as necessary.



Melon Aphis

2. For diseases, use Bordeaux mixture (page 23) every 10 days from the time stems begin to run.

3. The combined treatment, insecticide and fungicide (page 25), is effective for these vegetables and many others.

Onion.

INSECTS.—Little white maggot of the onion fly, boring the bulb and killing the plant. Onion thrips, very small yellowish insects, damage the foliage. Also white grubs and cutworms.

DISEASES.—Mildew, smut, are generally not injurious pests.

CONTROL.—1. Disinfect seeds in formalin before sowing (page 22), if necessary.

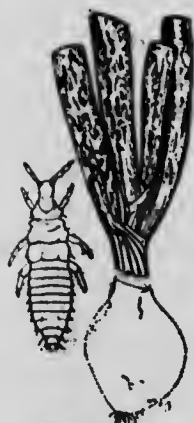
2. Mix seeds with wood ashes or soot and sow together so as to keep white grubs and cutworms away.

3. Mix phosphate to the earth around the onions to control the onion fly.

4.—When flies are dangerous, they must be prevented from laying their eggs on the leaves. A poisoned bait will attract and surely kill them. This bait is prepared as follows: dissolve $\frac{1}{2}$ of an ounce of sodium arsenate in 1 gallon of boiling water and add $\frac{1}{2}$ gallon of molasses; stir and mix well. Spread large drops of this mixture on the onions with a broom. This has an immediate effect on flies. Repeat the operation every day for one week. This remedy is about best; its use is the only one practical when large crops have to be treated.

5. Use Bordeaux mixture with sticker (page 18) so that it may adhere to the leaves.

6. Nicotine sulphate (page 20) or tobacco extract are used against onion thrips.



Onion Thrips.

Potatoes.

INSECTS.—Colorado potato beetle, the most dangerous enemy of this precious tuber, eating the leaves during the whole summer. Also blister beetles, plant lice, white grubs, wireworms.

DISEASES.—Powdery scab, common scab, dry rot, potato canker, attacking tubers; early and late blight; black leg, mosaic, etc., damage leaves and stalks and are afterwards transmitted to tubers. All of these diseases contribute in making the plant lose its vitality and in lessening the crop to a considerable extent. They can be prevented and the yield increased considerably in treating the seeds and the acreage under crop. No potatoes should be put into the ground without these elementary precautions being observed.

CONTROL.—1. Before planting, soak potato sets in formalin (page 22).



Potato Beetle

2. When shoots are 6 to 8 inches high, spray with Bordeaux mixture added, with Paris green (page 19) or arsenate of lead (page 18). This mixture both fights insects and prevents diseases.

3. Repeat this combined spraying operation every three weeks when the summer is dry, and every 10 or 12 days if the weather is wet and rainy. This prevents the development of blight and insects will not be permitted to do much damage.

Peas-Beans.

INSECTS.—Bean and pea weevils, both penetrate into the pods and hibernate into the seeds only coming out the following summer. Aphis, blister beetles, grasshoppers. The corn fly also damages young plants eating off their central stalk.

DISEASES.—Anthracnose, the most serious and most common; it is a kind of rust developping on the bean pods particularly; brown spots daily extent in size like a canker; blight, mildew, etc.



Pea Weevil

CONTROL.—1. Do not plant in a field where the crop was infested the year previous.

If seeds can be kept during one year in a well closed receptacle before being sown, weevils will come out and die.

2. Only perfectly sound seeds should be used; hand picking is one of the best means to control diseases.

3. Before sowing, fumigate seeds with carbon bisulphide (page 21) so as to kill insect pests which they might contain. Proceed as follows: place peas or beans into a water tight barrel; pour 3 ounces of carbon bisulphide on same (this quantity is enough for a barrel); close top with wet bags or otherwise to prevent insecticide exhalations from escaping. After 48 hours, open and plant.

4. For controlling rusts and other diseases, spray with Bordeaux mixture (page 23) as soon as the ill makes itself known, and afterwards every 10 days.

5. When plots are small, instead of Bordeaux mixture, one may use flower of sulphur sprinkled on beans or peas.

6. Be particular to select and place apart the soundest pods to be used for future planting.

7. If carbon bisulphide is used to treat seeds immediately after the picking more certain is the success.

Bean Anthracnose



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Radish.

INSECTS.—Most of the insects damaging cabbages, blister beetles.

DISEASE.—A discase darkens the root and dries it up.

- CONTROL.**—1. Arsenate of lead (page 18) is used against these plants.
2. To avoid disease sow elsewhere in a clean soil.

Tomato.

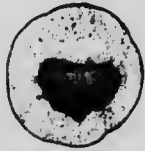
INSECTS.—A big caterpillar eats off the leaves; white grubs, cutworms, wireworms, etc.

DISEASES.—Mildew, leaf-spot, rot.

CONTROL.—1. Pull out and burn injured plants and fruits.

2. Spray with Bordeaux mixture (page 23) every 10 days to prevent diseases taking care to reach both the top and lower surfaces of leaves.

3. Big caterpillars may be picked by hands and destroyed. If too numerous add arsenate of lead (page 23) to Bordeaux mixture.



Tomato end rot

III.—INSECTS AND DISEASES INJURIOUS TO FRUIT TREES.

General treatment of the orchard.

1. Only good and hardy varieties should be planted. The orchard must be kept perfectly clean.
2. Cut off and burn trees or parts of trees infested by diseases, disinfect wounds with corrosive sublimate and cover with a good clay-colored paint, containing none or very little turpentine, or grafting wax, etc.
- 3.—Restore old orchards, scrape old to destroy oyster shell scales and burn all refuse. Remove rotten wood until sound wood is reached, daub with tar (none should be put on the bark) cover with wax or paint. If the cavity is a deep one, fill with cement.
4. During the months of October and April inspect all trees, remove egg masses, insect nests, cocoons on bark, leaves and limbs and burn the whole.
5. Wash trees with milk of lime in the fall and spring to protect them against sunstrokes and to destroy scales.
6. Protect young trees, particularly apple, up to 12 or 15 inches with tarred building paper, wire netting, etc. This will prevent rodents from eating the bark during the winter.
7. To check caterpillars, daub the trunks at a height of 4 or 5 feet with "treetanglefoot", grease, coal tar, lard and sulphur, castor oil and resin mixture.
8. Destroy all boring worms with a piece of wire or in suffocating them with carbon bisulphide (page 21).

Apple tree.

INSECTS.—Injurious to the fruits: codling moth, railroad worm, apple weevil, the larvae of which bore into the fruits and cause "wormy apples," meaning a considerable loss to growers.



Tent caterpillar



Round-headed apple tree borer



Oyster-shell Scale



Canker Worm

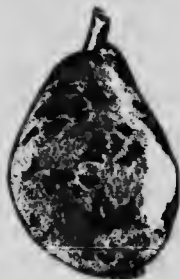
Injurious to leaves: pink and green aphid, sucking the underside of the leaves; a large number of caterpillars feed on the leaves, particularly: tent caterpillars, yellow-necked caterpillar, tussock moth, red-humped, fall web-worms spring and fall canker worms; sphinx or large green caterpillars, leaf rollers and miners, etc. They all contribute to diminish the vitality of the tree and to lessen its yield.

Bark: oyster-shell scales, found in large numbers on the bark of old trees; buffalo tree-hopper, tearing crescent shaped pieces of the bark for the purpose of laying its eggs; woolly aphid, causing cankers and which is more common to nurseries.

Wood: flat-headed apple-tree borer, working immediately under the bark; round-headed apple-tree borer, boring through the base of the trunk, particularly of young apple trees; bark beetle, imbricated snout-beetle.

Buds: bud-moth, the larva of which destroys these organs.

DISEASES.—The most widely spread is the apple scab which covers with spots both fruits and bark; blight develops on the trunk, branches and fruits. The apple canker destroys both bark and wood. Several species of rots are also known of (bitter, brown, black and dry) and are found on the various organs of the tree.



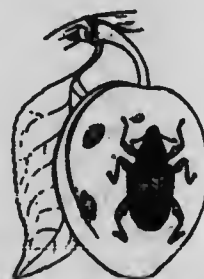
Pear Scab



Apple Scab



Codling Moth



Weevil

CONTROL BY SPRAYING.—First spray: when buds begin to show green. Use Bordeaux mixture (page 23), or lime-sulphur density 1.010 (page 25) both combined with arsenate of lead.

Second spray: when blossoms begin to redden, poisoned Bordeaux mixture or poisoned lime sulphur at 1,008 density.

Third spray: When blossoms begin to fall; poisoned Bordeaux mixture or lime sulphur at 1.006 density. If aphid are found under the leaves, add $\frac{1}{2}$ lb. of nicotine sulphate to the 40 gallons of either mixture.

Fourth spray: 15 days after the third, with same solutions. It is important that this fourth spray be made, because it has a remarkable effect on the control of diseases.

If necessary, a special spray with nicotine sulphate (page 21) will be made, during the summer, to kill apple aphid often literally infesting the foliage of the apple tree.

Pear Tree.

INSECTS.—Slug eating off all the green part of leaves; pear psylla and most of the insects injurious to the apple tree.

DISEASES.—See apple tree diseases.

CONTROL BY SPRAYING.—The same as for the apple tree.

Plum Tree.

INSECTS.—The plum curculio damages the fruits, the plum scale covers the bark. Several caterpillars injurious to the apple tree are also found on the plum tree.

DISEASES.—Black excrecencies form on branches and eat them up as a canker: this is the black knot. Plums are also damaged by the plum pocket, a disease which makes the fruit leak and turn dry. Also see apple tree diseases.



Pear Slug



Plum Scab



Black Knot



Brown Rot

CONTROL BY SPRAYING.—First spray: with Bordeaux mixture when buds begin to grow green (page 23).

SECOND SPRAY: when plums are set, with poisoned Bordeaux mixture (page 25).

Third spray: 3 weeks after the second, with poisoned Bordeaux mixture. For plum aphid, add nicotine sulphate to mixture.

From november to April, cut away and burn all black knots.

Cherry Tree.

INSECTS.—Cherry fly hollowing fruits and other plum insect pests.

DISEASES.—See plum tree.

CONTROL BY SPRAYING.—The same as for the plum tree.

IV.—INSECTS AND DISEASES INJURIOUS TO FRUIT BUSHES.

Gooseberry-Currant.

INSECTS—The most widely spread and equally the most dangerous are: the imported currant worm, a green caterpillar, dark spotted, eating up leaves; plant lice are also found by thousand lots under the leaves which they curl up. The saw-fly, striped bug and cane-borer are also to be reckoned with. •

DISEASES.—Mildew does much damage to leaves; blister rust covers the reverse side of leaves with a smooth orange-colored dust; white pine is destroyed in a few years when this disease is communicated to it.

CONTROL.—1. Only stout, hardy stalks, and free from rust should be planted as this terrible disease is presently causing damage in this Province it would be advisable not to multiply gooseberry and currant plantations.



Currant Rust

2. Pull out and burn all plants infested by rust and notify the Honorable Minister of Agriculture of the presence of this pest.

3. Spray as hereafter recommended:

First spray: with Bordeaux mixture (page 23) when buds are growing green; sulphur may also be sprinkled before leaves open to prevent mildew.

Second spray: with poisoned Bordeaux mixture, immediately after the blossoms appear (page 25).

Third spray: with poisoned Bordeaux mixture as soon as fruits have formed.



Currant Mildew

For plant lice, add nicotine sulphate to previous sprays, if necessary (page 20). As these sucking insects infest bushes practically during the whole summer, a nicotine spraying about every 15 days will be imperative to get rid of them.

Strawberry.

INSECTS—The white grub is very fond of its roots and often cause damage in newly planted bushes; plant lice, striped flea beetle, weevil.

DISEASE.—Spots on leaves.



White grub

CONTROL.—1. Soil should be well prepared and no weeds left so as to destroy white grubs. If they are too numerous, plant elsewhere.

2. Spray with Bordeaux mixture (page 23) when necessary.

Raspberry.

INSECTS.—Three borers: cane-borer, crown-borer and red-necked cane borer feeding on the pitch.

DISEASES.—Blight, orange rust, crown gall, anthracnose.



Wireworm adult and larva



CONTROL.—1. Destroy plants infested by the red-necked and the cane-borer.

2. Sprays:

First: with Bordeaux mixture before buds appear.

Second: when canes are 6 to 8 inches with poisoned Bordeaux mixture (page 25).

3. Keep a close watch on raspberry bushes and destroy immediately all insects found therein.

V.—INSECTS AND DISEASES INJURIOUS TO CEREAL CROPS.

Insects.

Grasshoppers, cutworms, white grubs; see first chapter.

ARMY WORMS.—Dark caterpillars most often invading fields in dense armies walking in a given direction and eating all plants they meet on their way. Not much feared up to now in this Province, but the black army worm has made its way to the Temiscaming region last year and might easily spread its havoc.

Remedies.—Army worms may be destroyed in three different manners, providing the remedy is applied as soon as the insect appears. Crops must be

actively looked over; otherwise everything will be cut away within three or four days.

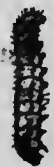


Army Worm

1. When caterpillars are but few, place a poisoned bait on the ground (page 19).
2. When in greater number, arsenate of lead mixture will be sprayed, when possible (page 18).
3. When they are numerous, trenches will be dug, in the direction they proceed and sufficiently ahead of them to complete the work before they reach the spot. A shallow ditch is first made with a plow or a log, giving the finishing touch with a shovel. The trench will be about 12 to 15 inches deep and about 10 inches wide. The wall facing the way caterpillars are marching should be as smooth as possible, vertical and beaten hard with a shovel; holes, 1 ft. deep, being made at every 15 feet in the trench. Caterpillars unable to ascend the abrupt slope fall into the holes where it is easy to crush them.

CUTWORMS.—Certain species of cutworms continually living underground, such as the glassy cutworms sometimes cause damages to oats, wheat, etc., during the month of June and up to the 15th of July.

Remedies.—Nothing but preventive measures are known as yet against these pests:



Glassy Cutworm

1. Do not sow in a piece of ground infested the previous year.
2. Cut out useless weeds upon which females lay their eggs.
3. When a field is badly infested, it must be plowed immediately in August; chickens will be permitted to follow the plow and hogs to pasture in the field.

HESSIAN-FLY.

The tiny white grubs of this fly eat the pitch of the plant. The attack can be difficultly foreseen and very often the damage is perceived too late when "flaxseed" is notice at the base of the stalk.

Remedy.—Destroy stubble left in the soil after the crop.

Diseases.

Rust appearing under the shape of small pockets attacked to the ears and containing fine dark-colored dust. Smut another disease which blackens

stalks and ears. Smut causes losses for several millions every year. This disease is serious but can be easily prevented by treating the seeds.

CONTROL.—1. To control rust on wheat and smut on oats, treat seeds in a formalin solution (page 22). Not a single bushel of wheat or oats should be sown that has not been previously treated in this way.

2. To control smut, allow seeds to go through three hot water baths as follows:

Water at 68 Far., degrees, during 4 or 5 hours.

Water at 112 Far., degrees, during 15 to 20 minutes.

Water at 112 Far., degrees, during 10 minutes.



Rust

VI.—SPRAYS.

INSECTICIDES.

This name is given to the various chemicals used in the struggle against insect pests. Insecticides are applied under powder, liquid or gas shape. The principal and most commonly used (arsenate of lead, Paris green) are sold in powder state, but are applied as a solution with water.

Chewing, sucking and boring insects.

We have already pointed out the treatment required by each plant and insects. It is however advisable to note briefly that insects according to their manner of feeding, form three groups necessitating different methods of control. In the first place are to be mentioned the *chewing* insects, armed with strong claws, and eating up leaves and fruits: caterpillars of all kinds, beetles, grasshoppers, cutworms and white grubs, blister beetles, come under this category. The safest and easiest way to control these highly dangerous pests is to poison their food with various substances. The *suckers* are provided with a beak, short or long, according to the case, which they plunge into the tissue of plants (leaves, bark, fruits) to extract juices, the sap, the liquid on which they make their living. Poisoning their food is impossible since it is the very sap of the plant. Consequently, their destruction is rendered possible by the use of substances killing them through contact, either in blocking the breathing organs, either in penetrating the body or in corroding the carapace of the insect. A third group could be added, that of the *borers*, formed of the worms boring under the bark or through the wood. Insecticides required for each group will be referred to, as well as the manner to prepare and use them.

Sticker.

This is no insecticide. This substance is mixed with insecticides or fungicides when spraying plants the leaves of which are smooth: cabbages, turnips, etc., This sticker makes the spraying mixture adhere to the leaves, while simply an aqueous solution would flow on the leaves without moistening them.

Formula.—Resin.....2 pounds.
Sal soda.....1 pound.
Water.....1 gallon.

Preparation.—Boil together during two hours, resin and sal soda in one gallon of water. Sal soda is obtainable at all drug stores.

Use.—Pour the product obtained after boiling into a 40 gallon insecticide or fungicide solution. To spray a garden of small area, one has only to reduce the dose according to the quantity of water contained in the solution.

FOR CHEWING INSECTS

Arsenate of lead.

Whitish powder or paste, with arsenic as base, like Paris green. It however has on the latter the advantage of adhering better to the leaves; it sticks for a longer time: one then says that "it is washed" more slowly by the rains. Besides, it does not damage the leaves. Paste arsenate of lead contains 50% of water, while powder does not contain any; the first is consequently half the strength of the second, twice the quantity must then be employed.

Preparation.—When using arsenate of lead under either form, care must always be taken to dilute the poison slowly: water is poured little by little while stirring continually so as to obtain a thin paste perfectly mixed, without any clods or grains. This is an essential element of success. There will only remain to pour this semi-liquid substance into a certain quantity of water and to stir hard before it goes into the sprayer.

FORMULAS.—1. To spray about one acre:

	Powder	Paste
Arsenate of lead....	2 lbs	4 pounds.
Water.....	40 gallons	40 gallons.

2. To spray a garden of small area:

Arsenate of lead..... $\frac{2}{3}$ of an ounce or 10 teaspoonfuls.
Water..... 1 gallon.

USE.—To spray all plants infested by chewing insects, particularly leaf-eaters. See each kind of plant to know how many sprayings are required, the time, etc.

Paris Green.

Another insecticide with arsenic as base, finely divided green powder, of a quicker action than lead arsenate but which has the inconvenience of "being washed down" more quickly. As it is more violent than the former, the dose must be proportionately less.

PREPARATION. Its preparation is the same as lead arsenate.

FORMULAS.— 1. To spray about one acre:

Paris green..... 8 ounces or $\frac{1}{2}$ pound.
Water.....40 gallons.

2. For tender leaf plants (potatoes, for instance).

Paris green..... 8 ounces or $\frac{1}{2}$ pound.
Quick lime..... 8 ounces or $\frac{1}{2}$ pound.
Water.....40 gallons.

3. For a small garde

Paris green..... 1 ounce or 1 tablespoonful.
Water..... 5 gallons.

USE.—Instead of lead arsenate as indicated for each plant.

Poison Bran Mash.

This bait is advantageously used against cutworms and grasshoppers. Poison mash attracts these pests which are killed after eating same. Two or three applications are often enough to clear an entire field of thousands of caterpillars or grasshoppers.

PREPARATION.—Mix bran to Paris green or arsenate of lead. Dilute molasses in water in a pail. Then pour this sweetened water slowly on poisoned bran, stirring hard so as to get the bran thoroughly moist throughout.

FORMULAS.— 1. For cutworms:

Water.....2 to 3 gallons.
Paris green $\frac{1}{2}$ pound.
Molasses.....1 quart.
Bran.....20 pounds.

2. Grasshoppers:

Use same formula as for cutworms, only adding the juice and sliced pulp of 3 lemons or oranges. Bran is sometimes replaced by sawdust, but for grasshoppers only.

3. For a small garden:

- Paris green 1 teaspoonful.
- Bran about 1 pound.
- Molasses 1 teaspoonful.
- Water Sufficiently to moisten the mixture.

USE.—To destroy cutworms, poison bran mash will be made into small balls and distributed around the plants, on the soil. As cutworms only come out at night to get their food, the distribution will be made at that time only. Grasshoppers look for something to eat during daytime; spread bran broadcast early in the morning.

FOR SUCKING INSECTS.

Sulfate of nicotine.

Black liquid tobacco extract sold by seedsmen, in half-pound boxes or more. It is sometimes known under the name of "Black leaf 40" in the trade. This remedy acts directly upon insect pests. It is used against plant lice, bugs, etc.

PREPARATION.—Consists solely in mixing the liquid purchased with a certain quantity of water.

FORMULA.— 1. For a large area:

- Sulfate of nicotine $\frac{1}{2}$ pound or $\frac{3}{8}$ of a pint.
- Water 40 gallons.

2. For an ordinary area :

- Sulfate of nicotine 1 ounce liquid.
- Water 8 gallons.

3. For a small garden:

- Sulfate of nicotine 1 teaspoonful.
- Water 1 gallon.

USE.—For spraying vegetables, we must add 2 pounds of hard soap (laundry soap) to the first formula; $\frac{1}{2}$ pound to the second and one cubic inch to the third. In all of the three cases, soap will be previously diluted in boiling water before mixing with the nicotine solution. Soap will permit of a more equal distribution of the insecticide and will make it stick to the leaves better. An important element of success in the fight against sucking insects consists in spraying as soon as they appear for the first time so as not to allow them to multiply, and to gain access to the lower surface of the leaves where they generally put up. In other words, nicotine must touch the insect; then, let us spray where it is to be found.

This remedy is used for the destruction of suckers on all plants indifferently. A special spray is not always necessary; it is sufficient, when making use of arse-

nate of lead, Bordeaux mixture or Paris green, to add $\frac{1}{2}$ pound of sulphate of nicotine to every 40 gallons of mixture or poisoned solution.

Kerosene emulsion.

FORMULA.—Hard soap $\frac{1}{2}$ pound
Kerosene (coal oil) 2 gallons.
Soft water (rain water preferably) 1 gallon.

PREPARATION.—When the water is boiling, dissolve soap, then add kerosene (coal oil) and stir for 5 or 10 minutes so as to obtain a thorough mixture. Mixing the liquids when they are hot only, is essential to success. A smooth, creamy solution is thus obtained which will become thicker as it cools. It will keep well, if sealed from air.

USE.—To be used, this solution must be diluted with 10 parts of hot water. Mix well and use after cooling.

—In a small garden where only a small quantity of emulsion is required one may proceed as follows: mix thoroughly 8 ounces of flour and 1 quart of kerosene, then add 2 gallons of hot water; stir 5 minutes and use.

BORING INSECTS.

Borers are those insects which bore galleries into the wood. These galleries usually have an exterior orifice, wider or smaller, through which the worm-dust is ejected. If any of this dust is noticed at the foot of the tree, it means that a worm is eating the wood. To get rid of this fruit or forest tree pest, we may use a flexible wire to kill it, but its destruction will be more safely affected with carbon bisulphide.

Carbon bisulphide.

Yellowish, easy-inflammable liquid of a bad smell, obtained at drug stores in one pint boxes.

USE.—This insecticide is used as bought. Carbon bisulphide is squirted one or several times with a syringe, into the gallery; and the opening is then closed with putty, soap or wax. The borer is killed by the escaping gas. Open after 24 hours. The round headed borer, the maple borer and the poplar borer are destroyed in this manner.

FUNGICIDES.

This name is given to certain chemicals or mixtures that have the property of preventing the development of plant diseases or of destroying their germs: potato scab, mildew, apple, cereal rust and most of the diseases of vegetables, fruit trees and bushes. Let us state here that these various diseases have caused crops to be lost valued at about \$60,000,000, in the Province of Quebec, last year. By this fact, we have lost 14 million bushels of potatoes valued at \$18,000,000 dollars, 4 million bushels of oats, valued at 3 million dollars; 350,000 bushels of beans, valued at 2 million dollars. The tax levied by these parasites is really too much expensive, particularly if we consider that we are in possession of the means to reduce it 50%; which would swell the purse of the Quebec farmer by \$30,000,000.

The fungicides, the preparation and use of which are herein described have everywhere given the best results. No reason should prevent farmers from making use of them: their own interest being at stake. This also affords a means for increasing production considerably and no person can give a proper excuse for sowing potatoes, wheat or oats that have not undergone the formalin treatment; and for growing fruit and vegetables without spraying them with Bordeaux mixture.

Formalin.

Liquid chemical, also called formaldehyde, found at all drug stores. It is a strong seed disinfectant; by using it, we will obtain healthy plants, stout, large crops and products of high quality.

PREPARATION.—Simply consists in pouring a determined quantity of formalin into a certain amount of water. Hereafter necessary details are given for the treatment of the various seeds.

POTATOES.—

Formula: 1 pint into 30 gallons of water (1 pint weighs 1 pound) or still one half pint (one half pound) into 15 gallons of water.

Length of the bath: 2 hours.

Potatoes (whole or cut) are put in clean bags and soaked into the barrel containing the formalin solution. After 2 hours, the bag is lifted and allowed to drain above the barrel. Potatoes will afterwards be spread on boards to dry. If the seeds are to be divided into sets after the bath, the following precautions must be taken: to have on hand several knives soaking in a receptacle filled with pure formalin. When one happens to slice a scabby, rotten or spoiled tuber, it must be thrown away, the knife must be dipped in formalin and another one used in its place. The same precaution applies any time when

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a similar case presents. Finally, when the seeds are put into the ground, care should be taken to use only receptacles (bags, boxes, buckets, pails) that are as neat as possible so as not to contaminate them anew, it would be a good idea to wash them in a formalin solution once the tubers have been treated.

WHEAT AND OATS.

First process: same dose as for potatoes, put seeds in bags and plunge into the solution during 5 minutes.

Second process: it appears that it gives better results than the previous one. Heap the grain on the floor 1 or 2 days before sowing time. Pour 1 pint of formalin into a barrel containing 40 gallons of water. A man provided with a watering can, a syringe or a broom (which he dips into the barrel, now and then and shakes hard) slowly moistens the grain, while another man armed with a shovel, turns it over continually until all the seeds are impregnated. To prevent the escaping of fumes, cover with neat bags or blankets during 2 or 3 hours. Then spread the grain so that it may dry up. The same as for potatoes, care should be exercised not to infect the seeds again, in using receptacles previously disinfected in formalin.

One pint bottle is enough to treat about 50 bushels of grain, which means less than 1 cent per bushel.

It is also to be remembered that wheat and oats thus treated slightly gain in bulk: the seeder shall consequently be set as if we were seeding $\frac{1}{3}$ or $\frac{1}{4}$ bushel more per acre.

ONIONS, BEANS, PEAS.

Allow onion seed to steep 15 minutes into a solution prepared as follows:

For a small quantity.

For an average quantity.

Formalin 1 teaspoonful.
Water 1 cup.

1 ounce.
2 gallons.

Bordeaux mixture.

This fungicide was discovered in 1885-87 by Millardet of Bordeaux (France), and experienced for the first time in Canada in 1890 by Professor Craig; it is used since 30 years with an astonishing success to control vegetable and tree diseases. Its efficiency has consequently been put to test.

FORMULA.— Quick lime 4 to 6 pounds.
Copper sulfate (bluestone)..... 3 to 4 pounds.
Water..... 40 gallons.

So as to avoid the "burning" of leaves more lime than bluestone must be used.

PREPARATION.—The following equipment is required in the preparation of Bordeaux mixture: 3 wooden barrels (copper injuring iron), one agitator 1 pail, 1 strainer, 1 small bag. The preparation consists in three distinct operations.

1.—*Copper sulfate solution.* In a *small bag*, place the bluestone which is to be dissolved in water. For this purpose, a *first barrel* is filled with 20 gallons of water; into which the bag containing the bluestone, suspended to a rope, will be immersed: 10 to 12 hours are required to effect the thorough dissolution of copper sulfate.

2. *Lime milk.* A good calcareous solution can only be obtained by slowly and progressively slaking the lime. Lime is placed in a pail, and water is poured upon it, a little quantity at a time, while the whole is stirred until a perfect lime milk is obtained. As lime contains impurities which must be eliminated, a *strainer* (sifter) is placed on the opening of a *second barrel* and the lime milk is poured into it. When this has been done, the 20 gallons of water to be contained, by the barrel are added and the whole is stirred with an agitator.

3. *Mixing the two stock solutions:* If Bordeaux mixture is required for immediate use, the materials contained in the two barrels will be poured into a *third barrel*; and so as to make a thorough mixture, the two stock solutions will be poured together. Then stir this 40 gallon liquid mass so that all constituents will be thoroughly mixed. The mixture will then assume a sky blue color. When this preparation is over the next thing to be done is to fill in the sprayer or watering can.

When the fungicide is needed for later use only, the two solutions are allowed to remain in their respective barrels until spraying-time has come. These may be kept for a fortnight although it is preferable to use the mixture immediately after it has been prepared; it then has its maximum efficiency.

The above method will be useful to most people. But in order to save time, owners of large orchards, and truck growers should rather proceed as follows.

The first operation will consist in dissolving 40 pounds of bluestone in 40 gallons of water or 1 pound of sulfate for each gallon of water.

Equally for the second operation, slake 40 to 60 pounds of lime, strain, and place 40 gallons of water in the barrel; each gallon of water will contain, pound or 1½ pound of lime.

On spraying day, after the liquid in the two barrels has been properly stirred, 4 gallons of lime solution (lime milk) will be poured into the barrel containing 20 gallons of water, and 4 gallons of bluestone solution in another barrel also containing 20 gallons of water. When each solution contained in the two first barrels will be poured into a third one, as already explained.

The same operations are repeated any time it is necessary to spray.

USE.—When the preparation is over, let us fill the watering-can or the hand or power sprayer. In the first case the operator will have to stir the mixture frequently; success being dependent on the thorough mixing of all elements, stirring, although unpleasant, is imperative. The other outfits do this work mechanically.

Strictly speaking, when using the watering-can, the third operation may be replaced by the following one. The stock solutions will be left in their own containers, and after stirring them energetically, an equal quantity of liquid will be taken in each barrel and poured into the watering-can; 40 gallons are usually enough to spray one acre garden or orchard.

Bordeaux mixture is used against practically all diseases; it is indicated herein, for each kind of cultivated plant, when and how to use same.

POISONED BORDEAUX MIXTURE.—It often happens that insects have to be controlled as well as diseases. The work will be made easy, by adding poison to 40 gallons of Bordeaux mixture, from the following table and according to the insecticide used:

Arsenate of lead (powder)	2 pounds.
Arsenate of lead (paste)	4 pounds.
Paris green	8 ounces.

Lime sulfur.

Mixture of flowers of sulfur and lime, sold all prepared, by seedsmen. This liquid only needs to be reduced, from a special dosage, for each spray. The use of a hydrometer is necessary for so doing. Its use is more complicated than Bordeaux mixture; besides, it is used only for fruit trees.

IMPORTANT INFORMATION

An act respecting the protection of plants from destructive insects and fungoid diseases.

(Assented to 19th February, 1914).

HIS MAJESTY, with the advice and consent of the Legislative Assembly of Quebec, enacts as follows:

“ SECTION XX

“PROTECTION OF PLANTS FROM DESTRUCTIVE INSECTS AND FUNGOID DISEASES

“2041c. It is forbidden, except under the conditions hereinafter set forth, to import into the Province any plant or part of a plant attacked by destructive insects or the plant diseases herein below specified.

“2041d. Upon the production of a document stating his official capacity, the entomologist of the Department of Agriculture of the Province, or his assistant or representative, shall have the right to enter any nursery, orchard or other premises wherein there is reason to believe that there are plants of any kind.

“2041e. It is forbidden to resist, in any manner, the action of the entomologist, his assistant or representative, when acting in accordance with this section.

“2041f. No one shall keep in his possession, nor offer for sale, nor in any way give to anybody whomsoever, plants, parts of plants which may be infested by any of the destructive insects or plant diseases hereinafter specified.

“2041g. The owner or occupant of any lot of land or nursery where the existence of any of the insects or diseases hereinafter specified may be ascertained or suspected, shall forthwith inform the Minister thereof, and at the same time give all useful information respecting the spread of the pest.

“2041b. During or after an inspection of any nurseries, green houses or any lot of land, the entomologist, his assistant or representative shall give the necessary instructions for the treatment or destruction of any plant infested by destructive insects or plant diseases. All such instructions shall be carried out by the owners or occupants of the premises or lots aforesaid.

“2041i. When the entomologist, or his assistant or representative, ascertains the existence in a nursery of any one of the destructive insects or plant

diseases specified in the list given below, no plant or part of a plant can be removed or transferred elsewhere until one or the other of the aforesaid officers has given the owners or occupant of the nursery a certificate stating that the instructions he has given for the treatment or destruction of the plants infested have been followed to such an extent as he deems necessary.

"2041j. By an authorization bearing his signature, the Minister may permit certain persons, for scientific purposes only, to import into the Province specimen of the destructive insects and of the plants attacked by any one of the plant diseases specified in the list given below.

"2041k. No compensation for expenses incurred or damages suffered through the treatment or destruction of any plants, trees or other vegetable matter attacked by any of the destructive insects or plant diseases specified in the list given below, or for any damages which may arise from the enforcement of this section, shall be allowed by any court when such treatment, destruction, expenses or damages result from the instructions given by the entomologist or his representative acting in their official capacity.

"2041l. Among the destructive insects and plant diseases to which this section shall apply, the following insects and diseases are expressly included:

1. The San José Scale.
2. The Brown Tail Moth.
3. The Gipsy Moth.
4. The Woolly Aphis.
5. Black Knot.
6. Apple Canker.
7. Potato Canker.
8. European Currant Rust.
9. White Pine Blister Rust.

Scientific Names.

1. *Aspidiotus perniciosus* Com.
2. *Euproctis chrysorrhoea* L.
3. *Portetria dispair* L.
4. *Schizoneura lanigera*, Hausm.
5. *Plowrightia morbosa* Sacc.
6. *Nectria ditissima* Tul.
7. *Chrysophlictis endobiotica* Schil.
8. *Cronartium ribicola* Fisch.
9. *Peridermium strobi*, Kleb.

"The Lieutenant-Governor in Council may extend the application of this section to other destructive insects and other plant diseases not included in the above list, when circumstances require and for a specified period."

"2041m. Between the 15th June and the 15th September of each year, the chief entomologist of the department of agriculture, or his assistant or representative, shall visit all nurseries in the Province in which plants are grown for commercial purposes, in order to ascertain the existence in such nurseries of any of the destructive insects or plant diseases specified in article 2041l, and shall deliver to the owner or person in charge of a nursery a certificate stating, if such be the case, that when he inspected such nursery, he did not ascertain the presence of any of the destructive insects or plants diseases specified in article 2041l; the date of the inspection in the following year.

"2041n. After the 15th September, 1914, every owner or person in charge of a nursery in the Province is forbidden to sell, give or deliver in any way to anybody, or to allow any plant or vegetable matter to go out of his nursery, unless he has received the certificate mentioned in article 2041m from the entomologist of the department of agriculture, or his assistant or representative.

"2041o. Every contravention of article 2041n, or every refusal to comply with the instructions given by the entomologist of the department of agriculture, or by his assistant or representative, with respect to the treatment or destruction of infested vegetable matter or of the destructive insects or diseases specified in article 2041l, shall render the person guilty of the same liable to a fine not exceeding one hundred dollars, with costs."

2. This act shall come into force on the day of its sanction.

An Act respecting the protection of bees

It is forbidden to spray plants with poisoned mixtures while such plants are in bloom. Prosecutions are liable to be taken against any person ignoring this law. The aim of this regulation is to protect bees from being poisoned while gathering honey on flowers.

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