

**CIHM
Microfiche
Series
(Monographs)**

**ICMH
Collection de
microfiches
(monographies)**



Canadian Institute for Historical Microreproductions / Institut canadien de microreproductions historiques

© 1996

Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

- ☐ Coloured covers / Couverture de couleur
- ☐ Covers damaged / Couverture endommagée
- ☐ Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- ☐ Cover title missing / Le titre de couverture manque
- ☐ Coloured maps / Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- ☒ Bound with other material / Relié avec d'autres documents
- ☐ Only edition available / Seule édition disponible
- ☒ Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- ☐ Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- ☐ Additional comments / Commentaires supplémentaires:

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- ☐ Coloured pages / Pages de couleur
- ☐ Pages damaged / Pages endommagées
- ☐ Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- ☒ Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- ☐ Pages detached / Pages détachées
- ☒ Showthrough / Transparence
- ☒ Quality of print varies / Qualité inégale de l'impression
- ☐ Includes supplementary material / Comprend du matériel supplémentaire
- ☐ Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- ☐ Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below /
Ce document est filmé au taux de réduction indiqué ci-dessous.

10x	14x	18x	22x	26x	30x
☐	☐	☐	☒	☐	☐
12x	16x	20x	24x	28x	32x

The copy filmed here has been reproduced thanks to the generosity of:

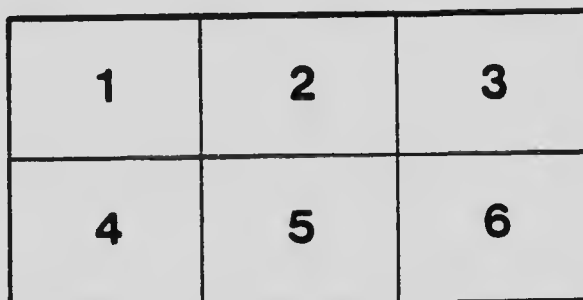
National Library of Canada

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Original copies in printed paper covers are filmed beginning with the front cover and ending on the last page with a printed or illustrated impression, or the back cover when appropriate. All other original copies are filmed beginning on the first page with a printed or illustrated impression, and ending on the last page with a printed or illustrated impression.

The last recorded frame on each microfiche shall contain the symbol $\rightarrow$ (meaning "CONTINUED"), or the symbol ∇ (meaning "END"), whichever applies.

Maps, plates, charts, etc., may be filmed at different reduction ratios. Those too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:



L'exemplaire filmé fut reproduit grâce à la générosité de:

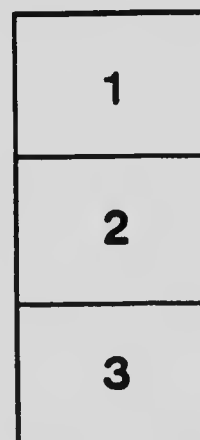
Bibliothèque nationale du Canada

Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

Les exemplaires originaux dont la couverture en papier est imprimée sont filmés en commençant par le premier plat et en terminant soit par la dernière page qui comporte une empreinte d'impression ou d'illustration, soit par le second plat, selon le cas. Tous les autres exemplaires originaux sont filmés en commençant par la première page qui comporte une empreinte d'impression ou d'illustration et en terminant par la dernière page qui comporte une telle empreinte.

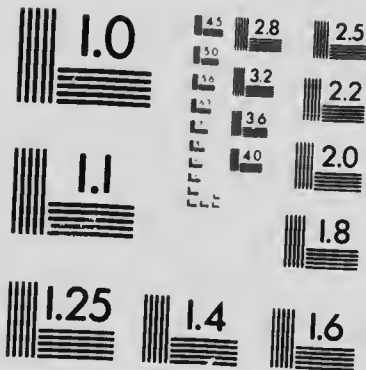
Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole $\rightarrow$ signifie "A SUIVRE", le symbole ∇ signifie "FIN".

Les cartes, planches, tableaux, etc., peuvent être filmés à des taux de réduction différents. Lorsque le document est trop grand pour être reproduit en un seul cliché, il est filmé à partir de l'angle supérieur gauche, de gauche à droite, et de haut en bas, en prenant le nombre d'images nécessaire. Les diagrammes suivants illustrent la méthode.



MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc.

1653 East Main Street
Rochester, New York 14609 U.S.A.
(716) 482-0300 - Phone
(716) 288-5989 - Fax

be
on
ta
fa
th
er
in
se
fa
de

du
fin
wi
vic
are
Pl
kn
m,
wi
me

wh
Po
of

—
—
En

MANITOBA AGRICULTURAL COLLEGE

INJURIOUS INSECTS

of

Garden, Field and Forest

F. W. BRODRICK, B.S.A.**Professor of Horticulture, Manitoba Agricultural College
Winnipeg, Manitoba**

A matter of great importance is the immense damage which is being done each year to our garden, field and forest crops by injurious insects. The extent of this injury is often not very apparent, but taken in the aggregate many millions of dollars of damage is done to farm and forest crops each year by parasitic insects. A study of the problem reveals the fact that practically every field and garden crop has its insect enemies. Some of these may do considerable injury each year, while others may do little apparent damage. In some cases certain forms of insect life are to be found doing a certain amount of injury each year, while in other cases the damage is done during periodical outbreaks.

Becoming a More Complicated Question.

With the settlement of the West and with the opening up of new districts, the insect problem becomes a more complicated one. From time to time new insects are being introduced in sundry ways, and with the introduction of new crops, new food plants are being provided. Some insects, when once introduced under conditions that are at all favorable, may spread rapidly and do considerable damage. The plant and tree grower is then confronted with the problem of knowing the insects that affect his crop, their method of attack, the injury done and the best method of control. He may be confronted with the possibility of having an entire crop wiped out, if remedial measures are not applied quickly.

The prolific way in which insects reproduce and the rapidity with which they develop accounts for the severity of frequent outbreaks. For instance, one or two weeks may be sufficient for the destruction of a crop by the army worm (*Leucania unipuncta*) or a wind break

Published by Authority of Hon. V. Winkler, Minister of Agriculture

may in a short time be defoliated by an outbreak of the canker worm (*Alsophilia pometaria*). Every year reports come to hand of some damage being done in garden, field, or forest by insect attack, and the importance of a knowledge of insect control is being forcibly impressed upon us.

Various Ways of Attack.

Insects attack plants in various ways and the nature of the injury caused by them may be very varied. Very often the severity of the attack, particularly with those insects which burrow within the tissues of trees and plants, is unnoticed until severe injury is done. Some insects may attack the roots and injure the plant in that way, while others work on the buds or leaves and by defoliating the tree or plant seriously interfere with its development. Serious injury is often done to trees in wind breaks and in our forests by these leaf eating insects. In regions where fruits are grown, the grower has to contend with the injuries of insects which bore into the fruit and cause it to become seriously deformed or to fall and decay.

Metamorphosis.

A study of insect life is interesting from the fact that they display many remarkable habits, and that they undergo a rather intricate development. Throughout their life they may pass through a number of well defined changes. For instance, a common house fly (*Musca domestica*) was not always a fly but lived for a time as a maggot under conditions most unsanitary. As it develops towards a fly, it rests for a time as a dormant pupa, which neither eats nor moves before it emerges as a full grown fly. The period of time that is required for insects to complete their development may vary from a few days, as in the case of our common mosquito, to several years, as in the case of the June beetle.

Some Specific Insects.

Turning now to a study of the insects themselves, it would be well to deal with a few of these insects, outlining their method of attack, describing briefly their life histories, and suggesting, if possible, methods of control.

GARDEN INSECTS.

Cut Worms.

In the spring and early summer more or less injury is done to garden crops by insects affecting the roots, the most serious of



Cut Worm Enlarged to Twice Natural Dimensions

which are the garden cut worms, which are the larvae of night flying

These belonging to the genus *Noctuidae*. With tender garden plants, unchecked, the ravages of cut worms may become serious.

These larvae, which are brownish or greenish, live in the soil, and come out during the evening and cut off tender garden plants, such as cabbages, ranunculus and tomatoes. The injury caused by them is most noticeable when the plants are young.



Young Plants in the Garden may be protected from Cut Worm ravages by small cylinders of tin or wire mesh.

The most effective means of dealing with these troublesome garden pests are by protecting the plants with paper, cards, or applying poisoned baits or poisoned shorts, mixed in the following proportions:

Shorts	50 lbs.
Paris Green	1 lb.
Molasses	1 gallon
Water	1 1/2 gallon

White Grubs.

In garden the work of white grubs, which are the larvae of a large brown beetle known as June beetle (*Leucosterna fusca*), may often be detected. These insects require from two to three years to complete their development and during their larval period are found feeding on the roots of tender garden plants and grasses. Poultry are fond of these large insects and if given an opportunity will destroy large numbers of them.

Wire Worms.

Wire worms are often found in the soil attacking the roots of garden crops as well as field crops. These insects, which are of a peculiar amber color, develop into long narrow beetles known as Click Beetles (*Agriotes lineatus*). They are called Click Beetles because when placed on their backs they turn over with a peculiar clicking sound. Their resistance to poisons makes their destruction difficult. Late fall plowing, which breaks up the pupae cells, is an effective way of dealing with them.

White Maggots.

Every year injury is done to the roots of onions and cabbages by small white maggots. These insects prove to be the larvae of small flies (*Phorbia ceparum* and *P. Brassicae*) which when fully developed are about the size of the common house fly. The eggs are laid by the adult insects on the surface of the soil near the roots of young plants. The newly-hatched larvae work into the soil and begin burrowing into the roots of the young plants, causing a decay. They pupate in the ground and emerge later as flies. In their control, rotation of crops should be practised and a strong growth of plants should be stimulated by the use of such quick acting fertilizers as nitrate of soda. Watering the soil around young onion plants every seven to ten days with hellebore solution in the proportion of two ounces to one gallon of water is quite effective in controlling the onion maggot.

Cabbage Worm

An insect common on the leaves of cabbages is the Cabbage Worm, the larvae of the imported Cabbage Butterfly (*Pieris rapae*). These larvae, which are of a pale green color, do considerable damage by eating holes in the leaves of the cabbage. They later develop into the pale white butterfly seen flitting about the cabbage fields during the summer. Collecting and destroying refuse lying about the cabbage fields and spraying the leaves of the cabbage with a solution of White Hellebore in the proportion of two ounces to one gallon of water is effective in holding the insect in check.

Blister Beetle and Potato Beetle.

Leaves of the potato are frequently destroyed by leaf eating beetles. The old fashioned Blister Beetle (*Epicauta pennsylvanica*) and the Colorado Potato Beetle (*Doryphora decemlineata*) are frequently found in potato fields. The latter, which was first found in the state of Colorado, is particularly destructive, the larvae and adults eating both leaves and stems. There are usually two broods during a season, the second being most destructive. The insects winter as adult beetles, and for this reason all refuse should be collected and destroyed. The spraying of the leaves with arsenical poisons, such as Paris green or arsenate of lead, should be effective in keeping these insects in control.

Army Worm.

The Army Worm (*Leucania nupuncta*) is a species of climbing cut worm and the larva of a night flying moth. The Army Worm derive its name from its peculiar habit of marching over the fields in large numbers and occasionally does serious injury to garden crops. These insects feed and carry on their migration during the night and remain dormant during the day. The use of coal tar barriers or spraying the affected plants with arsenical sprays may tend to check the onward march of these insects and keep them under control.

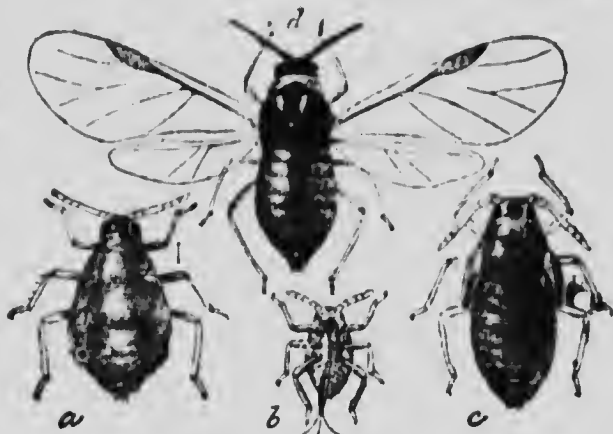
Grass Hoppers.

Grass hoppers are sometimes injurious to garden crops by eating the leaves. The young hoppers, which hatch in the spring from eggs laid in sand the previous fall, begin feeding on the leaves soon after hatching. They reach their development by fall. Grass hoppers may be collected in specially designed hopper dozers. Destroyed by scattering about the garden or fields the "middle manure," which is prepared by thoroughly mixing one pound of Paris green and two pounds of salt with sixty pounds of fresh horse droppings. These insects are very fond of this mixture and evidently prefer it to the food plants.

Plant Lice.

On garden vegetables, fruit plants and on plants growing in greenhouses are to be found small sucking insects known as Plant lice or Aphids. These insects, on account of the rapidity with which they develop, frequently become very numerous and do considerable

injury by attacking the tender parts of growing plants. They undergo a rather remarkable development and affect the plant injuriously by sucking up the juices. The winged forms which appear from time to time, allow for the distribution of the insect from place to place. They secrete a peculiar, sweet, sticky fluid called honey dew, which is attractive to ants. They may be controlled by the application of adhesive sprays such as kerosene emulsion or Nicotine Sulphate, which is



Plant Lice

There are a great many types of Plant Lice. They are usually about the size of small pin heads.

Commercially known as "Black Leaf 10."

Currant Worm.

The Currant Worm or Currant Saw Fly (*Nematus Ventricosus*) is particularly injurious to the garden red currant by feeding on the leaves and completely defoliating the plant. The greenish larvae, which hatch from the eggs laid on the under surface of the leaves, are very active feeders and soon strip off all the leaves if unmolested. When fully developed they pupate and later emerge as an active four winged fly. They may be controlled by the use of white hellebore in the proportion of two ounces to one gallon of water, or mixed with equal parts of flour and dusted on the leaves of the plant.

INSECTS AFFECTING SHADE AND FOREST TREES.

There are numerous insects affecting the trees around our homes in our windbreaks or in our forests. Forest insects frequently appear in large numbers and do serious injury to forest trees, particularly those forms which feed on the leaves. Both deciduous and coniferous trees have their insect parasites. A deal of injury is also done to forest trees by boring insects, particularly to coniferous trees whose woods are affected by the various boring beetles.

Canker Worm.

Among those insects affecting the leaves of deciduous trees are the Canker Worms, Fall Canker Worm (*Aisophila pametaria*) and Spring Canker Worm (*Paleacrita vernata*). The larvae of these insects, which have a peculiar looping motion, feed on the leaves of

such trees as the Manitoba maple, and if not destroyed in time may completely defoliate them. The adult female moths are wingless, but the males are winged. The insect winters over as eggs on the affected trees. Spraying the trees on the first appearance of injury with arsenical sprays is an effective way of holding them in check, while banding the trees early in the fall with bands of paper covered with pine tar or some sticky material is also recommended.

Tent Caterpillars.

Other injurious insects affecting our trees are the Tent Caterpillars (*Glusocampa disstrata*). These insects during their larval development live in small tents on the branches of trees, giving the trees an unsightly appearance. From these tents the larvae emerge and feed on the tender leaves and buds. Collecting and destroying tents or the egg masses in which condition the insect passes the winter or spraying the leaves with arsenical sprays are effective means of destroying the insect.



Canker Worm

The male winged Canker Worm is shown in figure A; the wingless female (d) the left hand of picture; the larvae at the top of the picture (c).

Western Willow Leaf Beetle.

During recent years more or less injury has been caused to the willows and poplars by a small, brownish beetle which feeds on the leaves of these trees and frequently appears in such large numbers as completely to defoliate them and leave them brown and bare. This small beetle is the Western Willow Leaf Beetle (*Galerucella decorata*). On account of the suddenness of their appearance and the injury caused by them, effective control measures should be employed as soon as they appear.

These beetles are tissue eaters, and the arsenical sprays, such as Paris Green and Arsenate of Lead, may be employed against them.

Plant Lice on Maples.

Every year more or less injury is caused to the Manitoba Maple by the Negundo Plant Louse (*Chaitophorus Negundinus*), a small greenish plant louse which collects in large numbers on the young growths and leaves of the Box Elder or Manitoba Maple. They are sucking insects and feed on the juices of the tender parts. As they draw their food from beneath the surface, they are not destroyed by any application of poisonous sprays applied to the surface of the tissues. The most effective means of control is the application of contact solutions, such as Nicotine Sulphate, known as "Black Leaf 40," kerosene emulsion or the tobacco solutions or soap washes.

Larch Saw Fly.

Of insects affecting forest trees, and particularly coniferous forest trees, none are more widely distributed or destructive than

The Larch Saw Fly or Larch Worm (*Nematus erichsonii*). Several outbreaks are reported from various parts of Canada, during recent years it has been found in localities throughout the Central West.

On account of its destructive habits, the life history of this insect has been very carefully studied. It is found that the adult flies lay their eggs in slits which are made on the terminal shoots, which subsequently die. The young green larvae which hatch out begin feeding on the fresh green leaves, and as they grow older they feed in clusters, stripping the whole tree of its foliage, which eventually causes the death of the trees. The larvae, which are of a greyish green color, are full grown in a few weeks. When full grown they descend the trunks of the trees and pupate in the loose turf at the base of the tree, the adult flies emerging from them the following June. These insects are held in check by insect eating birds and by natural parasites. On account of the habits of the tree, artificial remedies are difficult to apply, but the arsenical sprays can be used to good effect on windbreaks or on lawns.

Spruce Saw Fly.

The Spruce Saw Fly (*Lophyrus albertis*) which feeds on the buds and needles of the white spruce, is also quite injurious, but like the Larch Fly, can be effectively controlled with the arsenical sprays.

INSECT CONTROL.

In all probability the matter of greatest interest to the grower of plants and trees is the question of insect control. Frequently the measures employed have to be applied quickly to be effective, as the injury will be done in a comparatively short time. The natural agencies which are at work in holding insects in check, such as birds, predators and parasitic insects and



These eat Plant Lice

The lady beetles are active in destroying Plant Lice.

fungus disease are probably the most effective methods of insect control, and the object of the farmer should be to foster and protect in every possible way these protective agencies. Often cultural agencies, such as crop rotation, clean farming, growing of resistant varieties or the destruction of the crop at a critical time in the life of the insect, may be the most effective means of destroying insects or holding them in control. Where these are ineffective the grower may resort to the use of protective washes or sprays.

Solutions used for the destruction of insects are called insecticides and are classified according to their action upon the bodies of insects. Some exert a poisonous action on the insect's body by being absorbed on the food plants to which material has been applied and hence these are called food poisons. Others kill by coming in

direct contact with the insect's body, and are called contact poisons.

Food Poisons.

Paris Green, arsenate of lead, and calcium arsenate or calpoiso are some of the most effective food poisons on the market at present. To overcome the burning property which is sometimes present in Paris Green, add double the quantity of fresh unslacked lime when preparing it for use as a spray. As an example, when spraying for potato beetles, use one pound of Paris green and two pounds of lime to forty gallons of water. From a half to one pound of Paris green to forty gallons of water is the quantity generally used to destroy chewing insects. The non-adhesive qualities of this poison, the danger from burning, and the present high price of the product have caused some falling off in its use.

Arsenate of lead is one of the newer insecticides to be used in Manitoba. It possesses several distinct advantages over Paris green, and in many places in Eastern Canada and the United States it has superseded Paris green entirely. At present it is much cheaper than Paris green, will not burn the foliage in the least, will adhere much better to the foliage of the plants than Paris green, and, in addition to these advantages, it is quite effective as a food poison. It can be purchased in both paste and powdered form. The powder is perhaps the better of the two forms as it can be transported easier, will mix more readily with water, and will keep for a longer time without deterioration. Dosage: Powder—from one to three pounds to 40 gallons of water, depending on the kind of insect it is used against. Paste—from three to four pounds to 40 gallons of water.

Calcium Arsenate—Calcium arsenate, the trade name for which is "calpoiso," has recently been put on the market in Western Canada. It is one of the newest arsenical poisons, and, according to some authorities, it is quite satisfactory as a means of destroying many kinds of biting insects. The commercial article is sold in the form of a very fine powder. It mixes readily with water and remains in suspension for some time. Dosage: three pounds of powder to 40 gallons of water is the quantity recommended by the manufacturers.

Contact Poisons

Nicotine solutions, such as nicotine sulphate and "Black leaf 40," are amongst the best contact poisons. Pyrethrum powder and belladonna may also be used as contact poisons on the larval form of certain insects. Black leaf 40 and nicotine sulphate are made from the stems and leaves of tobacco and are guaranteed to contain 40 per cent. of nicotine. Both of these materials have been used in Canada for some time and have proved to be quite satisfactory. They mix readily with water, will not injure the most delicate foliage, and are comparatively low in cost. As a means of destroying all kinds of plant lice or aphids they are unexcelled.

In the face of what has been stated above, a general statement can be made regarding the control of insect pests. Insects which devour the external tissues of plants can be most effectively controlled by using food poisons. Those which suck the juices of plants cannot be killed by a food poison but, instead, require a contact poison such as "Black leaf 40" or nicotine sulphate.

