

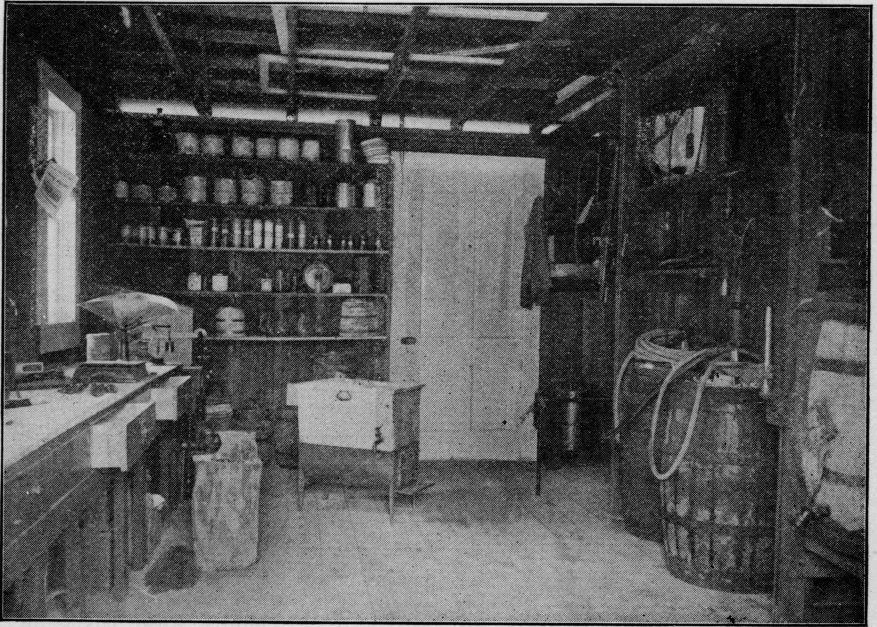
TEXAS AGRICULTURAL EXPERIMENT STATIONS

BULLETIN No. 89

INSECTS OF THE GARDEN

BY

ALBERT F. CONRADI
Entomologist



Interior of one of the Insecticide and Spray Machine Laboratories of the Department of Entomology

WITH A CHAPTER ON

THE MELON LOUSE AND OTHER APHIDS

BY

C. E. SANBORN
Co-operative Expert Entomologist
Specialist in Aphididae
U. S. Bur. Ent.

NOTE—Circular 11 of this Department should accompany this bulletin.

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NOTE.—The main station is located on the grounds of the Agricultural and Mechanical College in Brazos County. The Postoffice address is College Station, Texas. Reports and bulletins are sent free upon application to the Director.

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PREFACE.

This bulletin on "Insects of the Garden" has been prepared to answer many of the inquiries received at this Department from truck growers in all sections of Texas. The formulas for preparing the various insecticides have been omitted, because Circular 11 of this Department, which is now in press, will soon be issued. This circular contains information on how to prepare the different insecticides, and is sent free to any citizen of Texas upon application. It is hoped that another circular will be issued soon containing information about spray machinery.

The authors wish to express their indebtedness to Dr. Harrington, President of this College, through whose efforts the publication of this bulletin was made possible. We wish to acknowledge the assistance and courtesies extended by Dr. Howard, Chief of the Bureau of Entomology, in the preparation of electrotypes; to Mr. C. E. Bartholomew, of this Department, for the preparation of photographs; and to Mr. F. T. Foley, clerk and stenographer in this Department, for his customary painstaking work in preparing the manuscript for publication.

BEANS AND PEAS.

BEAN AND PEA WEEVILS.

(*Bruchus spp.*)

Frequently we find beans and peas with excavations like those shown in Figure 1. There are several species of weevils that are responsible for this injury, the most common being the cow pea weevil (*Bruchus 4-maculatus*), the pea weevil (*Bruchus pisi*), and another species (*Bruchus amicus*).

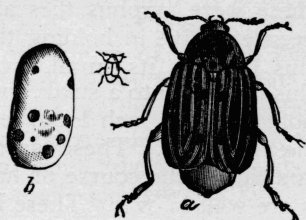


FIG. 1.—Pea weevil (*Bruchus pisi*). (After Riley).

These weevils deposit the eggs on the growing crop and the larvae gnaw into the pods. In autumn many are immature and are harvested with the crop and stored. In the spring a large per cent of the stored grain has been injured. The insects are distributed over all the well-settled portions of Texas, from the Red River to Brownsville.

REMEDIES.

The seed should be placed in a tight room and fumigated with carbon bisulphide at the rate of 1 lb. to 100 bushels for 48 hours. For smaller quantities it would be proportionately 1 oz. to 100 lbs. Where only a few seeds are to be treated, one should provide himself with a coal-oil barrel. This may be tightly closed at the top by placing over it burlap or heavy canvas weighted down with boards. In our experiments we used a canvas saturated with linseed oil, or painted, and then spread over the top and fastened by dropping a common hoop over the barrel. One barrel holds about 5 bushels or 300 lbs. of seed, which would require about 3 oz. of carbon bisulphide. This can be done outdoors away from buildings.

Often such seed is treated with water. One method is to drop the seed into scalding water in order to kill the adult beetles. The water must be immediately poured off to prevent injuring the seed or cooled immediately by adding cold water. Most of the weevilly seed will rise to the surface. There is no more satisfactory method, however, than the use of carbon bisulphide. It is cheap, thoroughly effective and easily applied.

In buying seed one should make sure that it is not infested by one or more species of the weevil.

DESTRUCTIVE PEA LOUSE.

(*Nectarophora destructor*, Johns.)

This pest has been sent to us from Dallas and has been observed in Victoria. It also occurs near College Station. It apparently is widely distributed in Texas, and as it is a most seriously destructive pea pest in other sections of the country it may be regarded in this State with apprehension.

NATURAL ENEMIES.

The material sent to us for identification in all cases was heavily parasitized. Besides, there were syrphus flies and lady bugs present, which no doubt have been effective in holding the pest in check up to this time. The syrphus fly lays its small, oval-shaped egg on the leaf among the lice. This hatches into a small, greenish maggot, which, when full grown, is about one-half inch long, legless, with no distinct head, and pointed at the front end. These larvae have been observed to eat several dozen plant lice in the course of half an hour.

The lady bird beetles are well known. These lay very small, yellowish or orange-colored eggs in clusters. One particular species (*Hippodamia convergens*), upon which careful observations have been made in breeding cages by Mr. C. E. Sanborn, of this Department, lays over 400 eggs. These hatch into little, alligator-like larvae, with six legs. When full-grown they hang themselves pendant from a leaf or stalk and transform to a pupa. (See Figs. 42 and 43.)

Another important enemy which is very abundant in this State is the "lace-winged fly." The adult has a bright-green color, with large wings distinctly netted-veined like lace work. (See Fig. 44.) No one can fail to recognize her eggs at sight. They are minute and light-colored objects at the ends of silken stalks. All these natural enemies are among the most important factors in the economy of Texas agriculture, and are more fully discussed beginning on Page 43.

REMEDIES.

Experience has shown that where the peas are planted in rows in well-fertilized land and the soil kept thoroughly mulched, so as to conserve the soil moisture, good crops have been made in spite of the presence of this pest. Spraying them with kerosene emulsion will kill many in small gardens, but on a large plantation, where the work can not be done so thoroughly, it was found unsatisfactory. The work of brushing them from the vines was originated by Prof. W. G. Johnson. They can be easily knocked off vines planted in rows, and if this is done in the heat of the day many of the lice are killed on the hot ground. The vines should be brushed with branches and should be immediately followed with a cultivator in order that the lice are covered up. Cultivation should then be discontinued for several days, as it is said that it requires 48 hours for the destruction of the adult insects when covered with earth.

The importance of cleaning up the field after harvest time can not be too strongly emphasized. Besides, weeds growing about the plantation should be kept down. (See Page 43 et seq.)

BEETS.

BEET LEAF MINER.

(*Pegomyia vicini*, Lintn.)

Every season the gardener observes the light-colored, semi-transparent trails on his beet leaves. This is due to a small insect that feeds under the epidermis of the leaf. Sometimes large areas are mined so that the leaf dies and often the plant is killed. The leaf miner is an enemy of beet, spinach and related plants.

The adult is about one-fourth of an inch long, of a gray color and white in front of the head. They hover about the food plant near the ground and lay their eggs on the lower surface of the leaves. The resulting larvae at once burrow into the leaf, making the curved and semi-circular mines so commonly seen. By holding up a leaf to the sun the maggot can be easily located.

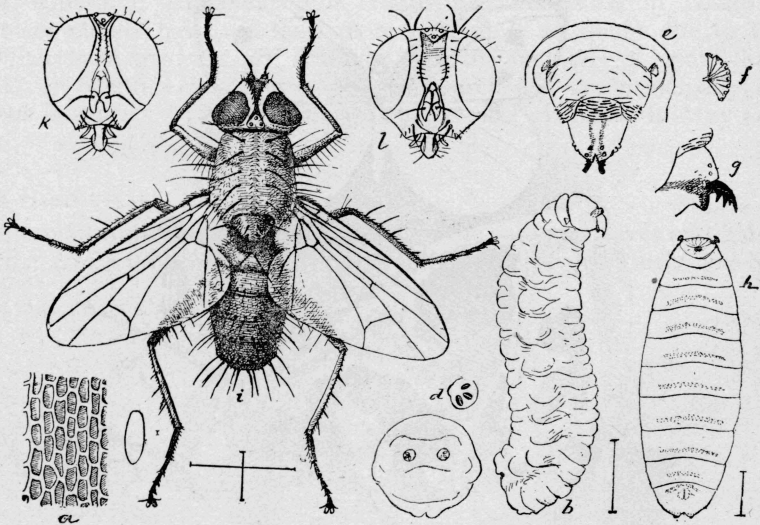


FIG. 2—Beet Leaf Miner. (*Pegomyia vicini*). i, adult fly; a, egg; b, larva or maggot; h, pupa. (From Howard, Bureau of Entomology, U. S. Department of Agriculture.)

When the larvae are full-grown, they repair to the surface of the soil to pupate, and at the end of 30 days from egg-laying the adult fly emerges.

CONTROL.

In their occurrence the insects fluctuate from year to year. They can not be reached with insecticides, and the only procedure of any

value is hand-picking and destroying the leaves upon which they appear. As the burrows are very conspicuous, it is not as laborious as would appear at first sight. It is important, as they breed in related wild plants, that weeds be kept down in early spring about the garden.

CABBAGE, MUSTARD, TURNIPS, RADISH AND CAULIFLOWER.

THE IMPORTED CABBAGE WORM.

(*Pontia rapae*, Linn.)

There are several kinds of worms that devour the leaves of cabbage and cauliflower plants. As all are controlled by the same methods, only the description of the most important is given. The green cabbage worm was brought to this country from Europe about 1857. The parents of the worms are the common white butterflies, the female having two black spots upon each of the front wings, while the male has only one. They may be seen hovering about various kinds of

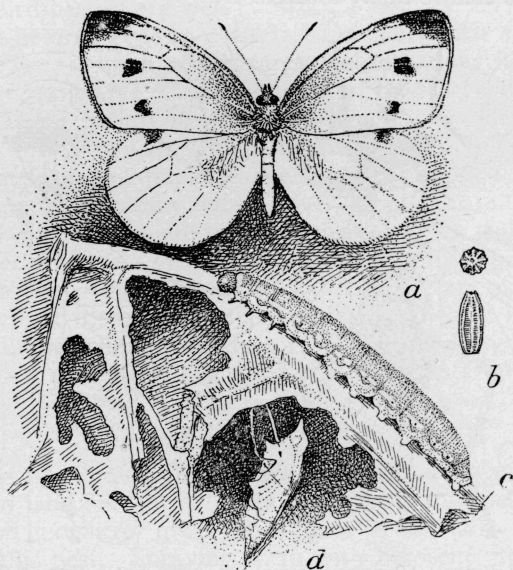


FIG. 3—Imported Cabbage Butterfly (*Pontia rapae*); a, female butterfly; b, above, egg as seen from above; below, egg as seen from side; c, larva in natural position on cabbage leaf; d, suspended chrysalis—a, c, d, slightly enlarged. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

flowers, sipping the nectar. They are diurnal, and fly from early morning until late in the afternoon, having great power of endurance on the wing, often migrating long distances. Other closely related species, notably the Southern cabbage butterfly, well known to everyone, were

formerly very injurious, but since the introduction of the imported species the Southern cabbage worms have been "crowded to the wall."

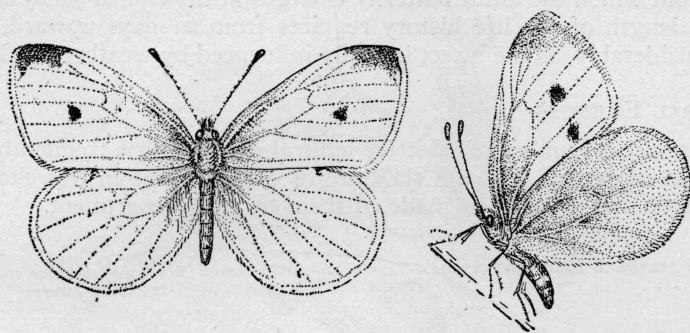


FIG. 4—Imported Cabbage Butterfly; male, wings expanded at left; wings folded in natural resting position at right. Somewhat enlarged. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

DISTRIBUTION IN TEXAS.

This insect occurs all over the humid sections of the State. Requests for information for controlling them have come to us chiefly from Wise, Hamilton, Angelina, San Augustine, and Wharton counties. That complaints have not been more general is no doubt due to the fact that most growers are familiar with the methods of controlling them. In South Texas they appear in March and are principally injurious in April. In North Texas they are most abundant in May and June.

LIFE HISTORY.

The small, yellow eggs are deposited on the cabbage leaves and hatch in from 4 to 8 days. The velvety green larvae eat voraciously and be-

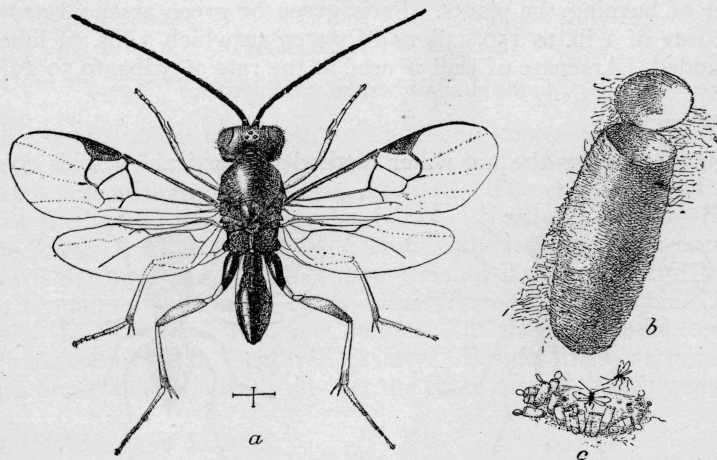


FIG. 5—A Parasite (*Apanteles glomeratus*, Linn.); a, adult fly; b, cocoon; c, flies escaping from cocoons; a, c, highly magnified. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

come full-grown in 2 weeks, molting 5 times. When full-grown they generally leave the plant and in some sheltered spot change to a chrysalis, from which the adult butterfly emerges at the end of 7 days.

The length of the life history requires from 21 days upward, varying considerably, as the insect is easily influenced by weather conditions.

NATURAL ENEMIES.

There are a number of effective natural enemies that frequently hold this pest in check. Though they are of great service in this State, no systematic study has been made of them by this Department.

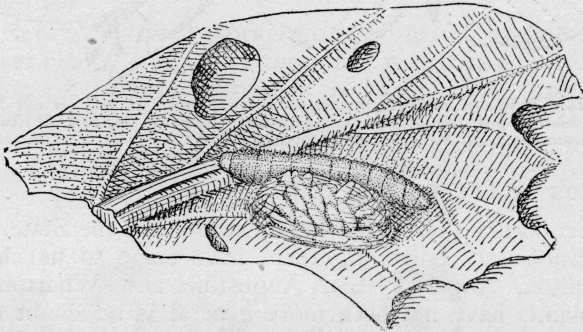


FIG. 6—Parasitized Cabbage Worm (*Pontia rapae*), showing cocoon mass of *Apanteles glomeratus* below. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

Remedies.

ARSENICALS.

For poisoning, Paris green, green arsenoid, and arsenate of lead are generally used. The first two may be used dry or as a spray. Where unskilled labor is employed the spray is preferable, as it involves less danger of burning the plants. Paris green or green arsenoid are used at the rate of 1 lb. to 150 gallons of water, to which 3 lbs. of lime has been added. Arsenate of lead is used at the rate of 3 lbs. to 50 gallons.

HOT WATER.

In small gardens the hot water method is practicable. This consists

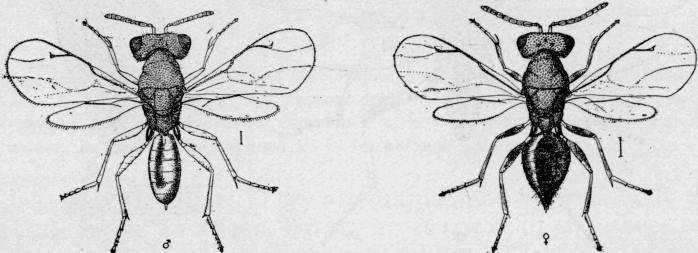


FIG. 7—A Parasite (*Pteromalus puparum*, Linn.); female at left, male at right; highly magnified. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

in pouring over the plant water heated to 133° F. Although it sometimes injures the plants, it is effective in destroying the cabbage worm.

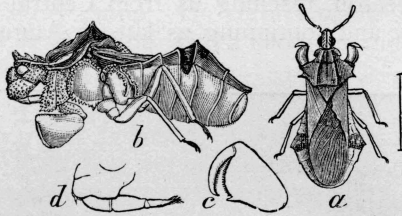


FIG. 8—*Phymata Wolfii*; a, dorsal view; b, lateral view; c, front leg; d, snout; a, b, enlarged; c, d, more enlarged. (From Riley).

HAND PICKING.

When plants are set out, any caterpillars that may be present should be destroyed by hand-picking.

PYRETHRUM, OR OTHER DUSTING MATERIAL.

Pyrethrum powder, also known as California Buhac, Dalmatian powder and Persian insect powder, when liberally dusted over the plants, is effective. It must be fresh, and the receptacle should never be left open so as to expose the powder to the air for some length of time. Prof. L. Bruner has suggested that plants liberally dusted with cornmeal will act as a deterrent to the caterpillars.

In the fall, when the crop is harvested, no refuse material should be left in the field. All remnants should be gathered. It is well at this time to allow a plant standing in the fields here and there for females in late summer to lay their eggs. If such plants are then kept poisoned they will be effective in killing many of the last generation of the season.

HARLEQUIN BUG.

(*Murgantia histrionica*, Hahn.)

This is one of the most injurious and best-known of the garden insects of Texas. It is widely distributed, and on account of its gaudy colors is conspicuous and easily recognized. The chief areas of injury during the last three years were as follows: Northeast Texas—East of a line drawn from Clay to Polk Counties, the main damage occurring between the 95th and 97th meridians; South Texas—Fayette to Brazoria Counties; Southwest Texas—East Tom Green, Kimble, Uvalde, Zavalla, La Salle and Nueces Counties. In the Panhandle, sporadic outbreaks occurred in Ochiltree County. Besides these sections, outbreaks occurred sporadically all over the State east of the 98th meridian.

LIFE HISTORY AND HABITS.

The harlequin bug, also known as the calico bug, is a flattened, oval-shaped insect, gaudily colored with red and yellow markings, and is

terribly destructive to cabbage, radish, mustard and other cruciferous plants. In South Texas they appear in February and March, doing the greatest injury in April. From that time on complaints are received during the entire season, reaching us from Central and North Texas chiefly during May and continuing as late as August and September in the Panhandle.

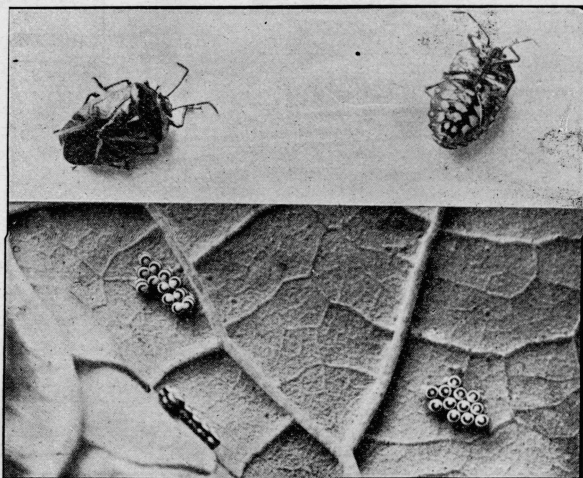


FIG. 9—Harlequin Cabbage Bug (*Murgantia histrionica*, Hahn.)
(Photo by E. C. Green.)

The eggs are deposited in parallel rows. They are about 1-20 of an inch long and 1-30 inch wide. Soon after oviposition they become of a whitish color, with black markings, then resembling small barrels in general shape. They hatch in about 4 days, and the young are at first pale-green and black. There are frequent color changes, especially near molts, and in this respect they resemble the adult bugs except for the absence of wing pads. The life history requires about 2 weeks for its completion, making a half-dozen broods possible in the course of a single season. Upon the approach of winter the adults hibernate under all kinds of rubbish. In early spring they reappear, attacking the first cruciferous plants accessible, which may be a wild species, or volunteer mustard, or perhaps the plants cultivated early and set out in seed beds. With the appearance of the cabbage they migrate to that crop.

Remedies.

CLEAN CULTURE AND TRAP PLANTS.

As the insects hibernate near old cabbage fields, attention should be given to thorough cleaning up of all rubbish on and about the field in order to destroy as many of these wintering specimens as possible. When they congregate on mustard or other plants in early spring, they may be destroyed by spraying plant and all with pure kerosene or a strong solution of kerosene emulsion. Pure kerosene kills the plants.

The planting of trap crops, as originated by Prof. H. E. Weed, formerly of the Mississippi Station, is practicable. A row of radishes planted near the cabbage early in the season will attract the bugs, and when they congregate thereon they are destroyed by kerosene applied with an ordinary spray pump. On certain plants in kitchen gardens, like kale, they may be swept off with a hand-net and destroyed.

INSECTICIDES.

The pest is difficult to destroy with insecticides, as the sprays must be made so strong that they generally injure the plants. During the last two seasons a number of experiments were conducted, using kerosene emulsion and whale oil soap. A 10-per-cent kerosene emulsion, also whale oil soap at the rate of 2 lbs. to 4 gallons of water, were effective in killing nymphs. A nymph newly molted was almost invariably killed by the sprays, while an older one was as difficult to kill as an adult. Growers are recommended to give these two sprays a thorough trial.

PLUMBER'S TORCH.

The insects may be scorched off the plants with an ordinary plumber's torch. After a little practice the operator will acquire sufficient skill so that injuries to the plants by the heat may be avoided. The writer has experimented with larger torches, but finds them too heavy and awkward for close manipulation.

CABBAGE LOUSE.

(*Aphis brassicae*, Linn.)

These are the small, green, soft-bodied insects that often appear in great numbers on the cabbages, turnips, radishes and allied plants, sucking the sap from the tissues. They present an external appearance as if covered with a thin coat of a whitish powder.

REMEDIES.

Any of the standard contact sprays, like kerosene emulsion, whale oil soap and tobacco decoction, are effective remedies. The sprays should be thoroughly applied with a pump having a Vermorel nozzle attached. A knapsack sprayer serves the purpose admirably.

They reproduce during the summer by giving birth to living young, but winter over in the egg stage. It is therefore apparent that where these pests are troublesome every remnant of cabbage left in the field after the crop is harvested should be destroyed.

CABBAGE MAGGOT.

(*Pegomyia brassica*, Bouche.)

When cabbage dies or becomes stunted from no visible cause, it may be due to the cabbage maggots. They often cause the roots to become thickened or malformed.

LIFE HISTORY.

The adult is a two-winged fly, similar to the house fly, which lays its eggs in the crevices near the roots. The resulting maggot gnaws tunnels and grooves in and around the roots, causing them to rot and malfom. They become full-grown in about 25 days and are then

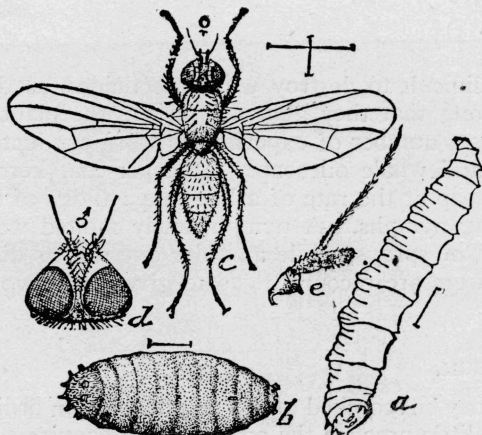


FIG. 10—Cabbage Maggot (*Pegomyia brassica*, Bouche.) (From Riley.)

about one-third inch long. They pupate in the soil near the roots, and the last brood winters chiefly in the pupa state.

REMEDIES.

The only practicable methods now known are those that prevent the fly from laying her eggs at the base of the plant. Professor Slingerland, in his exhaustive experiments at Cornell University, got good results from the tarred paper method—a hexagonal piece of tarred paper with a slit running to a star-shaped cut in the center, placed around the plant shortly after setting, thus preventing the fly from laying her eggs there. Special tools have been devised for cutting the paper rapidly.

TOBACCO.

Tobacco dust applied liberally about the base of the plant will restrict the ravages to some extent.

CARBOLIC ACID EMULSION.

This preparation has been used in a number of States during the past few years with apparent success. About one and one-half teacupfuls are applied to the soil at the base of the plant.

Hard Soap	I pound, or
Soft Soap	I quart.
Boiling Water	I gallon.
Carbolic Acid	I pint.

Dissolve the soap in the hot water and while still warm add the acid. Churn by pumping the mixture back into itself until emulsified. Dilute 30 times its weight in water.

CARBON BISULPHIDE.

The application of carbon bisulphide (high-life) is valuable on a small scale. A teaspoonful of the liquid is poured on a wad of cotton and buried in the soil at the base of the plant. The liquid should not touch the plant. By preparing the wads beforehand and carrying the bottle in the other, use the fingers to dig—a large area may be treated in this manner in a short time. Remember to keep fire away from carbon bisulphide, as the gas is inflammable and highly explosive.

WHITE GRUBS.

(*Lachnosterna spp.*)

The white grubs are the larvae of the June bugs, of which there are several species in Texas. The adult females lay their eggs in the soil. This occurs in the vicinity of College Station early in April, and our observations in the insectary and field show that they are laid from 2 to 2½ inches deep. The injury to truck crops, though serious, is of minor importance when compared with the untold harm done to grass lands, corn fields and wheat fields of Texas. As far as we can determine, the insect requires 2 years for the completion of its life history. The immature stages are all passed in the soil. As adults they often fly about and injure the foliage of shade trees by gnawing.

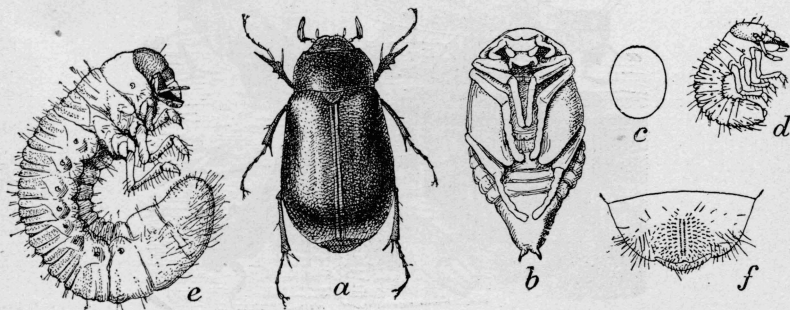


FIG. 11—White Grub, showing life history stages; a, beetle; b, pupa; c, egg; d, newly hatched larva; e, mature larva; all enlarged. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

REMEDIES.

When injurious to garden crops on a small scale it is practicable to use carbon bisulphide, the same as for the cabbage maggot.

The problem is a cultural one. They breed preferably in grass land. In North Texas they have been very injurious to wheat during the last two years.

Unlike the conditions in the Northern States, these grubs remain

near the surface during the winter. Investigations during the past season disclosed that they passed the winter anywhere from 3 to 7 inches below the surface, the majority being found from 3 to 5 inches. For this reason they can be reached with an 8-inch plowing at any season of the year. A meadow intended for corn or wheat, or even vegetable crops, should be broken up late in the fall, or, better still, during the coldest part of the winter, when these pests are sluggish. They are then exposed to the weather, as well as to the natural enemies, the most important of which are hogs and skunks. The land should be disked several times during the winter. It is well to let the first crop be cotton. Should it be desirable to follow this with corn, the land may be sown to cow peas and these plowed under in winter. This may be followed with wheat after the corn is harvested.

One of the most important enemies of the white grub is the common skunk. The thousands of burrows in the soil surface so often seen in the morning are the indications where white grubs were captured and eaten. The writer has examined the stomach contents of several dozen skunks and finds the chief food to be white grubs and grasshoppers.

GRASSHOPPERS.

The species most injurious to garden crops in Texas is the Differential Grasshopper, though minor injuries are occasioned by other species. The eggs are laid along the edges of cultivated fields and gardens, along ditches and in grass and alfalfa fields in the fall, and

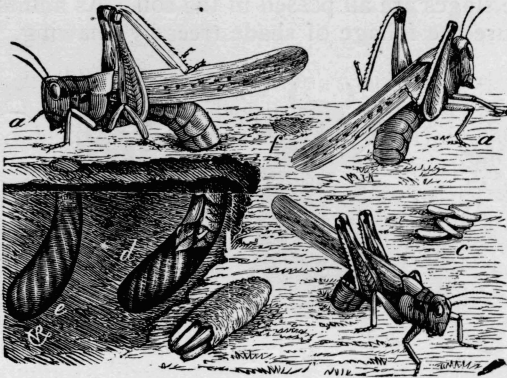


FIG. 12—Grasshoppers Laying Eggs. (After Riley).

in this stage pass the winter. They hatch in March, and during April and May are sent to this office with letters reporting them injurious to garden crops. When young they feed in droves, and must travel on foot. In South Texas adults are active all winter.

REMEDIES.

Gardeners should be on the lookout to discover where the eggs are laid in the fall. Such ground should be broken in winter in order to

destroy the egg pods. When hatched the battle must be fought early, when the pests are young. As they grow older the situation becomes more difficult, and after the wings have formed become uncontrollable.

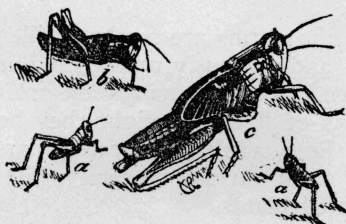


FIG. 13—Young Grasshoppers. (After Riley).

POISONING.

The poisoned bran mash and poisoned grass, as recommended under "cut worm", is applicable in this case. When the young grasshoppers first appear the grass and weeds surrounding the garden should be

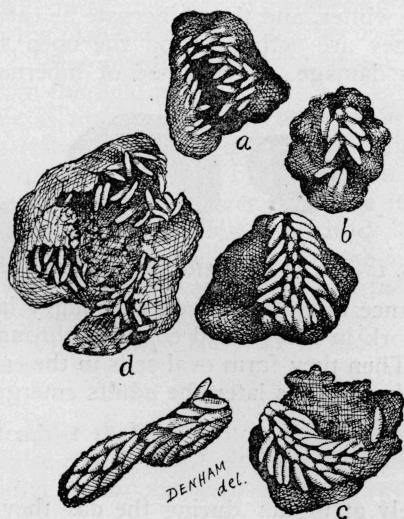


FIG. 14—Grasshopper Eggs.

sprayed or dusted with Paris green or London purple. An apparently effective recommendation originated in the Brazos bottoms, which consists of molasses and white arsenic mixed at the rate of 1 lb. to 10 gallons of molasses, and this scattered over the weeds.

CUT WORMS.

From every section of the State we receive complaints of cut worm injury to garden crops, principally from South Texas and West Central Texas.

Although there are various species that are injurious, their life his-

tory and habits are similar. The principal ones coming to our attention are *Agrotis ypsilon*, Rott., and *Feltia malefida*, Guen.

HABITS.

The parents of the cut worms are moths (millers), generally having the front wings dark and variously marked, while the hind wings are lighter colored. When at rest the wings are folded on the back. On account of their habits of flying at night they belong to the class of night-flying moths. Both adults and caterpillars feed at night, the moths sipping nectar from various flowers, while the adult larvae are devouring our cultivated plants.

The eggs are deposited on grass, leaves, bark and on various other objects, where the young will have a food supply available. The larvae are so well known that detailed descriptions are superfluous. During the day they hide under objects near the food plant or enter into the soil. When exposed or otherwise disturbed they curl up. They have three pairs of true legs on the front part of the body and five pairs of fleshy appendages further back called the pro-legs. They become partially grown before winter, and then hibernate as caterpillars. In South Texas, however, they are active during the open seasons of winter, doing more or less damage. This mode of hibernation accounts for



FIG. 15—Cut Worm (After Riley and Howard).

their early appearance in spring, when as hungry larvae they resume their destructive work in March and continue through April and May until full-grown. Then they form oval cells in the earth and transform to pupae. About three weeks later the adults emerge to lay their eggs for another brood.

MODES OF INJURY.

They feed entirely at night; during the day they hide in the earth near the base of the food plant. Some feed by cutting off the plants, others draw the plant partly into the ground. Some feed simply on foliage, gnawing it full of holes similar to cabbage worms.

REMEDIES.

Cut worms naturally feed on grass land, and although the injury is not then noticeable, if such land is plowed in spring the pests maintain themselves on the buried grass until the crop is planted, when their presence will soon be recognized.

CULTURAL CONTROL.

The land should be thoroughly and deeply plowed during winter or very early in the spring. In this operation many of the worms will be

crushed, others exposed to inclement weather conditions and natural enemies. By thus fallowing the land, many will be starved out before the crop is planted.

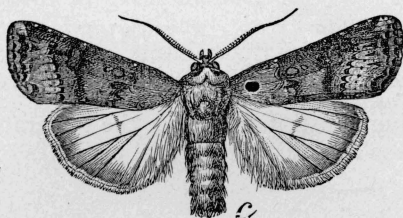


FIG. 16—Cut Worm Moth. (After Riley and Howard.)

POISONING.

Where cut worms are anticipated in a garden to be planted, the poisoned bran mash should be distributed a day or two before planting. This should be done as late in the afternoon as possible, as the moisture will cause it to bake in the hot sun, remembering that the worms feed at night. Before the plants are set drop a heaping tablespoonful every three feet apart. After planting, apply it at the base of each plant. Keep chickens from the field.

There is danger of making the bran too wet, and it will then bake. Gardeners are, therefore, cautioned to follow the directions implicitly.

For larger areas, mix one pound Paris green in one barrel of water. Cut some succulent grass, like clover, immerse it in the Paris green solution and scatter it over the infested territory late in the afternoon. On young plants not immediately ready for table use the Paris green solution may be sprayed in the case of the leaf-feeding species.

FALSE CHINCH BUGS.

(*Nysius angustatus*, Uhl.)

This insect resembles the true chinch bug in general shape so much that it is called "false chinch bug." It lacks the black spots on the wing covers. These pests appear suddenly in great swarms, and in a short

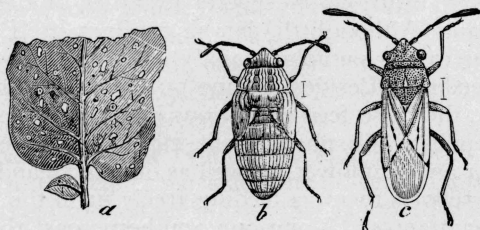


FIG. 17—False Chinch Bug (*Nysius angustatus*); a, part of small leaf of potato showing punctures of the bug; b, last stage of nymph; c, adult; a, natural size; b, c, much enlarged. (After Riley, Division of Entomology).

time lay waste turnips, mustards and other cruciferous plants, and generally disappear as suddenly as they came. We have as yet found no

remedy that is practicable. Early in the morning they are in the soil at the base of the plants, where they may be dislodged with tobacco dust or kerosene emulsion.

CABBAGE SNAKE.

(*Mermis albicans*, Diesing.)

The accompanying illustration shows the general appearance of the cabbage snake. These animals are internal parasites of grasshoppers and

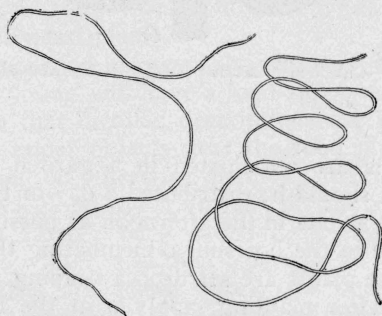


FIG. 18—"Cabbage Snake" (*Mermis albicans*, Dies.)
(From Chittenden, U. S. Department of Agriculture).

cabbage worms, and when they accidentally escape from the host when resting on the cabbage plant, it accounts for their presence. They are not injurious.

CUCUMBERS, CANTALoupES, MELONS AND SQUASH.

THE STRIPED CUCUMBER BEETLE.

(*Diabrotica vittata*, Fab.)

The striped cucumber beetle is becoming more destructive each season. At present it is distributed over the entire humid section of Texas and is very injurious in several localities of the State west of the 98th meridian. Although the larvae confines itself to the roots of plants belonging to the pumpkin family, the beetles are more or less miscellaneous feeders. Besides feeding on the various members of the pumpkin family, they also feed on various kinds of flowers, beans, peas, apple blossoms, pollen, silk, unripe fruit, etc. They have been found on golden-rod, aster and sunflower, as well as on cherry and related plants. Mr. Chittenden reports them as feeding freely upon the prickly cucumber or wild balsam apple. Along our Southern coast they are very injurious as far north as Gonzales and Harris Counties. During the last two years severe sporadic outbreaks occurred in the territory along the 31st parallel of latitude, especially in Grimes and Jasper Counties. Further north they are destructively abundant from McLennan County

northeastward to Delta County. Sporadic outbreaks also occur in Hamilton, Brown and Coleman Counties. They appear in March, and may be seen in the gardens in great numbers to July, the greatest injury being done in May. They are hardy in all stages, and, as far as we know, natural enemies are of little importance in this State. Although they have been more or less fluctuating during the last three years, outbreaks may be expected at any time in any locality. For that reason every gardener should be prepared to fight these pests when they threaten the destruction of his crops.

NATURE OF INJURY.

During the warm weather of early spring the hungry adult beetles that have hibernated in protected spots appear in large numbers. At that time they are more or less miscellaneous feeders and attack various

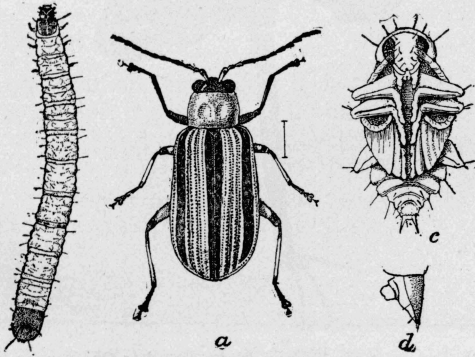


FIG. 19—Striped Cucumber Beetle (*Diabrotica vittata*). (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

kinds of vegetation to satisfy their voracious appetites. After a few days' feeding, when this hunger becomes partially satisfied, they are more particular about what they eat. As their emergence from winter quarters and the appearance of the young Cucurbit vines are almost simultaneous, they soon attack them, gnawing the foliage full of holes and eating the epidermis. They gnaw the stem, giving it a scurfy appearance, and the young plants having less than 4 to 6 leaves soon die. At this time there is no conspicuous sudden wilting, but the plants die naturally from the wounds given.

In about a week after the beetles appear they begin to mate. They become partial to the tender parts and the flowers, if any, and it is difficult to induce them to feed on foliage that is coated with various kinds of insecticides. Soon after oviposition is completed they become less numerous and the gardener becomes hopeful of a crop, only to be mortified at seeing his apparently healthy and vigorous plants suddenly wilt. If the large, black squash bugs are present, he does not hesitate to accuse this insect of the injury. If at this time the roots are examined there may be found a number of slender, worm-like larvae working

below the soil, seriously injuring the underground parts in every conceivable way. These worms are the young striped cucumber beetles, and their presence is accounted for in the life history that follows:

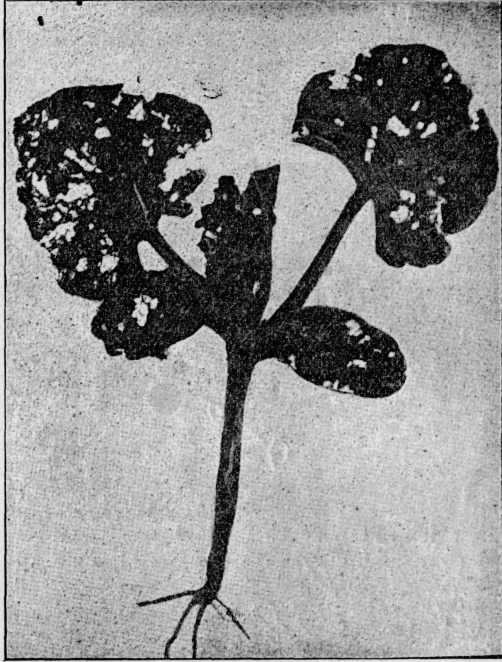


FIG. 20—Work of Striped Beetle on Young Plant. (After Quaintance, Florida Experiment Station).

LIFE HISTORY.

The eggs are laid on various parts of the plant, in the soil and in crevices near the bases of the plant. They are small, lemon-yellow or orange-colored objects, about $\frac{1}{4} \times \frac{1}{8}$ inches. The resulting larvae is a small, light-colored, slender, worm-like creature, with a dark-brown head. They live in the moist earth, gnawing the underground stems and roots, as well as the fruit where it comes in contact with the soil. After about four weeks of injurious feeding they transform to the pupa, and after another ten days the adults emerge. In Texas several broods may develop in a single season. They winter as full-grown beetles in the ground, under rubbish or in other protected spots.

Remedies.

COVERING PLANTS.

The greatest injury by the adult beetles is done in early spring, when the plants are young, and especially when a dry season prevails. After the plants have formed from 4 to 6 leaves they are much less easily killed. It is therefore recommended, especially in small gardens, to

cover the plants with a gauze made of cheesecloth or a 5c canvas. The frame may be easily made by cutting a barrel hoop in two halves and crossing them over each other at the center. Care should be exercised that the ground is packed firmly at the base of these frames, otherwise the beetle will burrow under them. These frames are easily handled, can be readily stored for the winter, and will last a number of seasons. They should be left on the plants as long as possible, and should never be taken from them until from 4 to 6 leaves are formed.

EARLY PLANTING.

In order to have the plants started before the beetles appear, it is well to plant them in greenhouses or hotbeds. After a little study the normal time of appearance of the first brood of hibernating weevils can be learned, and these plants can then be set out after the first eggs are laid. Where late squashes are planted this can be arranged so that no plants will be above the ground before the time the first eggs are laid.

SOWING AN EXCESS OF SEED.

Where the condition of the insects is not well known in localities where they are injurious, it is well to plant an excessive amount of seed. After the eggs are laid and the larvae develop, some of the plants will die, but a sufficient number will be left for a good stand. In many cases it is then necessary to thin the plants, and this should be done after the first danger is past.

CLEAN CULTURE AND TRAP PLANTS.

In the fall, when the crop has been harvested, the vines that remain in the field contain many larvae in the soil and in the roots. For that reason the plants should be pulled or plowed up, thrown on the ground in piles, in which a number of the surviving weevils will congregate. A week later these piles should be saturated with some inflammable substance and burned. It has been recommended to plant beans in alternate rows with Cucurbits, assuming that the beetles would be attracted to the beans, and having an unlimited food supply there, would not be forced to go to other plants. We have had no practical demonstration of this in Texas, and nothing can be said at this time as to the merits of this method. It is recommended for trial, however, and while it may not be successful in some localities it may in others, as the habits of this beetle are variable in different sections.

Poisons and Repellants.

DRIVING WITH AIR-SLAKED LIME.

These insects appear some seasons in enormous numbers and in the course of a single day, so that very prompt action is necessary to prevent them from seriously injuring the crop. A practical method was therefore advised some years ago. Air-slaked lime is dusted over the plants in the morning, when the beetles are active, beginning on the

windward side of the field, taking every plant as it comes. The wind carries the dust forward, gradually dislodging the beetles. The work must be done slowly, and when a field is gone over similar action is necessary on the next field where they will become injurious.

DILUTED ARSENICS.

One of these methods consists in dusting a certain number of plants with air-slaked lime, wood ashes or land plaster, while others are simply sprayed with a solution of Paris green, 1 lb. to 200 gallons of water. The beetles often leave the plants that are dusted and congregate on the apparently clean plants containing the spray. This will kill many beetles, but in some cases it is not a protection to the plant, the plant being considerably gnawed before the beetles die. The most satisfactory of the dusting methods is the mixing of Paris green or green arsenoid with land plaster, flour, road dust or some simliar diluent, at the rate of 1 of poison to 75 of diluent by weight, and profusely dusted over the plants. When this mixture has been previously saturated with turpentine it will add to its effectiveness as a repellant.

TOBACCO AND PYRETHRUM.

Pyrethrum powder or tobacco dust, liberally scattered over the plants, acts as a repellant, the latter being at the same time a good fertilizer. But in all our experiments in the Department work we have never been able to save a crop with either of these substances.

BORDEAUX MIXTURE AND ARSENITES.

Bordeaux mixture is a substance extremely distasteful to many kinds of insects, and this preparation, containing Paris green or green arsenoid at the rate of 1 lb. to 175 gallons of mixture, or arsenate of lead at the rate of 3 lbs. to 50 gallons, has been found to be the most effective method of controlling this pest.

It will be seen that many different methods for controlling this insect have been recommended, and the grower is urged not to depend on one method alone, but to combine several. Bordeaux mixture and arsenites, also the poisoned dust, have been the most satisfactory and have always controlled the insect where the cultivation of the crop received careful attention. No weed should be allowed to grow, and the surface of the soil should be well cultivated and mulched. The planter should use good judgment in setting out his crop in the spring, and should urge his neighbors to co-operate with him in concerted efforts in fighting the pest.

SQUASH BUGS.

(*Anasa tristis*, DeG.)

The female lays her eggs generally on the under surface of the leaf, but frequently, especially when abundant, may deposit them on the upper surface. Sometimes they are closely crowded together, at other

times they are scattered over the entire surface of the leaf and are inconspicuous. The scattering of the eggs is not normal and happens only when the insect is disturbed while laying. When first laid the eggs are whitish, but soon become darker, finally changing to a coppery bronze a day or two before hatching. They are about 1-16 inch

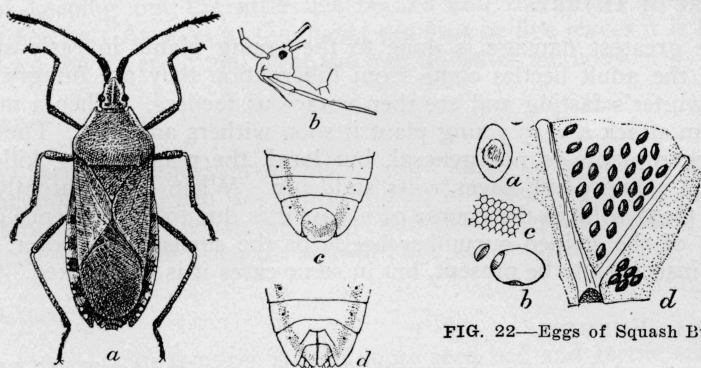


FIG. 21—Adult Squash Bug (*Anasa tristis*, DeG).
From Chittenden, Bureau of Entomology,
U. S. Department of Agriculture).

FIG. 22—Eggs of Squash Bug.

long, 1-20 inch wide, and hatch in about 14 days. The newly hatched young are of a beautiful crimson color, which makes them very conspicuous on the green background of the leaf. Because of this coloration they are frequently mistaken for chinch bugs.

The young become full-grown in about 33 days after having molted five times. During this period they feed in clusters on the lower surface of the leaves, obtaining their food by sucking with their jointed

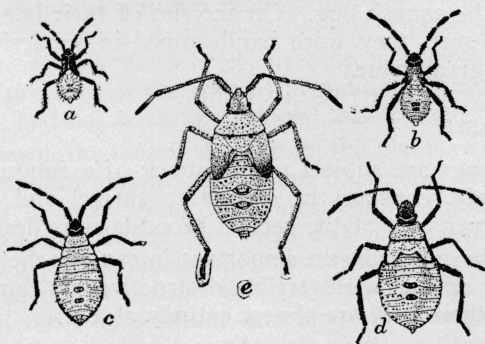


FIG. 23—Squash Bug Nymphs. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

beaks. When one leaf is dried up and killed they proceed to another, and where they are numerous enough they kill the entire plants.

Although there is but one brood in the far North, there are at least three in Texas. Upon the approach of winter the full-grown bugs retire under boards, stones, rubbish and such other shelter as they may

find in their erratic wanderings. There they remain dormant until again enlivened by the warm sunshine of spring, when they resume their attacks on the young squash plants as the latter appear above ground.

NATURE OF INJURY.

The greatest damage is done to the young plants in early spring. When the adult beetles come from hibernation they are hungry from their winter's fasting and are then voracious feeders. When a number of them attack a very young plant it soon withers and dies. The effect on larger plants is not general, but local, the plants being killed by degrees. The plant never wilts suddenly. When an apparently vigorous plant wilts in the course of a day, it is due to the presence of the young of the striped cucumber beetle or the squash vine borer. The latter insect may be present, but in some cases it is overlooked.

NATURAL ENEMIES.

The squash bugs are frequently heavily parasited by Tachinid flies, by which many are destroyed. The adult parasitic fly lays its eggs on the surface of the bug. The resulting maggot bores into the body of the insect, devouring the contents and killing it in a short time. It then descends into the soil to transform into a pupa, from which the adult parasite emerges. These flies are very prolific and have a shorter life history, so that when abundant they render valuable services in destroying the bugs.

EGG PARASITES.

These parasites have been reported* as having destroyed 30 per cent of the eggs of the squash bug. On account of their late appearance in the season, however, they were handicapped in rendering any immediate service of great value.

FUNGOUS DISEASES.

The squash bugs are subject to the attack of a fungus that ramifies through the body, causing the insects to shrivel and die. In some seasons a large per cent of the second brood is thus destroyed.

These parasites no doubt are important in causing the fluctuations of the pest. They appear with terrible destructiveness during some seasons, while in others they are almost entirely absent.

Remedial Measures.

PROTECTION BY NETTINGS.

The most dangerous attack from the squash bug is that made upon the young plants when they first come up and before they have any but the two seed-leaves. At this period one bug may be able to de-

* F. H. Chittenden, Bulletin No. 19, New Series.

stroy the plant in a very short time. To prevent this it is often worth while, in garden practice, to cover the hills with netting of some sort. The edges, however, must be thoroughly buried under the soil, or the bugs will dig under and get inside, where they will be unmolested and soon ruin the plant. Of course, this netting has the additional advantage of keeping out the little flea beetles and the yellow and black striped beetles. As soon as the plants get four or five leaves it is better to remove the covering and fight the bug by other methods.

EXCESSIVE SEEDING.

Most farmers plant a great many more seeds of squashes, melons and cucumbers than can develop properly, in order to provide against the destruction of the whole hill by the numerous enemies present. This is especially desirable when the squash bugs are abundant.

GOOD CULTURE.

The squash plant requires a deep, loose seed bed and fertile soil. If these conditions are favorable, the plant shows great vitality and thrift; in this case, the attack of insect enemies is not so effective. On the other hand, plants grown in a sterile, compact soil are very easily subdued. Therefore, keep the seed bed in good condition by cultivating and weeding it, and thus reduce the obstacles to the development of the plant to a minimum.

CLEAN CULTURE.

It is generally acknowledged that a system of clean culture on the farm discourages insect pests. The burning of useless rubbish in fields and along fences late in autumn reduces the winter shelter for insects, as well as destroys such as are already present. The collection and destruction of the squash vines after the crop is harvested will tend to discourage the presence of the bugs by preventing the maturing of some of the nymphs, and not attracting winged adults from other fields.

As far as known, the insects develop on the plants of the squash vine family only, including pumpkins, melons, cucumbers and gourds. The bugs that occur in early spring, therefore, will be those only that have developed upon plants that furnish them with food supply until hibernation. It is the general practice that no attention is paid to the young bugs that are abundant on the vines at harvest time. They develop into adults and retire into winter quarters. It is therefore important that as soon as the crop is harvested all vines are destroyed.

BOARD TRAPS.

It has long been known that if small boards, such as old shingles, are laid loosely upon the ground beside the squash vines a large proportion of the bugs will congregate under these at night, so that they are easily collected the next morning. This is well worth practicing in connection with hand-picking of the vines.

TRAP SQUASH PLANTS.

The squash bugs, as already indicated, have a decided preference for squashes rather than cucumbers, melons or other similar vines. In growing the other crops this fact may well be taken advantage of by planting squashes between the other hills and a week or so earlier. The attack of the bugs will thus be concentrated upon the squashes, and the hand-picking will be more effective. Even in fields of squashes the method may be employed to advantage by planting extra squash seeds between the regular hills, and, if practicable, planting them earlier than the main crop. Of course, these trap plants, with whatever eggs there may be upon them, are to be pulled up and so treated as to destroy the eggs before the latter begin to hatch.

MELON WORM.

(*Diaphania hyalinata*, Linn.)

Considering the increased interest in truck farming and the large areas planted to melons, cantaloupes, etc., it is well to be prepared to control this pest, which has done serious injury in several sections of the State the past season. Another closely related species, the Pickle Worm (*D. nitidalis*), caused similar injuries and is illustrated in Fig. 24.



FIG. 24—Pickle Worm. (After Quaintance).

The first brood of young melon worms will be found feeding on the blossoms and vines. They should then be destroyed by hand-picking or by poisoning with Paris green or a mixture of Paris green and flour. The Bordeaux arsenical spray recommended for the striped cucumber beetle

is useful. After they begin to bore in the fruit no practical methods of prevention are known. As they pupate on neighboring weeds, it is all-important that all weeds about the melon fields are kept down.

SQUASH VINE BORERS.

(*Melittia satyriniformis*, Hbn.)

Often it happens that a squash vine that appeared healthy suddenly wilts down and dies from no visible cause. We may then suspect the presence of this insect. By cutting open the vine and root we find the tunnels that were produced by the pest. When the grub becomes full-grown it enters the soil and pupates, and in that stage passes the winter. The next spring the full-grown moth appears.

LIFE HISTORY.

It makes its appearance at College Station about April 20. It is strange that we have never received specimens for identification at this office, and the only way we can account for it is that the dying of plants, when caused by this insect, is frequently attributed to some visible pest, such as the squash bug or stink bugs. The eggs are oval, of a reddish

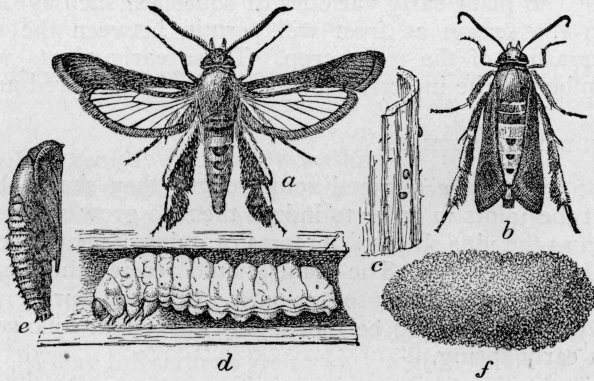


FIG. 25—Squash Vine Borer (*Melittia satyriniformis*). (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

color, and laid anywhere on the plants, chiefly along the stems. Mr. Chittenden records that a single moth may lay 212 eggs. They hatch in about 10 days, and the larvae require about one month to become full-grown, but, like the cabbage worm, the length of the life history varies with the conditions of temperature and climate.

The larva is a slender, whitish grub, with a dark head and sparsely hairy. When full-grown it enters the soil, constructing the cocoons shown at F, in which the chrysalis is formed.

Remedies.

There are no insecticides of any practical value for controlling this insect. Like many of our garden pests, cultural methods must be the

main source of reliance. When the larvae have once entered the vine they can only be dislodged by cutting them out. This is laborious, but not at all impracticable, at least on a small scale. At the point where the insect is working there is more or less accumulation of yellow excrement, and this serves to help locate it. The incision should always be made lengthwise, so as not to injure the stem.

As the insect winters in the soil in the pupa condition, growers are cautioned not to grow pumpkins or squashes on or near the same ground a second year.

Although the adults are active on the wing during bright days they become less so at night and on cloudy days, when they may be seen sitting on the leaves. The moth measures about $1\frac{1}{4}$ inches from tip to tip of extended wings. The front wings are greenish, while the hind are partially transparent, which accounts for the insect being called "clear-winged moth." The hind legs bear a fringe of long hairs. When observed they should be captured and destroyed.

TRAP PLANTS.

The chief food plants of the insect are squashes and pumpkins, though sometimes they attack cucumbers, melons and cantaloupes. It is recommended to plant early varieties of squashes, such as Crook-neck, as early in the season as frost will permit, between the subsequent rows of squashes of the main crop. These early plants will attract a large number of the insects, which can then be gathered and burned.

OTHER CULTURAL METHODS.

After the vines have attained some length they should be covered with soil at the joints in order to induce them to grow secondary roots, and as soon as the vine shows symptoms of dying it should be pulled up and completely destroyed. The plant should receive thorough cultivation, and, knowing that the insect pupates in the soil during winter, the ground at that time should be thoroughly harrowed, followed by deep plowing in early spring.

RED SPIDERS.

(*Tetranychus bimaculatus*; Harv.)

These little plant-feeding spinning mites appear on the foliage of cucumbers and related plants as minute, brown or blood-red specks, which may be moving or stationary. They occur on both sides of the leaf and on the stems. They feed by sucking the sap, and as they occur principally during a drouth their presence soon tells heavily on a plant's vitality. The leaves dry up, die and fall to the ground. They are more serious pests in greenhouses than in the open.

The insect when full-grown is about 1-5 inch long. Some have a black spot on each side. They have four pairs of legs. They spin the threads over the surface when feeding. Under these webs they lay

their eggs and the six-legged young develop. They have a wide range of food plants.

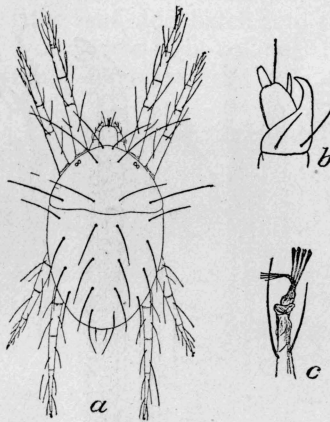


FIG. 26—Red Spider (*Tetranychus bimaculatus*). (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

Remedies.

These insects are most abundant during a drought. The past season an unusual number of inquiries reached us from every drought-stricken section of Texas. In small gardens, where there are water connections, the best remedy is a heavy washing of the plants. It should be remembered that during a drought the most important thing is to keep a good soil mulch, especially when the plants are young.

The most efficient insecticide is sulphur. This may be liberally dusted on the plant when the dew is on or sprayed at any time of the day. Our experiments show that spraying is more effective than dry sulphuring. The spray is used in the proportion of 1 oz. to 1 gallon of water. Where infestations are serious, a little whale oil soap, tobacco water, kerosene emulsion or lime added will increase the adhesiveness to the plant and add to the effectiveness of the spray.

SOUTHERN CORN ROOT WORM.

(*Diabrotica 12-punctata*. Oliv.)

This pest is more or less destructive everywhere in the humid sections of Texas. The chief injury is done to our corn crop as the larval stage is mostly passed in corn roots, and it has therefore received the common name of Southern corn root worm. The larvae abound in the roots of Johnson grass, and where this plant is abundant injury may always be anticipated.

As adults they come from the Johnson grass and corn fields to our gardens, injuring various kinds of plants, especially the squashes and

cucumbers, and it is then known by the common name of "12-spotted cucumber beetle" on account of the twelve black spots on the wing covers.

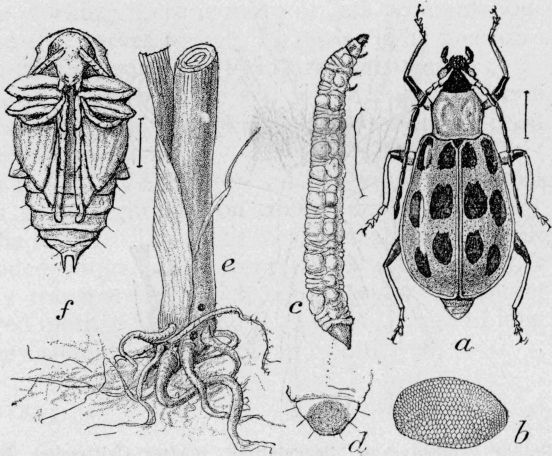


FIG. 27—Southern Corn Root Worm (*Diabrotica 12-punctata*). (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

Remedies.

Although there is no practical way of preventing the injuries in the larval stages, the beetle can be controlled by thorough spraying with Paris green, arsenate of lead or green arsenoid. The Bordeaux mixture, to which arsenicals have been added, as recommended under striped cucumber beetle, is also effective.

ONION AND GARLIC.

ONION THRIPS.

(*Thrips tabaci*, Lind.)

During the last two years this insect has been very injurious in Falls, Robertson, Bexar, Hays, La Salle, Webb and Irion counties. Along the Rio Grande they appear as early as the latter part of January, the greatest injury being done in the early part of April. Further north the complaints come in most frequently during May. Less important outbreaks come to our attention from other localities.

The insects are of minute size, and in small gardens often do great injury before their presence is detected.

NATURE OF INJURY.

The onion thrips are destructive to foliage. The plant dries out, fades and dies. Its presence on onions is soon recognized by the plant turning white, while the cabbage and cauliflower begin to appear scalded on the lower surface. The chief injury is done by chafing off the outer skin or epidermis of the plants attacked. It has been found feeding on 37 different species of plants, including the onion.

LIFE HISTORY.

The eggs are minute, elongated, colorless objects, deposited singly beneath the epidermis of the leaf, and hatch into the nymphs in about $3\frac{1}{2}$ days. At first the young are light-colored, but as feeding continues they change to green. They are very agile, and feed in clusters.

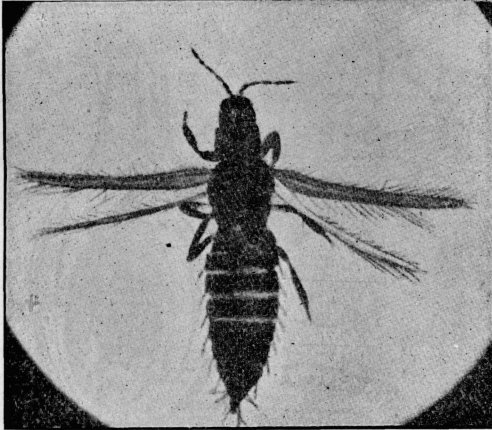


FIG. 28—Onion Thrips (*Thrips tabaci*, Lind.). (After Quaintance, Florida Experiment Station).

At the end of 9 days they pupate, and the adults appear at the end of 13 days after egg-laying. Where the pupa stage is passed normally has not been determined.

The full-grown thrips is 1 millimeter long, of a pale-yellow color, with black eyes and snout. The hind margin of the wings bear fringes of long hairs, and shorter ones occur on the front wings, giving them an appearance resembling small feathers. The male is smaller than the female.

REMEDIES.

This Department has carried on experiments with kerosene emulsion, whale oil soap and rose leaf insecticides. The latter two were the most effective, and it is difficult to state which is best. Whale oil soap at the rate of 2 lbs. to 4 gallons was the most effective temporarily, while rose leaf adhered longer to the foliage, which was an advantage over whale oil soap. These experiments were carried on during a drought. Both insecticides should be thoroughly tried this coming season. The best labor available should be employed for this work, so that the spraying is done thoroughly. Frequently the poor results are entirely traceable to indifferent work done by cheap labor.

ONION MAGGOT.

(Pegomyia ceparum, M.)

The onion maggot has not come to our attention in Texas, but every grower should be on the lookout for it. It is one of the most destructive garden insects and one of the most difficult to combat. It is closely

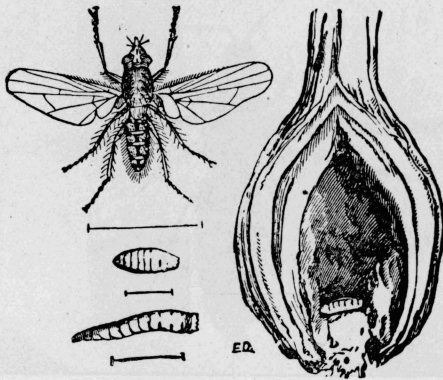


FIG. 29—Onion Maggot (*Phorbia ceparum*). (After Riley).

related to the cabbage maggot and resembles it in life history and habits. The adult, a two-winged fly, lays minute white eggs on the bulbs or lower portion of the plant. Maggots hatching therefrom bore into the bulbs. They soon absorb the moisture, and the plant dies. When full-grown the maggots are nearly half an inch long, of a white color, and, like most other fly maggots, are pointed at the front ends.

PREVENTIVE MEASURES.

The onion bed should be frequently changed. The bulbs should be well covered with soil. On very small plats the use of carbon bisulphide is practical when applied as for the cabbage maggot. An insecticide extensively used in the East is carbolic acid emulsion, the formula for which is given under cabbage maggot in this bulletin. It is applied as for cabbage maggot, also sprinkled over the soil and with a garden rake stirred into the surface.

SEED CORN MAGGOT.

(Pegomyia fusciceps, Zett.)

This insect is threatening to become an onion and garlic pest in this State. During the past year it was sent to the entomologist for onion maggot.

The life history stages are illustrated in the accompanying figure. The fly is about 1-6 of an inch long.

INJURY.

According to reports from other States, it is a subterranean pest. In Texas it is equally injurious to the plant above ground between the leaf

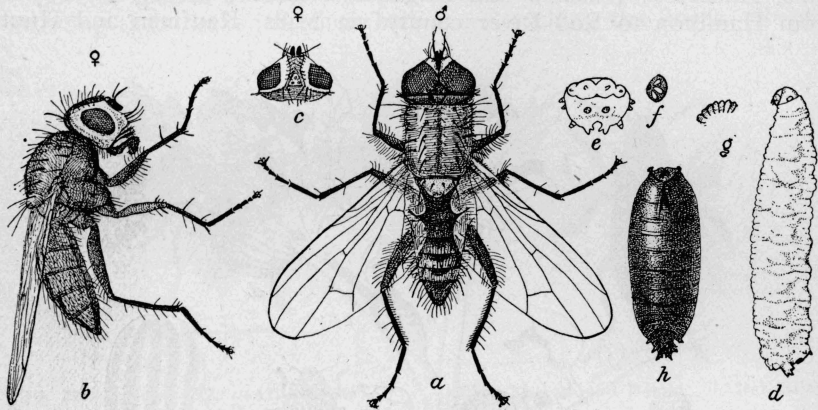


FIG. 30—Seed Corn Maggot (*Pegomyia fusciceps*, Zett.). (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

sheath and also on the inside of the stalks. The leaves turn yellow, dry up, and the plant decays.

PREVENTIVE MEASURES.

On a small scale, when the roots are chiefly attacked, carbon bisulphide can be applied as in cabbage maggot. As soon as a plant shows signs of infestation it should be dug up, not pulled up, and thrown into a vessel containing kerosene. Carbolic acid emulsion applied to the soil reduces the ravages of the pest, and onion sets should be immersed in the solution before planting. It is well to spray the onion field with carbolic acid emulsion, and then give the surface a shallow cultivation.

IRISH POTATOES.

THE COLORADO POTATO BEETLE.

(*Leptinotarsa 10-lineata*, Say.)

The Colorado potato beetle is one of the most familiar insects in the older States of our country. It is a native of the Rocky Mountain region, and until the middle of the last century confined itself to various weeds of the potato plant genus. With the settlement of the country and the cultivation of domesticated plants its food supply of wild plants became limited and it soon became a formidable pest of the potato. The various attempts at combating it led to the discovery of Paris green as an insecticide.

The pest occurs throughout Texas, but the chief injury is reported

from the older and more thickly settled portion east of the 98th meridian and north of the 31st parallel. The area of greatest injury during the last three years may be represented by two diagonal lines, one line of which extends from Baylor to Jasper counties through Young, Jack, Ellis, Anderson, Houston and Angelina counties; the other extends from Hamilton to Red River county via Mills, Kaufman and Hunt

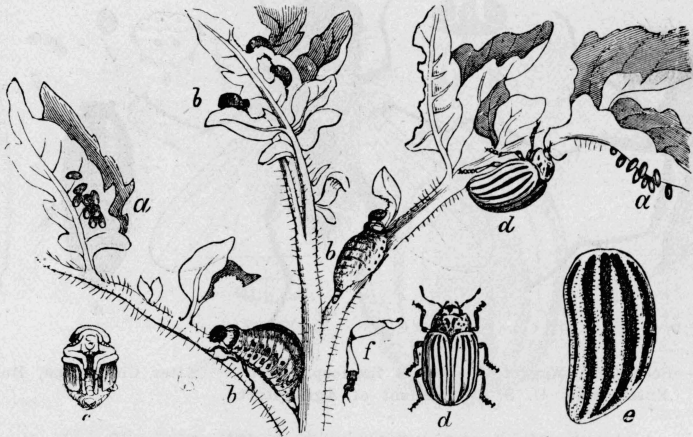


FIG. 31—Colorado Potato Beetle (*Leptinotarsa 10-lineata*). (After Riley).

counties, the intersection being in Ellis county. Sporadic areas occur in other places, chiefly in Travis and Fort Bend counties. On the ranches of South Texas, where its wild food plants are yet plentiful, it feeds chiefly on the bull nettle, but eventually it will become a potato pest as the country is being more thoroughly grazed or brought into cultivation.

LIFE HISTORY.

The females lay their little yellow eggs on the under surface of the leaf, generally near the tip. A single female is capable of laying from 600 to 1,000 eggs in the course of a month, and in the meantime the adults feed vigorously on the foliage. In about seven days they hatch into the brown, soft-bodied larvae which are so destructive, and which many growers erroneously mistake for females. After feeding about 34 days conspicuously on the foliage they enter the soil and there transform to naked, yellowish pupae, from which eventually emerges the adult insect. The last generation of the season for the most part remains in the soil over winter and in spring emerges in time to attack the young potato plants.

NATURAL ENEMIES.

This pest is more or less influenced by the weather conditions. Often during a variable winter many die a natural death, while during extreme drought a large percentage die before they reach maturity.

A species of Tachinid fly, resembling in general appearance a house fly and to science known as *Lydella doryphorae*, Ril., is an important parasite. This fly lays an egg on the potato beetle, which hatches into a small white maggot that bores into the beetle, killing it before it matures.

Several species of bugs are predaceous on the insect, killing it by inserting their beaks into their bodies and sucking the juices. Several

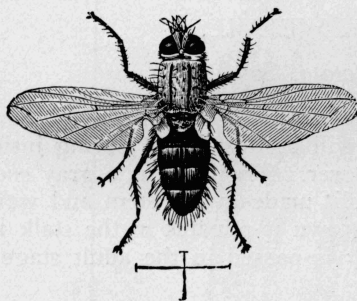


FIG. 32—Tachina Fly. (After Riley).



FIG. 33—Ground Beetle. (After Riley).

species of ladybird beetles are destructive to the eggs, while several species of ground beetles eat the larvae and the full-grown insects.

REMEDIES.

The use of the arsenical poisons in controlling this pest has long been known. Paris green, green arsenoid and arsenate of lead all work admirably. London purple is often less uniform in composition and contains more free arsenic, so that there is greater danger of injuring the plants.

For small areas, Paris green or green arsenoid may be used dry by mixing with 100 times their weight of land plaster, air-slaked lime or flour, and applied when the dew is on or when the plants are moist. Although the dusting can be done with a tin can having the bottom perforated, it is better to buy a good powder gun for this purpose. Where a wet application is desired, 1 lb. Paris green should be used with every 100 gallons of water, to which 1 lb. of quicklime should be added. Arsenite of lime or arsenite or soda are as effective as Paris green, and less expensive. Arsenate of lead is also effective when used 3 lbs. to 50 gallons of water, though its action is slower.

FLEA BEETLES.

There are several species of flea beetles that are injurious, principally to cucumbers, melons, tomatoes and potatoes. We have not made a systematic study of them, but as we have studied the methods of destroying them a knowledge of their scientific names is not of great importance for the purposes of this bulletin.

These flea beetles are so called on account of their habit of jumping like fleas when disturbed. They have powerful hind legs and can jump

long distances with astonishing rapidity. They do not eat large areas of tissue like caterpillars, but gnaw the leaf full of holes.

CONTROL.

The Bordeaux arsenical sprays and the poison dusts, as recommended under striped cucumber beetles, are the best remedies known for these insects. (See Page 23.)

POTATO STALK WEEVIL.

(*Trichobaris trinotata*, Say.)

When the potato plants wilt the stems should be cut open. No doubt the little, light-colored, footless grub will be discovered boring inside. This is the larva of the potato stalk borer. The adult is a gray snout beetle, which deposits her eggs in a slit made in the stem and works downward to the roots. When full-grown it pupates in the stalk immediately below the soil. The winter is passed in the adult stage in various sheltered places.

REMEDIES.

As soon as the plant shows wilting it should be destroyed, and as soon as the crop is harvested all vines should be gathered and burned, in order to prevent any immature stages to mature and pass the winter. As the adults feed on members of the nightshade family, it is important to keep down our common nettles and Jamestown weeds. Nothing is more important than a well-fertilized seed bed to stimulate the growth of the plant.

SWEET CORN.

CORN EAR WORM.

(*Heliothis obsoleta*, Fab.)

This insect is the same as the cotton boll worm, corn ear worm and tomato worm. The insect is too well known to require description. It occurs abundantly everywhere in the humid sections of Texas, extending toward the Panhandle in Northwest Texas. In spring these large worms bore into the fruit of tomatoes. When the corn reaches the "milk" stage, they may be seen tunneling about among the kernels, making unsightly furrows, which render it unmarketable. When the corn becomes too hard they proceed to the cotton bolls.

REMEDIES.

No direct remedies can be applied in the corn-infesting stage. The last brood of the season in Texas feeds principally on the cotton bolls, and it is in the cotton fields that they enter the soil for pupation, to remain during the winter. The pupae are sensitive and cannot endure much disturbance. Late fall and winter plowing is therefore the

most practicable recommendation against this pest. In this operation many are destroyed directly by crushing. Others are buried too deep for emergence, while those that are exposed become accessible to the

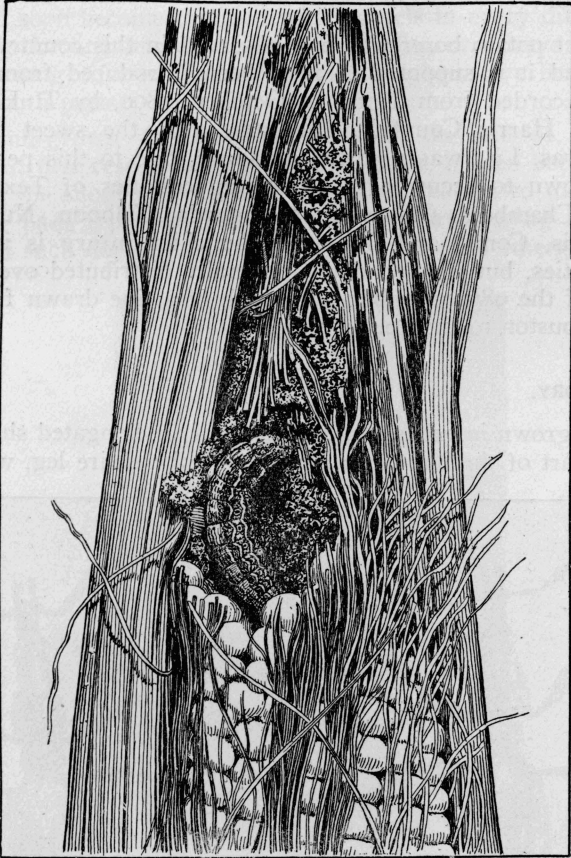


FIG. 34—Corn Ear Worm. (After Quaintance, Bureau of Entomology, U. S. Department of Agriculture).

various natural enemies, such as birds and parasites. Such cultivation when univerrally practiced is our only hope of reducing the pest to insignificant proportions.

As they prefer corn in the milk stage a few rows should be planted between tomato rows when the latter are attacked.

SWEET POTATO.

SWEET POTATO BORER.

(*Cylas formicarius*, Fab.)

There is no industry in Texas that is more seriously threatened with destruction than the growing of sweet potatoes. In some sections the

industry has already been abandoned in discouragement on account of this pest.

DISTRIBUTION.

The sweet potato borer was first observed in this country near New Orleans, and it is supposed to have been introduced from Cuba. It was first recorded from Texas in October, 1890, by T. H. Edwards, Bay View, Harris County. The same year the sweet potato crop around Buras, La., was reported a failure, due to this pest. It is at present known to occur in the following counties of Texas, namely, Jefferson, Chambers, Galveston, Matagorda, Calhoun, Nueces, Cameron, Harris, Comal and Travis. The chief injury is in the Gulf Coast counties, but it is no doubt generally distributed over the territory east of the 98th meridian and south of a line drawn from Austin through Houston to the 30th parallel.

LIFE HISTORY.

The full-grown insect is a snout beetle of an elongated shape, having the front part of the body, the feelers, and the entire leg, with the ex-

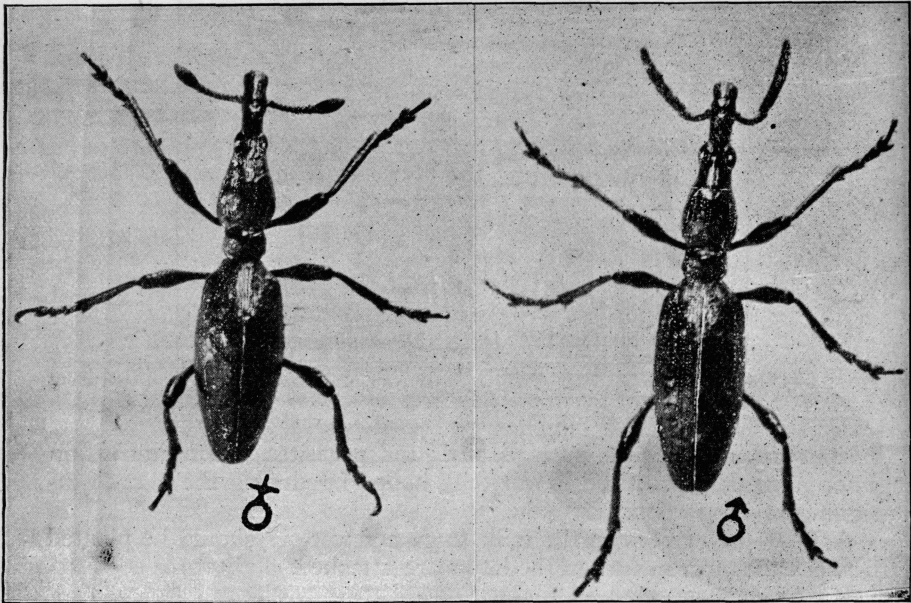


FIG. 35—Sweet Potato Borer (*Cylas formicarius*); adult male and female.

ception of the black tip, reddish-brown. The head, wing covers and abdomen are bluish-black. When the insects are from 2 to 5 days old the eggs are laid. They are deposited in the vine near the surface of the ground, generally in cavities made by the insect. In the bins they are laid in cavities eaten into the tubers. They are broadly oval in

shape, of a yellowish-white color, and about 1-40 of an inch long. The larvae burrow their way into the tubers, burrowing onward until full-grown. We have reared them in sweet potato stems before any tubers had developed. Where a number of insects are present the potato will soon become ramified with tunnels in every direction, making it unfit for any use whatever. The full-grown larva is about 1-5 of an inch long, of a whitish color, with a light-brown head and dark-colored mouth parts.

When full-grown the larva pupates at the end of its burrow. Although at first resembling the larva in color, it soon becomes darker. It exhibits the snout folded down upon the breast, also the feelers and legs, while pads represent the wings of the forthcoming beetle. After six days of such dormant life the full-grown weevil emerges.



FIG. 36—Egg and Larva Stages.

The entire life history requires from 30 to 35 days, so that several broods are possible during a single season. In South Texas they breed all winter in the bins; at College Station they hibernate during the winter.

HABITS AND FOOD PLANTS.

The sweet potato borer in the region of sweet potato cultivation may be met with at any season of the year. It is as destructive in the bin as in the fields. It is slow in traveling from place to place. Thus far we have not been able to observe the weevil in flight, all migrations being on foot, except when carried by vehicles through accident.

The insects belong to the beetles known as general feeders. It lives on members of the Convolvulus family, and especially on the sweet potato. Professor Tyron, of New South Wales, Australia, reports that "of some 5 or 6 varieties of sweet potatoes which seemed to comprise more than one species of *Ipomaea*, procured in British New Guinea and grown in Queensland, not one escaped its attacks when grown in beetle-infested fields." In our investigations in this State

we have not found any variety that is immune. Very little has been done on this subject. The claim is made by some growers that early varieties are more seriously injured than later ones; also, that they are more destructive on loose, sandy soils than in heavy lands. We know of an instance where an infested plot containing 28 plants, only one hill was injured and the tubers of this plant were partly exposed above ground.

REMEDIES.

On account of the slow and broken movements of the adults and the concealed habits of the immature stages, the presence of the insect is difficult to discover. It is necessary that every grower in the weevil area, which has been already defined, be on guard. An occurrence of the pest has been reported as far north as Marlin, but the specimen did not accompany the communication. The possibility of the northern limit of its range cannot be predicted with certainty. They survive the mild winters at College Station.

Every sweet potato grower should examine his crops for worm-eaten tracks in the tubers or in the base of the vines. Where these are discovered, further investigations will undoubtedly uncover a larva or pupa. Where the grower is in doubt, the suspected potato should be securely packed in a wooden or tin box, so that no escape is possible in the passage through the mails (see Circular 9 of this office), and sent to the State Entomologist for determination.

DO NOT EXPOSE TUBERS.

When the insect is known to be present, tubers should not be allowed to remain exposed, and should be covered with soil. Where beetle attack is anticipated, deep planting should be practiced, and if conditions will permit the planting should be in flats, because outbreaks will be more readily noticed than when planted in ridges. Such planting will admit of cultivation that will keep all cracks in the soil closed during drought, thus shutting up all entering channels by which the adults may reach the tubers.

When the crop is known to be infested, it should be harvested as soon as possible, for every day the infestation will increase and the value of the crop decrease. All the tubers showing no sign of infestation should be separated from the infested ones. The former should be placed in a weevil-tight bin, and the latter absolutely destroyed. The vines should be gathered and burned, and the grower should convince himself that to his knowledge no vines or tubers remain in the field.

METHODS OF SPREAD.

During the past decade there has been a desire for new seeds, and this no doubt is partly responsible for the introduction of the pest into this country. It may be disseminated in sweet potato sets intended for planting. They are spread in the tubers on the markets, and in this manner it is carried great distances. Where potatoes are packed in

burlap or some similar substance, the weevils emerging en route escape and endanger the country along the railroad line. Infested tubers are bought in the local market and carried home, thus infesting local farms. This should induce everyone to realize the importance of using the most scrupulous care to avoid placing the infested tubers on the market. Seed potatoes and slips for planting purposes should be procured from sources where the pest has never been known to occur.

Insecticides.

POISONING.

Where the weevils appear in the field they often gnaw the plants. An application of Paris green or arsenate of lead is effective. The grower should acquaint himself with the weeds on his farm which belong to the sweet potato family. Here the adults are enabled to maintain themselves in the absence of sweet potatoes, and such plants should be destroyed or poisoned.

FUMIGATION.

In the bins the potatoes should be fumigated with high-life (carbon-bisulphide) at the rate of 3 lbs. to 100 bushels for 30 hours. It should be remembered that this insecticide is inflammable, and when ignited explodes violently. For that reason fires of any kind should not be brought near a building when such fumigations are carried on.

TOMATOES.

TOMATO WORM.

(*Phlegatontius sexta*, L.)

These are the large, green, naked caterpillars with a long curved spine at the hind end of the body. When full-grown they measure upward of three inches in length. They pupate in the soil, and may then be recognized, when dug up, by the appendage on the side of the body resembling a jug handle. The adult is one of the humming bird moths.

REMEDIES.

On account of the large size, hand-picking involves the least amount of trouble. They can be poisoned, but a liberal application is necessary as the insects need a great deal to kill them.

BLISTER BEETLES.

There are a number of blister beetles or Spanish flies in Texas that are of common occurrence. The small black species (*Epicauta pennsylvanica*, DeG.) may be found abundantly on our common broom weed in late fall. It has been reported to us from South Texas injuring the onion plants by eating them off at the surface of the ground. It is also destructive to potatoes, cabbage, mustard, carrots and corn. A large, ashy-gray species (*Macrobasis albida*, Say.) is frequently re-

ported injurious to tomatoes. A large blue species (*Pomphopoea texana*, F.) is causing apprehension in the minds of the fruit growers in North Texas, as the insect appears at blooming time and is terribly destructive to the blossoms of peach and plum, which it devours. We have given it the common name of "fruit-blister beetle."

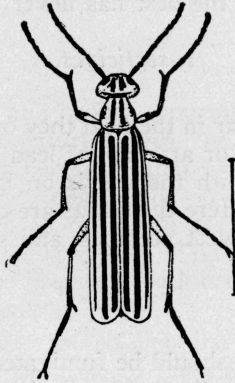


FIG. 37—Striped Blister Beetle (*Epicauta lemniscata*). (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

The species doing the most serious damage, however, is the striped beetle, also known to some as old-fashioned potato bug (*Epicauta lemniscata*).

DISTRIBUTION.

It is chiefly destructive in the territory east of the 97th meridian and south of a line drawn east and west through Burleson County. Reports of injury also reach us from farther west, from Hays and Erath Counties. Although it attacks various kinds of plants when hungry, it is mainly an alfalfa and potato pest in Texas. It attacks all kinds of garden vegetables, and at this writing we have a report that it eats growing corn at Sugarland, Texas.

Remedies.

POISONING.

When the injuries are sufficiently threatening to warrant extermination of the pest, Paris green or green arsenoid may be applied. These poisons may be sprayed in the usual manner, or may be applied mixed with a diluent, when it will kill some, but drive away many of them. It should be remembered, however, that these beetles respond to poisons very slowly, and the applications must, therefore, be made thoroughly.

In the vegetable garden the old practice of driving the beetles with dry brushes into windrows of straw and then setting fire to the straw is practicable on a **small scale**.

REPELLANT.

In gardens we have had success by spraying the plants with whale oil soap. This is distasteful to the beetle and often prevents serious attacks.

STINK BUGS.

The tomato stink bug (*Nezara hiliaris*) and the leaf-footed plant bug (*Leptoglossus phyllopus*), illustrated in the accompanying figure, are

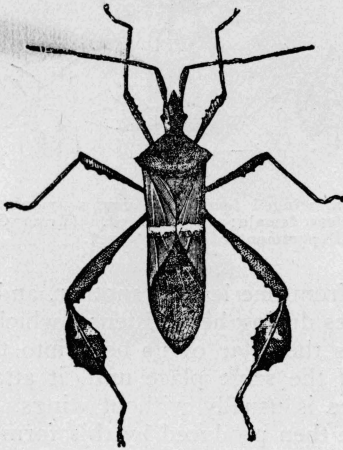


FIG. 38—Leaf Footed Plant Bug (*Leptoglossus phyllopus*). (After Hubbard).

doing considerable injury to tomatoes. The injury reported to us in all cases was caused by the adults. They breed on wild plants, principally thistles, and may be met with during the entire summer. At this writing we have no practical remedy to recommend except the keeping down of weeds about the gardens. By so doing the immature stages will be destroyed. The insects are sluggish on cloudy days, and hand-picking should then be practiced.

THE COTTON OR MELON APHIS, AND OTHER APHIDS: THEIR INIMICAL INSECTS, AND FRIENDS.

The melon aphis (*Aphis gossypii*, Glov.) has proved itself to be a very serious pest since 1854. The last four or five years, however, since the extensive growing of cantaloupes in this State, it has created damage unsurpassed in its Texas history.

This small and ordinarily inconspicuous insect is more frequently noticed on account of its work than by reason of its form or appearance. The insect itself, on melon or other similar vines, is not often noticed until colonies have been founded in destructive numbers. Consequently, it is necessary for the planter to know its characteristics and methods of attack, so that it may be controlled before doing serious injury.

METHOD OF ATTACK.

The first form which appears in melon fields locates itself on the ventral side of the leaves. This is a female. She produces young, not by laying eggs, but by giving birth to about four or ten per day. She may remain on the ventral side of a single leaf for two or three days,

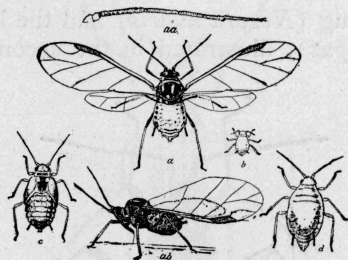


FIG. 39—*Aphis gossypii*; a, winged female; b, young nymph or larva; c, last stage of nymph; d, wingless female; all enlarged. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

or she may migrate from one leaf to another, and thus establish small colonies on many vines during her existence, which is about one month.

Each young inserts the setae of its beak into the tissue of the leaf and often remains at the same place until it attains the adult stage, which in this instance is usually without wings. This requires about six days. Young are then produced by this form usually on the same leaf on which it was born. In two weeks from the visitation of a migratory form and the birth of one young, a colony of about fifty can be established on one leaf. On account of a loss of nourishment on the one side while the leaf is growing, it begins to curl. If it is immature while the colony is developing, its lateral margins will grow toward each other and finally form an enclosure for the protection of the aphids.

At the age of six days each individual has attained its growth, and if the leaf on which it was born is becoming non-succulent it may crawl away from it and establish itself on a younger and more succulent one. This method of establishing themselves brings great numbers to the terminal buds of the vines, which retards the growth by corrugating all the younger leaves.

Some of the young of these generations generally acquire wings and fly to other vines and establish colonies. Consequently, strict attention must be given to the vines, and if infestation occurs and no parasites can be found to exterminate it, they must at once be treated, before it is too late to be effectual.

METHODS OF PREVENTION AND CONTROL.

In the fall is the proper time to begin the campaign. The chief base of operation is a trap crop for the retention of inimical insects. Rape, such as is often sown for hog pasture, is the best crop for this purpose. It is hardy, and will live through ordinary winters in this latitude. Be-

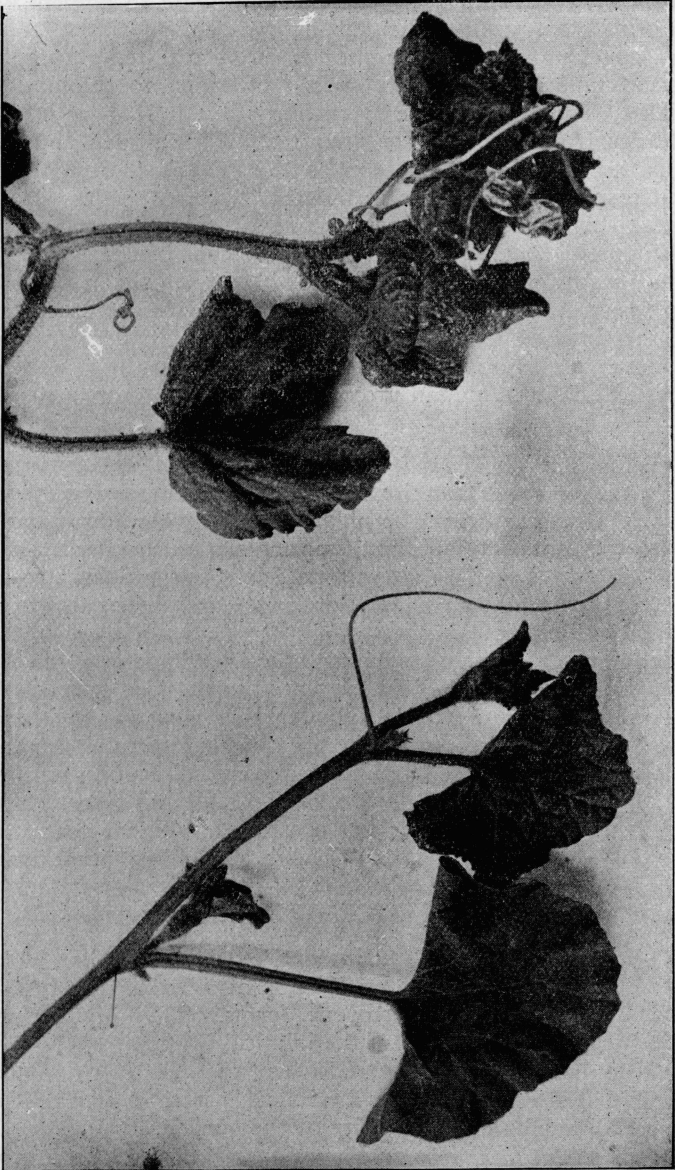


FIG. 40.—Injurious Effects of Melon Lice. (Photo by O. E. Bartholomew).

sides being hardy, it is a natural food plant of an aphid, which has a universal distribution. This insect (*Aphis brassicae*, L.) furnishes in itself food material for the majority of the parasitical and predatory insects which destroy aphids in general.

After this plant attains a height of three or four inches, or has three or four leaves, it generally becomes naturally infested with aphids. If infestation fails to occur, care should be taken to colonize the field artificially. This can be done by cutting a dozen or more infested cabbage leaves from your own or your neighbor's garden and scattering them in the rape field. As soon as the field is thoroughly infested, inimical insects, such as Coccinellids or ladybird beetles, also internal parasites, should be present. If none of these insects are present, your Entomological Department should be consulted.

If the trap crop is properly planted, it will remain in a condition to sustain insect life until after canteloupes are ripe, or other truck has passed the stage of being damaged by aphids. Furthermore, there will have been enough inimical insects migrating from the rape field to exterminate all other aphids in proximity to the trap crop.

FACTS CONCERNING THE PLANTING OF THE TRAP CROP.

The manager must exercise his own judgment in regard to where in his field a trap crop can be planted to the most advantage. If the field is square and contains about four acres, it will be necessary to plant two or three rows of the rape on one side. If the field is rectangular, plant a few rows at each end. For larger and different shaped fields the same principles obtain.

The chief thing of which one must take advantage is to plant the trap crop on the margin of the field, or placed in the field which is likely to be the most foul with weeds and debris when cool weather begins, because it is in such places that the predaceous insects hibernate. Rotten or hollow logs, with loose bark, furnish some of the best natural hibernating places for these insects that can be had, and since it is essential to have as many inimical insects as possible the coming year, it is necessary to provide as many as possible with good hibernation quarters.

OTHER APHIDS.

The principles used in subjecting and exterminating the melon aphid are thoroughly reliable in the eradication of all other aphids except the gall-forming and some subterranean forms. They are Nature's own remedies augmented in favor of the inimical insects.

If a little patch of infested rape is kept growing in proximity to the garden it will attract and sustain inimical insects in sufficient numbers to subject all aphids in the vicinity of the garden.

All truck farms, orchards or plantations should contain a proportionately large patch or two of rape. Before one crop of this matures another should be planted or sown, so that the inimical enemies may have an infested field in which to breed. In addition to its aforementioned value, rape is said to make good hog pasture. However, I have no good proof for this.

OTHER REMEDIES.

When managers have not prepared against attacks of aphids, the following method of eradication is the best artificial remedy.

Remedy for infested vines which grow on the ground, such as canteloupe vines.

CONSTRUCTION OF APPARATUS.

For vines two or three feet long, a light frame four feet wide and six feet long, supported by legs eight inches long, is a convenient size. Lumber three fourths of an inch thick and two inches wide is suitable. Construct a frame, and nail an eight-inch leg to each corner. For frames six feet long or longer, strengthen by connecting the ends with a crosspiece. Two diagonals should be used for strengthening the frame, and also for convenience in handling, but one of the latter should not be attached until the cloth cover is in position. The latter may be made of 7c or 8c muslin, or a cheaper grade, which is not so porous as to allow a passage of gas after being oiled.

The size of the cloth should be prepared two feet wider and two feet longer than the frame which is to be covered. This is sufficient for an eight-inch wall and a four-inch lap to the ground. On the latter, dirt may be placed to keep the gas from escaping.

After the cloth has been sewed and cut into the sizes desired, it should be saturated in a vessel of linseed oil, which will fill the pores. It should then be wrung out, slightly dried and placed over the frame and held in place by nailing the diagonal to the frame above the cloth. Four covers of above size may be rendered sufficiently gas-tight by the use of one gallon of linseed oil.

The number of frames to be made depends on the amount of infestation and the rapidity of the operator. In ordinary cases, about ten frames are sufficient for one man's attention.

METHOD OF APPLICATION.

Place the frame over the infested plant. Take one sheet of Aphis Punk or one-half sheet of Nice-Fume paper, tear same into two equal parts, light same, and put each piece in a tin oyster or similar can, which has perforations at the bottom edge, made by driving a large nail through the side, and place each can in opposite corners of the frame, but not on the vine; light according to directions. By this time many of the beneficial insects have escaped from under the cover. With a trowel or other convenient small tool place a little dirt on the border of the cloth which lies on the ground to prevent the escape of gas. The frame should remain in position long enough to suffocate all aphids under it which is usually from three to thirty minutes. One man should have enough frames to handle so that each one in succession may remain on a vine during the above time.

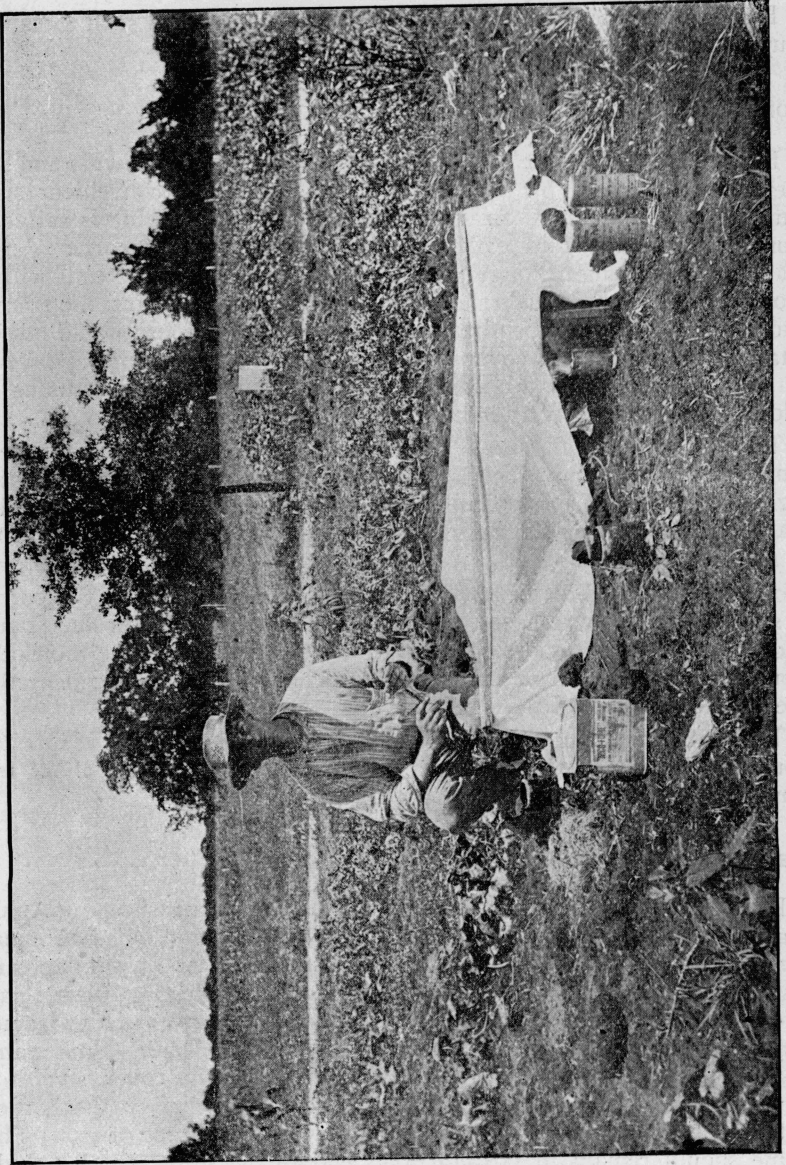


FIG. 41—Fumigating Cantaloupe Vines. (Photo by C. E. Bartholomew).

BRIEF SUGGESTIONS REGARDING FUMIGATION.

(1). In localities where the melon louse is expected to be injurious, the local merchant who cares to deal in insecticides should be informed and should have his fumigating papers in stock.

(2). Vines should not be deranged by the operator except in instances where vines protrude only a few inches from beneath the cover.

(3). The best time for fumigating is when there is no wind and the vines are damp.

(4). Arrange size of frames best adapted for the size of the vines. Do not allow the leaves to touch the top of the cover.

(5). Give the frame plenty of time and sufficient gas by experimenting.

METHODS FOR FUMIGATING SUCH PLANTS AS CABBAGES, TOMATOES AND EGGPLANT.

From material similar to that used for fumigating melon vines construct a hood which will cover the plant. For a frame, use two wires bent into a semi-circle. Tack the top of the hood to the middle of these wires, where they should cross in their centers, also tack the bottom of the hood to the end of each wire. The hood should be made so that it will lap on the ground an inch or two. A very small piece of fumigating paper is sufficient to eradicate all the aphids that a hood of this kind will cover.

INIMICAL INSECTS.

Many species of aphids are often controlled in certain localities by their inimical insects. The wheat aphid, (*Toxoptera graminum*, Rond.),

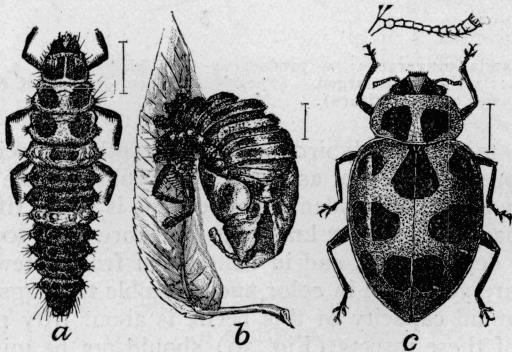


FIG. 42—*Megilla maculata*; a, larva; b, empty pupal skin; c, beetle with enlarged antennae above; all enlarged. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

commonly known as the green bug, furnishes a good example of this subjugation. In the years 1902 and 1903 it was infested to such an extent with its natural enemies that up to date it has not survived the attack. As soon, however, as these natural enemies succumb for the

want of food material, the green bug will have an open field for operation and will flourish until subdued again by its enemies.

The chief reason why the green bug is thus naturally exterminated is because it does not migrate from wheat, its host plant in the fall of the year. The latter furnishes shelter for the inimical insects, as well as the aphids, and when spring gives renewed energy to the one it also gives it to the other, and the consequence is that eradication of the aphids follows at once. The chief point which the owner of the infested field must consider is to see that the aphids are properly infested before it is too late.

The chief inimical insects to aphids in general are the Coccinellids or ladybird beetles. See Figs. 42 and 43, which illustrate some stages in the life history of these insects.

While the ladybird (*Megilla maculata*) has been the most responsible for the control of the green bug (*Toxoptera graminum*, Rond.), and the corn aphid (*Aphis maidis*, Fitch.), the ladybird (*Hippodamia convergens*) has been the most promising in controlling the melon aphid (*Aphis gossypii*, Glov.).

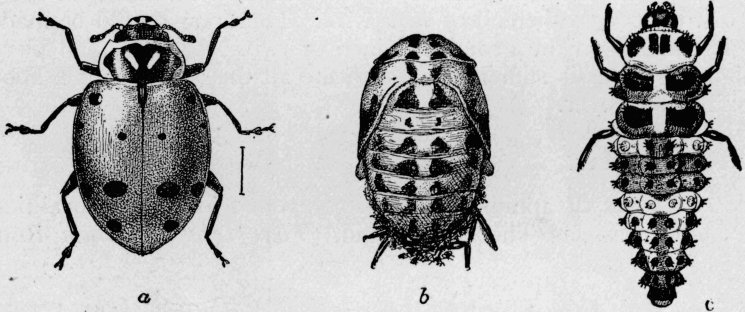


FIG. 43—*Hippodamia convergens*; a, predaceous lady bird beetle; a, adult; b, pupa; c, larva; all much enlarged. (From Chittenden, Bureau of Entomology, U. S. Department of Agriculture).

In addition to these ladybird beetles, are other species which are equally ravenous, but are not as hardy and prolific. The average egg-laying capacity of the *Hippodamia convergens* is about fifteen eggs per day, and ordinary females are known to lay more than 500 eggs apiece. The latter are deposited on end in bunches of from a few to fifty in a place. They are yellowish in color and resemble the eggs of the potato beetle. The aphid capacity of this beetle is about fifty per day. The larval forms of these insects (Fig. 39) should not be mistaken for injurious insects.

In addition to the brightly-colored ladybird beetles as aphid eaters are a few species of small dark-colored beetles about one-fifth as large. These are scymnus beetles. The larvae of these have a woolly appearance. The eggs are deposited sporadically among aphid colonies and are small, light-brown and inconspicuous.

The *Chrisopa* or lace-wing flies and hemerobids are more frail than

the coccinellids, but are equally fond of aphids. Fig. 3 illustrates the different stages in the life history of a lace-wing fly.

The hemerobid, which preys on melon aphids, are similar in shape to the lace-wings, but are smaller and are of a brownish color. Their

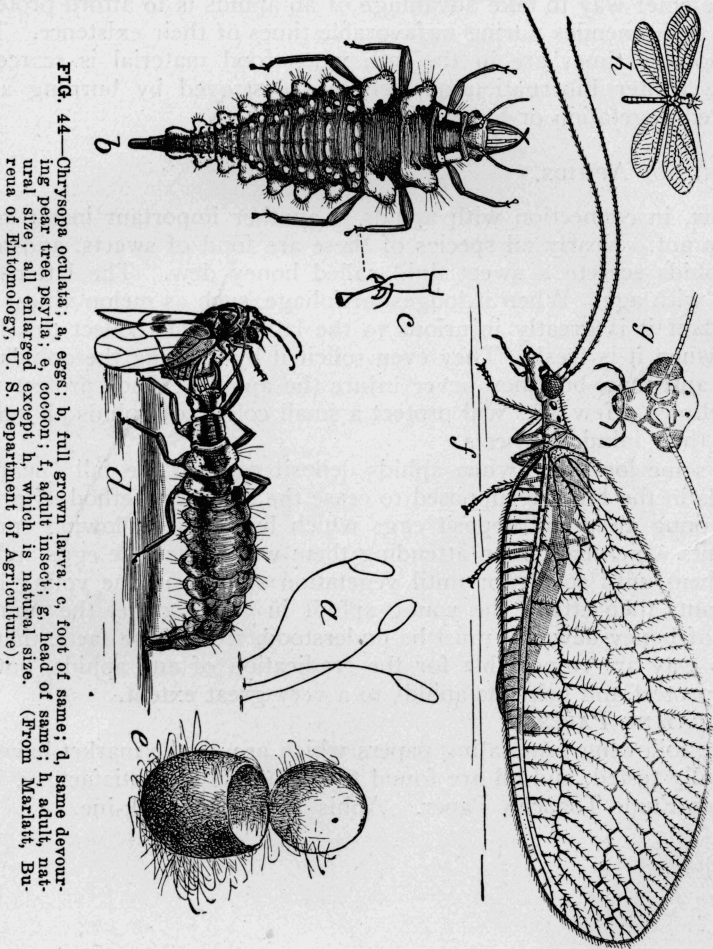


FIG. 44—*Chrysopa oculata*: a, eggs; b, full grown larva; c, foot of same; d, same devouring pear tree psylla; e, cocoon; f, adult insect; g, head of same; h, adult, natural size; all enlarged except h, which is natural size. (From Marshall, Bureau of Entomology, U. S. Department of Agriculture).

eggs are not placed on pedicles as those of the lace-wing, but are similar to scymnus beetle eggs. In addition to these predatory insects are dipterous and hymenopterous enemies.

The dipterous enemies are beneficial in the larval stage. The adults do not eat the aphids. The eggs are deposited sporadically on plants infested with aphids. The larvae have no legs and are not as active as coccinellid larvae, although they are greedy eaters.

Of the hymenopterous enemies we have one which is predaceous in the larval stage; the remainder are internal parasites. While the internal parasites are of great importance in subduing the aphids, they

can not be said to be as expedient as those forms which devour the aphids, since one egg of an internal parasite uses but one aphid in the development of the insect hatching from it, while one egg from a beetle uses several hundred in the development of the insect which hatches from it.

The chief way to take advantage of all aphids is to afford protection to all their enemies during unfavorable times of their existence. These unfavorable times are in the fall, when food material is scarce and where winter hibernation quarters are destroyed by burning aphid-infested vegetation or by plowing it under.

FRIENDS OF APHIDS.

Now, in connection with aphids is another important insect known as the ant. Nearly all species of these are fond of sweets, and nearly all aphids secrete a sweet fluid called honey dew. The latter turns black with age. When it lodges on foliage, such as melon vines, when abundant it is greatly injurious to the latter. Ants collect this honey dew when it is fresh. They even solicit it by exciting the aphids with their antennae, but they never injure the aphids. They protect them. Sometimes a few ants will protect a small colony of aphids all summer from their inimical insects.

In some localities, when aphids deposit eggs in the fall (nearly all aphids in the fall are supposed to cease the summer method of producing young alive and deposit eggs which hatch the following spring), the ants which have been attending them will gather the eggs and care for them until spring or until vegetation starts and the young hatch. The ants then attend the young aphids in order to get the summer's crop of honey dew. It must be understood, from these facts, that ants in no way are responsible for the eradication of any aphids, but that they protect and help the aphids to a very great extent.

FUMIGATING PAPERS.

The following fumigating papers which are on the market have been carefully tested, and all are found to be thoroughly satisfactory.

Nico-Fume-Tobacco Paper. Aphis Punk. To-bak-ine.