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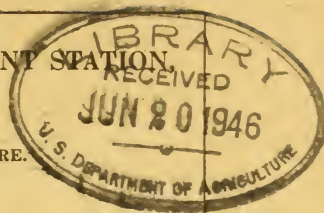


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VIRGIN ISLANDS AGRICULTURAL EXPERIMENT STATION

ST. CROIX, VIRGIN ISLANDS, U. S. A.

Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE.



BULLETIN No. 4.

TRUCK-CROP INSECT PESTS IN THE VIRGIN ISLANDS AND METHODS OF COMBATING THEM.

BY

CHARLES E. WILSON, Entomologist.



Issued June 21, 1923.



WASHINGTON:
GOVERNMENT PRINTING OFFICE,
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ST. CROIX.

[Under the supervision of the States Relations Service, United States Department of
Agriculture.]

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TRUCK-CROP INSECT PESTS IN THE VIRGIN ISLANDS AND METHODS OF COMBATING THEM.¹

CONTENTS.

	Page.		Page.
Bean, <i>Canavalia</i> spp., cowpea, and		Lettuce-----	21
Lima bean-----	1	Mustard, Chinese cabbage, Chinese	
Beets and chard-----	6	mustard-----	22
Broccoli, cabbage, cauliflower, and		Okra-----	23
kohl-rabi-----	10	Pepper-----	24
Carrots-----	13	Sweet potato-----	25
Corn-----	13	Tomato-----	28
Cucumber, melon, and squash-----	19	Tannia-----	34
Eggplant-----	21	Yam-----	35

INTRODUCTION.

All the truck crops grown in the Virgin Islands are susceptible to insect attack. To combat these pests successfully it is necessary to know something of their habits, life histories, physical characteristics, and methods of attack. The histories given in this bulletin are based upon laboratory rearings and may be slightly different from those had under field conditions.

The crops are listed alphabetically or in groups of closely related species, and the insect pests are listed in the order of their importance, the life histories of those species only which do considerable damage to the crops being given.

INSECT PESTS ATTACKING BEANS, CANAVALIA SPP., COWPEAS, AND LIMA BEANS.

LESSER CORN STALK-BORER (*Elasmopalpus lignosellus*).

The lesser corn stalk-borer, or bean stem-borer, as it is sometimes called, has been found widely distributed in South America, Central America, the United States, Mexico, and the Bahama Islands. In St. Croix specimens have been reared from bush and pole varieties of beans, Lima beans, corn, cowpeas, elephant grass (*Pennisetum purpureum*), guinea grass (*Panicum maximum*), and young sugarcane shoots. The greatest amount of injury, which is noticeable in September, October, March, and April, is done to beans, corn, and cowpeas.

The larva.—The full-grown larva is of bluish-green color, has a brown head, and is about half an inch long. (Fig. 1.) Each body

¹ The writer acknowledges his indebtedness to Dr. L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture, and to other specialists of that bureau for their courtesy in determining many of the species mentioned in this bulletin and for the illustrations, all of which were supplied by the Bureau of Entomology.

segment has one brown spot. The first segment of the thorax is black. The larva is very active in all its stages.

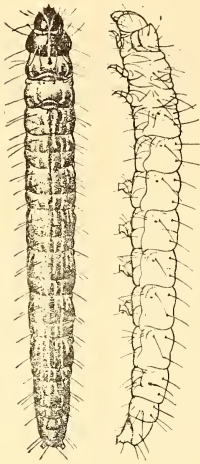


FIG. 1.—The lesser corn-stalk borer:
Larva. Greatly enlarged.

The life history of *E. lignosellus* has been carefully worked out by Luginbill and Ainslie,² who found that from 13 to 41 days are required for the larvæ, depending upon the temperature. This wide variation in time does not occur under St. Croix conditions. In specimens reared during September and October, 1920, and in March and April, 1922, the larval period was usually 15 days, and under drought conditions, 20 days.

The larva girdles the stalk of old plants and enters the stalk of young plants immediately below the surface of the soil, whence it tunnels upward from 1 to 3 inches into the heart of the plant. It does not remain long in the stalk, but envelopes itself in a silk tube which it spins and covers with particles of dirt. This tube is attached to the stalk at the entrance hole. (Fig. 2.) Plants damaged by the larvæ of *E. lignosellus* seldom recover.

The cocoon.—The cocoon is made from strong, closely woven silken thread and is usually covered with trash and particles of dirt. (Fig. 3.)

The pupa.—The pupa is formed about two days after the larva has completed its development. The adult moth emerged after eight days in March and April and after six or eight days in September. (Fig. 4.)

The pupa is yellowish-brown in color and about one-third inch long.

The adult.—The adult moth has a wing expanse of about three-fourths inch. The forewings are narrow, blackish-brown in color, and may show lighter markings. The hindwings are a lustrous grayish-white bordered with brown. The ventral surface is a lustrous light brownish-gray. The head and the thorax are similar to the forewings in color, and the abdomen is grayish. (Fig. 5.)

BEAN LEAF-WEBBER (*Nacoleia indicata*).

The bean leaf-webber has a wide range, being found in South Africa, southern Asia, South America, the West Indies, and Florida. It is undoubtedly indigenous to the Tropics. The injury caused by this insect is done in the larval stage. It folds parts of the same leaf



FIG. 2.—Feeding tubes attached at entrance to tunnels, at base of sorghum stalks.

² U. S. Dept. Agr., Bul. 539 (1917), p. 15.

or different leaves together and skeletonizes them. The larvæ have been found on beans, cowpeas, and Lima bean leaves. The native food plant observed by the writer was the rattlebox (*Crotalaria* spp.).

The egg.—The eggs are deposited on the underside of the leaf and hatch in from four to six days.

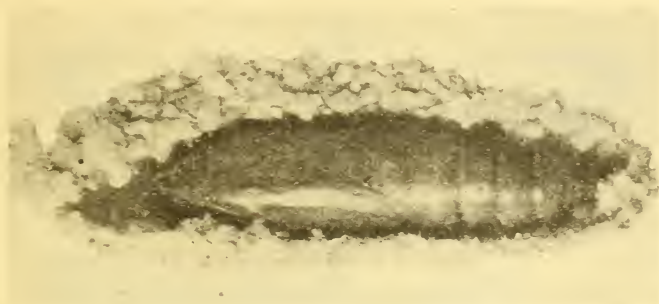


FIG. 3.—Cocoon opened, showing pupa *in situ*.

The larva.—The young larva is yellowish-white and feeds on the surface of the leaf. In a short time it folds the leaves or webs two leaves together and retreats within the inclosure to develop. During its stage of development the larva excretes a soft material which produces a filthy condition of the leaves on which it feeds. The mature larva is about one-half to three-quarters inch long, dirty-green or yellowish-green in color, and very active when disturbed. The larval period lasts from 14 to 20 days.

The adult.—The adult moth is golden-yellow, small, and active. The upper surfaces of the wings are crossed transversely by black wavy lines, and the two inner lines of the forewings continue across the hind wing. The third black line extends from the anterior margin of the forewing transversely across about three-fourths the distance. The lustrous ventral surface and the abdomen and legs are slightly lighter in color than the wings. (Fig. 6.)

CONTROL.

Since the larvae have not been found in any numbers, no control measures were undertaken.

A parasitic-fly larva (*Exorista pyste*) has been reared from the leaf-webber, and no doubt plays an important part in its control.

BEAN LEAF-ROLLER (*Eudamus proteus*).

The bean leaf-roller is widely distributed, occurring in the southern part of the United States, throughout the West Indies, Argentina, Paraguay, Venezuela, and Central America. (Fig. 7.) In St. Croix this species is kept in check by natural enemies.



FIG. 4.—The lesser corn-stalk borer: Pupa. Greatly enlarged.

The egg.—The eggs are deposited on the lower surface of young leaves either singly or in small groups. They turn yellow shortly after being laid, and hatch in from 4 to 6 days.

The larva.—The young larvæ feed for a short time, then fold the leaves and retreat in the inclosure thus afforded. The full-grown

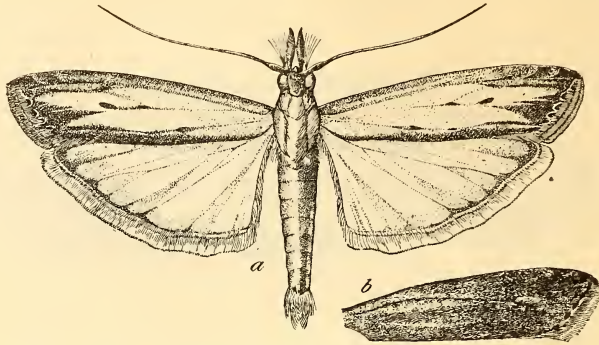


FIG. 5.—The lesser corn-stalk borer: a, Male moth; b, forewing of female moth. Greatly enlarged.

larva is slightly over an inch long, has a black head, which is spotted with orange near the mandibles, and a yellow body, dotted with black. A median black line and two yellowish lines are found on the dorsal surface, and a yellowish stripe runs along on each side. The neck is very narrow and the head very prominent. Five molts occur during the larval period, which covers from 14 to 20 days.

The pupa.—The pupa is about three-fourths inch long and is lustrous brown, but within a few days after pupation becomes coated with white. The pupal period lasts from 6 to 10 days.



FIG. 6.—*Nacoleia indicata*: Male moth. Enlarged.

The adult.—The adult skipper butterfly has a wing expanse from $1\frac{1}{2}$ to 2 inches. The forewings are brown, marked with white. The hind wings are tailed, of brown color, and have a white line along the outer margin. The thorax and wings are clothed with lustrous green hairs.

CONTROL.

The bean leaf-roller is controlled by two parasites, a tachinid-fly larva (*Exorista pyste*) and a chalcid-fly larva (*Chalcis robusta*).

BEAN POD-BORER (*Fundella cistipennis*).

The larvæ of the bean pod-borer have been found abundantly present in the pods of *Canavalia* spp., and a few specimens have been reared from cowpeas. They are taken from seed pods of *Canavalia* every month of the year, but the broods reach their height in August, October, December, February, and April. This insect seems to undergo a dormant period during May, June, and July. At the experiment station the life history of the bean pod-borer was followed during August, February, and April.

The egg.—The eggs are deposited singly at any place along the seed pod, are of grayish-green color, and require from five to eight days to hatch.

The larva.—Upon hatching the larva is small, has a yellowish-white body and a light-brown head.

It feeds from three to five days on the outer part of the pod, and occasionally bores through it. The pea of the cowpea and the fleshy part of the *Canavalia* pod are eaten, but the bean is seldom touched. The full-grown larva is about half an inch long, has a black or dark-brown head, and a lustrous grayish white, almost pearly, body, which is sparsely covered with hair. The segments are often tinged with pink. The ventral surface of the body is lighter than the dorsal surface. Before transforming to the pupal stage it becomes bluish-green. The larva is active when disturbed. The larval period lasts from 14 to 25 days.

The pupa.—Pupation takes place in a tough, finely woven, grayish-brown cocoon, which is made inconspicuous by its covering of grass. The pupa is from three-eighths to half an inch long and is of brown color. The pupal period lasts from 14 to 18 days.

The adult.—The adult moth has a wing expanse of from five-eighths to seven-eighths inch. The forewings are blue-gray and have a dark-brown or black spot in the center at about one-third the distance from the base. The hind wings are a lustrous pearly-white and are bordered on the outer margin with gray.

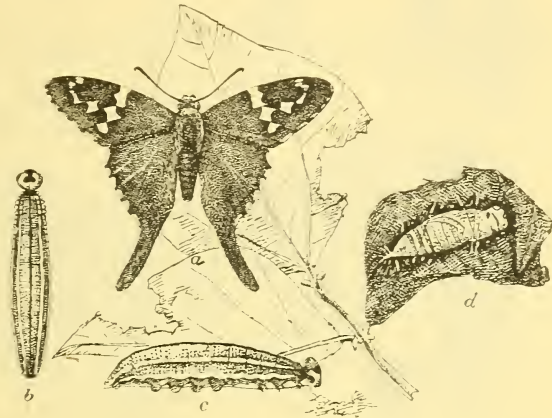


FIG. 7.—*Eudamus proteus*: a, Butterfly; b, larva, dorsal view; c, larva, lateral view; d, chrysalis in rolled-up leaf, somewhat enlarged.

CONTROL.

The destruction of infested pods is recommended for the control of the bean pod-borer.

INSECT PESTS ATTACKING BEETS AND CHARD.

HAWAIIAN BEET WEBWORM (*Zinckenia fascialis*).

The Hawaiian beet webworm is a widely distributed species, being found in the United States, South America, southern Europe, Australia, South Africa, Madagascar, Japan, Hawaii, Haiti, Porto Rico, and the Virgin Islands. It is undoubtedly indigenous to the Tropics. In St. Croix it feeds on *Amaranthus* spp., beets, carrots, purslane, eggplant, and wild cucumber. It prefers all species of *Amaranthus*, as well as beets and young carrots.

Specimens are found every month in the year, but the most destructive broods to truck crops occur in October and November, and in February and March.

The egg.—The eggs are smooth, of creamy white color, and are deposited singly, in pairs, or in rows on the underside of the leaf. They are, for the most part, found along the midrib in beets, and hatch in about four days. (Fig. 8.)

The larva.—The young larvæ feed on the underside of the leaf, and when nearly mature eat the whole leaf. They are about three-fourths inch long, of yellowish-white or green color, and do

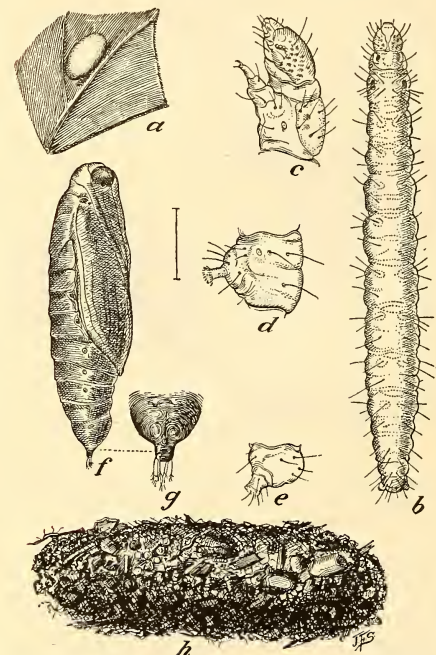


FIG. 8.—Hawaiian beetle webworm: a, Egg on leaf; b, larva, dorsal view; c, larva, head and first thoracic segment; d, abdominal segment, lateral view; e, anal segment; f, pupa, lateral view; g, cremaster; h, cocoon. All enlarged.

considerable damage to beets by webbing the leaves together and skeletonizing them. Development is completed in from 10 to 15 days. The mature larva crawls down the stems and forms a cocoon just beneath the surface of the soil, where it pupates.

The pupa.—The cocoons are oblong and consist of particles of dirt and trash which have been webbed together with silken threads. About two days after the cocoon is constructed the larva transforms into a pale-brown pupa having a smooth, lustrous surface.

The adult.—The adult moth is very active. The forewings are rather narrow and are banded with white. The hind wings bear

a white band which meets the inner white band of the forewings when the wings are spread. The wings are dark brownish-black. (Fig. 9.)

CONTROL.

Natural enemies.—The gray kingbird (*Tyrannus dominicensis dominicensis*), locally known as the "chittery," has been observed to catch the adult moths which fly about the beets or *Amaranthus* spp., and the black witch (*Crotophaga ani*) to pick the larvæ from the leaves. Chickens are very fond of the larvæ, but the injury they do to the garden offsets their good.

A ground-beetle (*Calosoma* spp.), which is often found around beets and *Amaranthus* spp., undoubtedly eats the larvæ of the Hawaiian beet webworm.

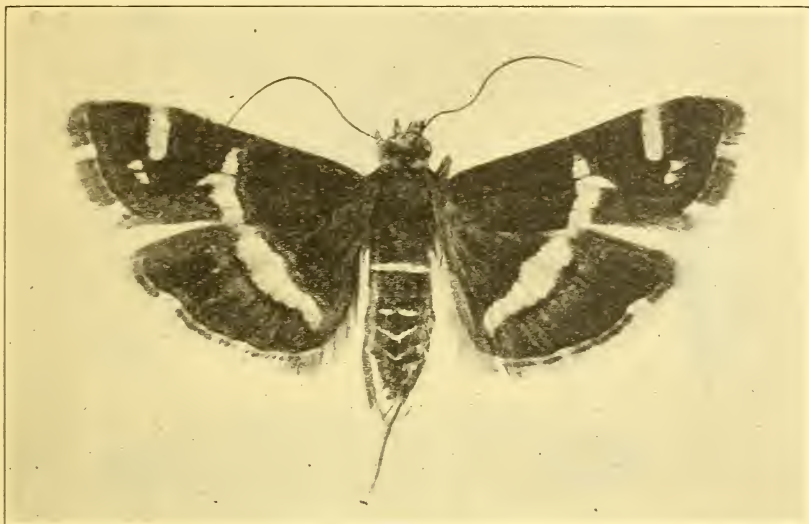


FIG. 9.—The Hawaiian beet webworm (*Zinckenia fascialis*): Female moth. Enlarged.

Parasites are very important in the control of the Hawaiian beet webworm. The species reared from larvæ, collected in the field, have included *Exorista pyste*, *Argyrophylax albincisa*, *Eiphosoma annulatum*, *Enicospilus concolor*, and *Chalcis ovata*. Probably *Exorista pyste* is the most important of the parasites. *Enicospilus concolor* is often seen in the beet patches, but only one specimen has been reared from larvæ taken in the field, and the writer is not certain whether this was obtained from *Z. fascialis* or *Pachyzancla bipunctalis*, as the record was accidentally destroyed.

Between February 20 and March 20 there were placed in breeding cages 210 larvæ of *Z. fascialis*, and there were obtained from them 52 specimens of *E. pyste*, 8 of *A. albincisa*, 8 of *E. annulatum*, and 1 of *C. ovata*. Practically 33 per cent of the larvæ were parasitized.

The highest percentage of parasitism occurred on March 20, when 50.5 per cent of the larvæ were parasitized. The fly *Exorista pyste* was found to be the most common parasite of *Z. fascialis*. Of the

210 larvæ collected from February 20 to March 20, fully 26 per cent were parasitized by this fly.

CONTROL.

Arsenicals.—Paris green and air-slaked lime, 1 to 8 parts, respectively, or arsenate of lead and air-slaked lime in equal parts, have given satisfactory results as a control measure.

SOUTHERN BEET WEBWORM (*Pachyzancla bipunctalis*).

The southern beet webworm is a widely distributed species, being found in South Africa, South America, the West Indies, and the

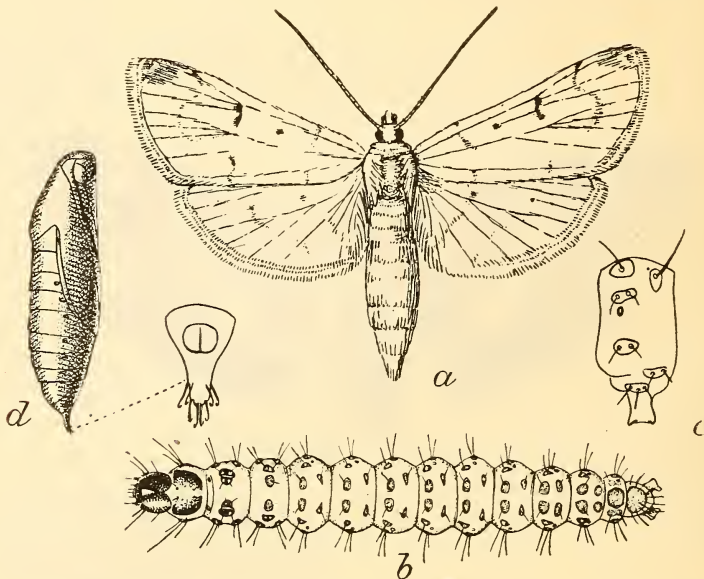


FIG. 10.—Southern beet webworm (*Pachyzancla bipunctalis*): a, Moth; b, larva; c, lateral view of first proleg and abdominal segment of larva; d, pupa, with cremaster showing location of hooks at right. a, b, d, About three times natural size.

southern part of the United States. Like the Hawaiian beet webworm, the southern beet webworm feeds on *Amaranthus* spp., beets, young carrots, purslane, and spinach. (Fig. 10.)

The egg.—The eggs, which are flattened somewhat against the surface upon which they are deposited, are laid in small groups of four or five, usually on the underside of the leaf. They are of yellowish color and hatch in from four to six days.

The larva.—The young larva is yellowish in color and becomes darker as it develops. The mature larva is about three-fourths inch long and of a dark, dirty green color. The head is dark brown or brownish-black. Before pupating the larva feeds from 12 to 20 days, depending upon drought conditions. It folds the leaves together, or webs two leaves, and conceals itself within the shelter thus afforded. While sheltered it skeletonizes the leaves.

The pupa.—The pupa, which is dark brown in color and about two-fifths inch long, is formed in the webbed leaves. The pupal period lasts from 6 to 10 days.

The adult.—The adult moth varies in color from yellowish-gray to buff and is very active when disturbed. It has a wing expanse of approximately 1 inch. The wing markings are almost inconspicuous on the pale forms, but three distinct black dots are found near the anterior margin of the forewing on the dark forms. Both the forewings and the hind wings are crossed transversely by narrow, wavy lines. Two small black dots are found on the anterior margin of the third abdominal segment.

CONTROL.

Parasites.—Only one parasite (*Exorista pyste*) has been reared from *P. bipunctalis*. Specimens of larvæ collected in the field during February and March showed 12½ per cent parasitism by this fly. It is likely that *P. bipunctalis* is parasitized by the same insects as is *Z. fascialis*.

Arsenicals.—The arsenicals used for the control of the Hawaiian beet webworm are also used for the southern beet webworm.

GARDEN WEBWORM (*Loxostege similis*).

The garden webworm, or beet webworm, is found throughout the United States, South America, and the West Indies. It feeds on *Amaranthus* spp., from which it migrates to beets. There are no sharply defined generations in St. Croix. The larvæ are found every month in the year, but are most destructive in October, November, February, and April. They injure the beet by webbing the leaves.

The egg.—The eggs are deposited singly or in rows, rarely in patches, on the underside of the leaf, and hatch in from three to five days, depending upon moisture conditions. When first laid, they are of creamy-white color.

The larva.—The young larvæ are yellowish-white in color and have black heads. They become dark as they develop and are greenish-brown when fully grown. At this time they are about three-fourths inch long. Three black dots form a triangle on each side near the back of each body segment, and a short, stiff hair arises from each dot. The larvæ mature in about three weeks and enter the soil to pupate.

The pupa.—Pupation takes place in a silken cocoon which is formed very close to the surface of the soil. The pupa is of light-brown color and is pointed at both ends. The pupal period lasts from 8 to 10 days.

The adult.—The moth has a wing expanse of about 1 inch, is dark gray to reddish-brown in color and very active.

CONTROL.

The garden webworm can be controlled by the destruction of all species of *Amaranthus*, which is its native food plant.

A TROPICAL CATERPILLAR (*Xylomiges sunia*).

The egg.—The eggs of a tropical caterpillar (*Xylomiges sunia*) are deposited in clusters of 200 and 300 on the underside of the leaves

of the castor bean, cotton, beet, and chard. They are covered with light-gray down from the body of the female. They are light green in color and hatch in from four to eight days.

The larva.—The larva matures in from 12 to 20 days and is from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long when it is fully grown. The dorsal surface is marked with velvety black patches, and the sides are banded with yellow.

The pupa.—Pupation takes place in the soil, the pupal period lasting from 10 to 12 days. The pupa is a lustrous smooth brown.

The adult.—The moth has a wing expanse of from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches. The forewings are grayish-brown and the hind wings are a glistening pearly-white.

The tropical caterpillar has not been commonly found on beets, but was very destructive to chard in October, 1920.

CONTROL.

Dusting the beet plants with arsenate of lead and air-slaked lime in equal parts has given satisfactory results as a control measure at the experiment station.

INSECT PESTS ATTACKING BROCCOLI, CABBAGE, CAULIFLOWER, AND KOHL-RABI.

SOUTHERN CABBAGE BUTTERFLY (*Pontia monuste*).

The larvæ of the southern cabbage butterfly feed on cabbage, cauliflower, Chinese cabbage, kohl-rabi, Chinese mustard, mustard, radish, turnip, and kale leaves. They are also occasionally taken from various species of cruciferous weeds.

The egg.—From 3 to 27 eggs are deposited in clusters, each cluster usually averaging between 8 and 14 eggs. The eggs are bright yellowish-orange in color and hatch in from two to five days.

The larva.—The larva is grayish-green in color and is sprinkled with hair. The full-grown larva is about $1\frac{1}{2}$ inches long and of grayish-green color blotched with yellow. The body is thickly covered with grayish hairs and is marked with four longitudinal stripes on the dorsal surface. The caterpillars are very destructive to the leaves of host plants during the 14 to 20 days covering the larval period.

The pupa.—Pupation usually occurs on the underside of the leaf or in some other sheltered place. The pupa is about an inch long, is naked, of grayish-brown color, and hangs from the leaf by silken threads attached to the posterior end and middle of the body. The pupal period lasts from 8 to 12 days.

The adult.—The adult has a wing expanse of about 3 inches. The butterfly is white, marked with brown or black on the outer margin of the forewings. (Fig. 11.)

CONTROL.

The larvæ of the southern cabbage butterfly may be held in check by the use of arsenicals as recommended for the control of the diamond-back moth.

DIAMOND-BACK MOTH (*Plutella maculipennis*).

The diamond-back moth is a cosmopolitan species, being found throughout the United States, Europe, Hawaii, Porto Rico, and the Virgin Islands. (Fig. 12.)

The egg.—The eggs are of greenish-white or yellowish color and are small and scale-like. They are deposited singly, and any number of them may be found on the underside of the same leaf. They hatch in from 10 to 15 days.

The larva.—The young larva is of yellowish-white color and has a black head. It matures in from 14 to 18 days and is about three-eighths inch long, of a dirty-green color, and very active when disturbed. The head is light yellow and is marked with brown. The mature larva spins a loosely constructed cocoon of grayish or white



FIG. 11.—*Pontia monuste*: Male butterfly. Much enlarged.

silken threads on the underside of the leaf, usually along the midrib, and pupates within.

In St. Croix the larvæ and adults appear the latter part of November and gradually increase in numbers until the early part of March. Decrease in numbers continues from this time until about the middle of May, when they disappear. They feed on various cruciferous plants and skeletonize the leaves.

The pupa.—The pupa is of light yellow color and about one-fourth inch long. The pupal period lasts from 10 to 15 days.

The adult.—The moth has a wing expanse of one-half to five-eighths inch. The wings are gray or brownish-gray, with lighter markings. The diamond-back moth is so called from the fact that its wings when folded exhibit a row of whitish diamond-shaped markings along their junction.

CONTROL.

Paris green and air-slaked lime in parts 1 to 8, and arsenate of lead and air-slaked lime in equal parts, both gave satisfactory re-

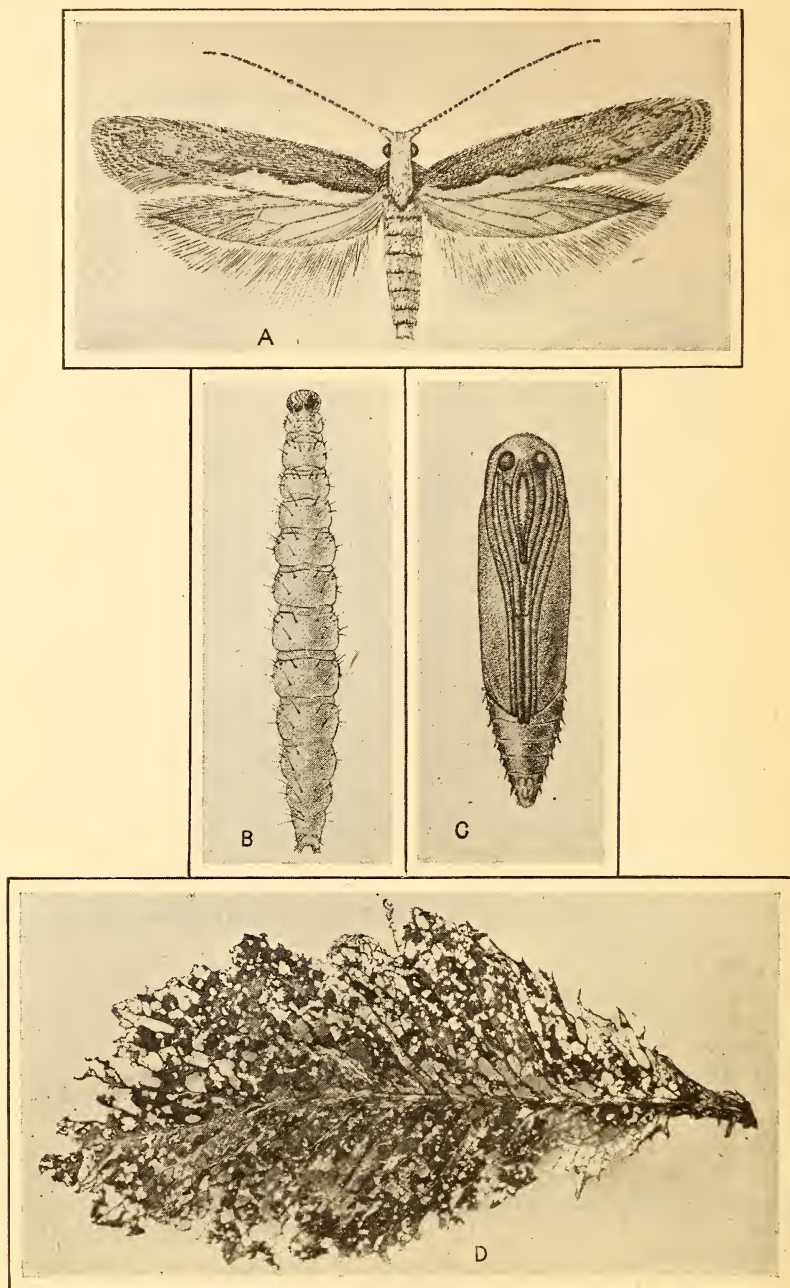


FIG. 12.—*Plutella maculipennis*: A, adult, much enlarged; B, larva, enlarged; C, pupa, enlarged; D, leaf of mustard, showing injury by insect.

sults as control measures at the experiment station. In January, 1922, a few cabbage plants made good growth when sprayed with arsenate of lead and soap, 4 and 5 pounds, respectively, to 50 gallons of water.

WHITE FLY (*Bemisia inconspicua*).

The larvæ and pupæ of the white fly are found on the underside of the leaves of beans, sweet potatoes, and cruciferous plants. The eggs are deposited on the underside of the leaf and hatch in about six days. After crawling about the leaf for a short time, the larvæ insert their beaks into the tissue and begin feeding. At this time they are inconspicuous and resemble the color of the leaf. During periods of drought they do severe damage by sucking the plant juices from the leaves. When they are full grown, the larvæ transform into pupæ which vary somewhat in size and are more or less oval in outline. The pupæ are of pale yellowish color and have serrated margins. The adult is small and of yellowish-white color.

CONTROL.

The use of 2 pounds of whale-oil soap to 5 gallons of water, sprayed with some force on the underside of the leaf, gave satisfactory results at the experiment station.

The larvæ of the ladybird beetle (*Cycloneda sanguinea*) eat large numbers of the larvæ and pupæ of this insect pest.

INSECT ENEMIES OF CARROTS.

Zinckenia fascialis, *Pachyzancla bipunctalis*, *Loxostege bifidalis*, and *L. similalis* have severely damaged carrots at the experiment station. (For life histories and methods of control, see beet insect pests.)

INSECT ENEMIES OF CORN.

CORN LEAFHOPPER (*Dicranotropis maidis*).

The corn fulgorid, or corn leafhopper as it is sometimes called, severely damages corn and Hopi maize throughout the year in St. Croix. Nymphs and adults can be found from the time the corn germinates until it is harvested. The pest attacks the upper surface of the midrib of the leaves near their union with the stalk, punctures both leaves and stalk, and sucks the juice from the plant. Damage is more noticeable in wet weather than during periods of drought. After the leafhoppers have fed on the corn plant for a few days the leaves become parched and dry, and the plant looks as if it had been burned. When severely infested, the plant dies.

The egg.—The eggs are deposited on the funnel-shaped terminal leaves, and are of yellowish-white color, small, and somewhat flask-shaped. When the eggs are about ready to hatch the black eyes of the nymphs can be seen through the shell. From 8 to 12 days are required for hatching, depending upon the temperature.

The nymphs.—The eggs hatch into wingless nymphs which acquire wing growth with each successive molt. They molt five times and mature in between 15 and 20 days.

The adult.—The adults are of bluish-gray color. The wings are delicately constructed and have tips somewhat mottled with black. The head and thorax are brownish-yellow. Both nymphs and adults are very active.

CONTROL.

The contact insecticides used were carbolineum, tobacco wash, and whale-oil soap tobacco wash, none of which gave satisfactory results.

The carbolineum insecticide was diluted 1 part to 100 parts water. This treatment was discontinued because very few leafhopper adults or nymphs were killed and probably about 75 per cent of the corn

plants were badly burned, while probably 25 per cent of the plants were killed.

The tobacco wash was used on a plot of 10 rows, the solution being diluted 1 to 50 parts water. One spraying showed that about 50 per cent of the adults and nymphs were killed, and, also, that at least 50 per cent of the corn plants were either badly burned or killed. Spraying with this solution was therefore discontinued.

The spray next tried for control was a homemade solution of whale-oil soap and tobacco

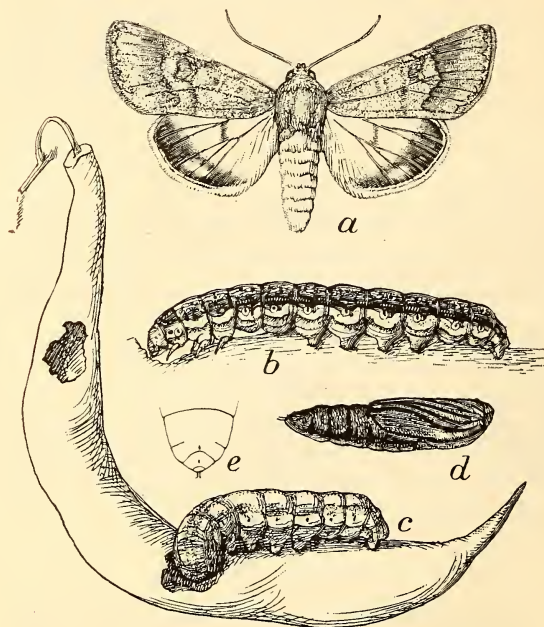


FIG. 13.—*Heliothis obsoleta*: a, Adult moth; b, dark full-grown larva; c, light-colored full-grown larva; d, pupa, natural size.

bacco water, 1 pound of whale-oil soap being completely dissolved in 6 gallons of water and 1 pound of leaf tobacco or stems being steeped in 2 gallons of water. The whale-oil soap solution and tobacco were mixed and used without diluting. The results obtained, while not satisfactory, were an improvement over the two former solutions. About 25 per cent of the corn plants were severely burned, but at least 50 per cent of the nymphs and adults were destroyed. Further experiments with this solution should be made before it is discarded as useless.

CORN EARWORM (*Heliothis obsoleta*).

The corn earworm, also known as the tomato fruit worm, bollworm, cotton bollworm, and budworm, is found in most of the temperate and tropical regions of the world. (Fig. 13.) The larvæ are

very destructive to corn from the time the plants are 8 or 10 inches high until the crop is gathered. All varieties of sweet corn are more susceptible than field varieties to attack. (Fig. 14.)

The egg.—The eggs, which are small and white, are deposited on the leaf or fruit of the host plant and hatch in from two and one-half to seven days.

The larva.—The young larvæ feed upon the shell from which they emerge, and then upon the host plant. They are of yellowish-white color, have a black head, and molt six times during the larval period. The full-grown larvæ vary greatly in color, ranging from pale green, pinkish, and gray-green to light and dark brown, grayish black, or almost black. The mature larva is about $1\frac{1}{2}$ inches long. (Fig. 15.)

The pupa.—Pupation takes place in an earthen cell which is formed at a depth of from 2 to 4 inches below the surface of the ground. The pupa is brown and has a shiny surface. The pupal period lasts from 14 to 18 days.

CONTROL.

No satisfactory control has been had at the experiment station from the use of arsenicals, and picking by hand is considered too expensive a task to be of value.

Parasites reared from the corn earworm included the Hymenoptera, *Chalcis*, spp., *Spilochalcis femorata*, *S. vittata*, and *Enicospilus concolor*, and the dipteran, *Exorista pyste*. A predacious ground beetle (*Calosoma* sp.) eats the larvæ when they drop from the plant to pupate. The adult moths are caught by the gray kingbird and the black witch.

SUGAR-CANE MOTH BORER (*Diatræa saccharalis*).

The sugar-cane moth borer was first reported as a pest to cane by Guiling in 1828 in the West Indies. It is now found throughout the tropical and subtropical regions of the Western Hemisphere. In St. Croix the pest has been taken from corn, elephant grass, Guatemala grass, Hopi maize, Para grass (*Panicum barbinode*), and sugar cane. Its attacks on corn are confined to the mature stalks. During February and March, 1921, the sugar-cane moth borer was found in every stalk growing on an experimental plat at the experiment station. The plat was near a cane plat, which probably accounts for the high percentage of infestation. Hopi maize was more readily attacked than corn, and considerable injury was done before the stalks reached maturity.

The egg.—Creamy white when deposited, the flat, scale-like eggs gradually turn dark, becoming reddish-brown just before they hatch. They are laid on the underside of the leaf in rows, overlapping one another in shingle fashion and hatch in from five to six days.

The larva.—The young larva is hairy and of dark color, but gradually becomes light, and when full grown is dirty-white covered with dark spots, each of which bears a short, dark bristle. The full-grown larva is about 1 inch long and has a dark-brown head. It completes its development in from 20 to 35 days, depending upon the food supply and climatic conditions.

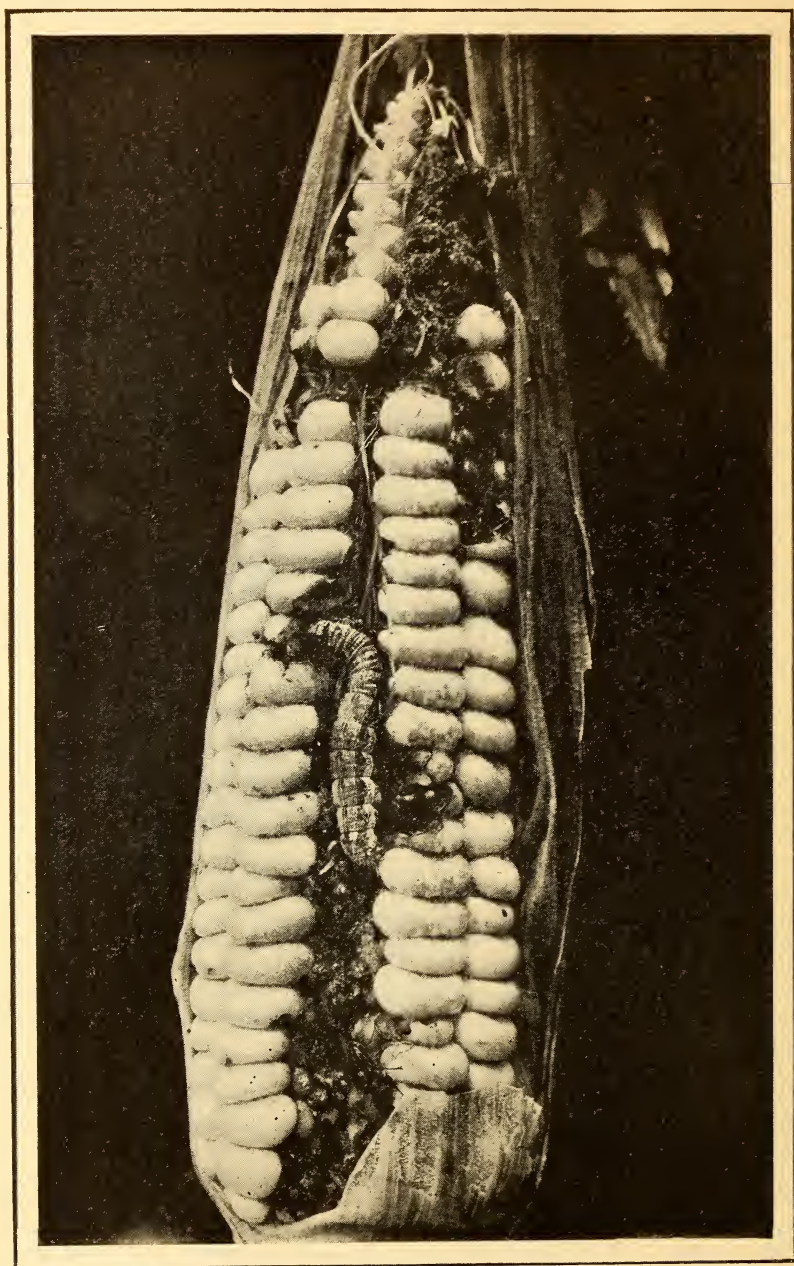


FIG. 14.—Corn earworm and its injury to ear of corn.

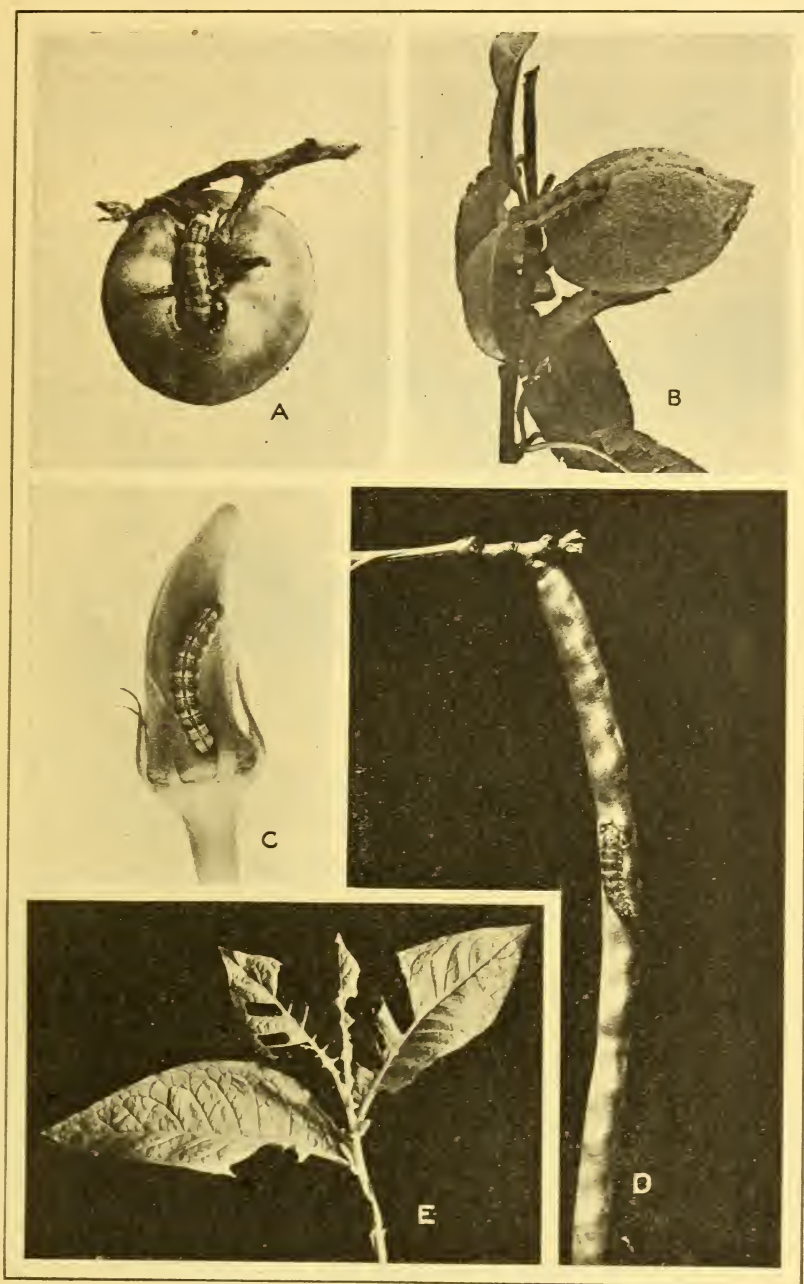


FIG. 15 —Corn earworm boring into. A, tomato; B, peach; C, okra pod; D, cowpea; E, growing tip of tobacco plant injured by cornworm.

The pupa.—The pupa is slightly over three-fourths inch long, of brown color, and, with the exception of the posterior end, is smooth. The pupal period lasts from 7 to 10 days.

The adult.—The wing expanse of the adult is from three-fourths to 1½ inches. The forewings are light-brown and usually bear two rows of rather distinct dark-brown dots which run diagonally across the outer half of the wing. The hind wings are a lustrous white.

CONTROL.

Corn or Hopi maize stalks which are infested with the sugar-cane stalk borer should be cut and burned as soon as the crop is harvested.

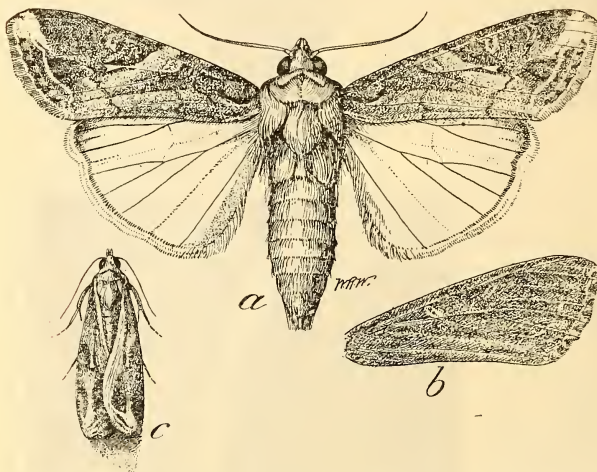


FIG. 16.—The fall army worm: *a*, Male moth; *b*, right front wing of female moth; *c*, moth in resting position; *a*, *b*, about twice natural size; *c*, very slightly enlarged.

Larvæ, collected from corn stalks, were found parasitized by the tachinid fly (*Exorista pyste*).

A parasitic fungus (*Cordyceps barberi*) often attacks the larvæ.

FALL ARMY WORM
(*Laphygma frugiperda*).

The damage done by the grass worm, fall army worm, southern

grass worm, and corn earworm, as it is occasionally called, is equaled only by that done by *Heliothis obsoleta*. The work of the two species is similar, and the larvæ of one is often mistaken for those of the other. (Fig. 16.)

The egg.—The eggs are deposited at night in clusters of from 50 to 400. They vary in color from light gray to pearly-white and for the most part are covered with grayish down from the moth's body, and hatch in from two to six days.

The larva.—The larvæ feed upon the shell from which they emerge and then upon blades of grass. The young larva has a jet-black head and a white body, which darkens with age. Four molts occur during the larval period, the first occurring the first day, the second in one and one-half to two days, the third in from two to four days, and the fourth in from two and one-half to four days. From 7 to 12 days are therefore required for maturity. The full-grown larva is about 1½ inches long and varies in color from light greenish-yellow to almost black. A wavy line adorns each side of the body and three narrow yellow stripes run along the back. On the dorsal surface of each segment there are four black dots, and the front part of the

head is marked with a white inverted Y. The full-grown larva enters the soil to pupate.

The pupa.—The pupa is incased in an earthen cell from one-half to 2 inches beneath the soil surface. The pupal period lasts from 10 to 14 days.

The adult.—The moth varies greatly in color; but usually has a gray body, front wings that shade from dark gray to brown mottled with black and white, and hind wings that are lustrous white. The wing expanse is from $1\frac{1}{4}$ to almost $1\frac{1}{2}$ inches.

CONTROL.

Arsenicals have not been found to be of practical value for use in controlling the larvæ of *L. frugiperda* on corn. The damage caused by the burning of the leaves is almost as severe as the injury inflicted by the worms.

Natural enemies attacking the corn earworm are the gray kingbird, the black witch, chickens, the ground beetle; hymenopterous insects, including *Chalcis* spp., *Spilochalcis femorata*, *S. vittata*, and *Enicospilus concolor*; and a dipterous parasite (*Exorista pygme*). Lizards and ants also destroy the larvæ.

ROOT GRUBS (*Ligyrus tumulosus*).

The larvæ are white grubs having brown heads. The adults are rather robust, hairy, medium-sized beetles of dark-brown color. Both larvæ and adults may eat the cornstalk below the surface of the ground, but such an attack is considered as accidental. They are rarely found in any but manured fields. Pen manure contains numerous grubs which may be introduced into the field with the manure.

No control measures are needed for this species.

INSECT PESTS OF CUCUMBER, MELON, AND SQUASH.

MELON WORM (*Diaphania hyalinata*).

The melon worm is the most injurious pest of cucurbits in St. Croix. It attacks the muskmelon more severely than it does the other cucurbits.

The egg.—The eggs are deposited on the underside of the leaf. They are white, somewhat rounded, and hatch in from three to five days.

The larva.—The larvæ are pale green or yellowish-green in color and from three-fourths to 1 inch long. They complete their development in from 14 to 20 days, and develop more rapidly during the damp rainy weather from September to January than at any other time. Drought conditions retard their development. The larvæ feed in a retreat afforded by the folding of the leaf or the webbing of two leaves with silk which they spin. They destroy the leaves while feeding upon them and bore into the stalk and melons.

The pupa.—Pupation takes place in a loosely woven cocoon which is made in the folded leaf. The pupa is smooth and of a lustrous light-brown color. The duration of the pupal period is five days.

The adult.—The moth has a wing expanse of about 1 inch. The wings are pearly white bordered with blackish-brown. The upper surface of the anterior third of the thorax is brownish-black. The abdomen terminates in a brush of shiny yellow, elongated scales.

CONTROL.

The melon worm may be partly controlled by dusting the plants with 1 part Paris green to 8 or 10 parts air-slaked lime, or arsenate of lead and air-slaked lime in equal parts.

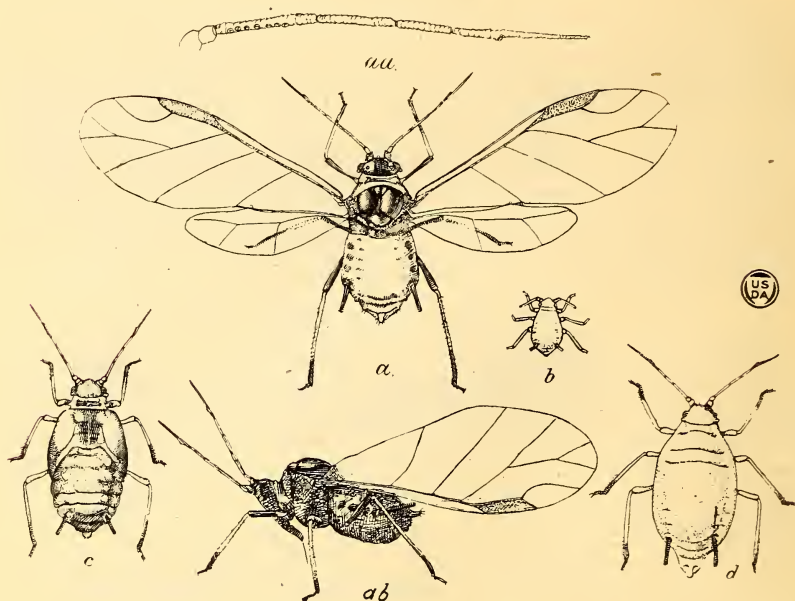


FIG. 17.—*Aphis gossypii*: *a*, Winged female; *aa*, enlarged antennæ of same; *ab*, dark female, side view; *b*, young nymph or larva; *c*, last stage of nymph; *d*, winged female. All greatly enlarged.

MELON APHIS (*Aphis gossypii*).

The melon aphid, also commonly known as the plant louse, cotton aphid, and cotton louse, is one of the most destructive pests of cucurbits. (Fig. 17.) It causes the leaves to assume a curled and blistered appearance and seriously checks the growth of the young plant by sucking the sap. Both winged and wingless forms occur in the same colonies, a few of which may be found at any time of the year. Both forms vary in color from yellowish to deep olive green or almost black, and have pale yellow legs and antennæ.

CONTROL.

The melon aphid is controlled to a large extent by two natural enemies, a parasitic hymenopteron (*Lysiphlebus testaceipes*) and a predaceous ladybird beetle, usually called the "red ladybird" (*Cycloneda sanguinea*). The larvæ and adults of *C. sanguinea* feed upon the aphid colonies. The ladybird beetle lays from three to

seven eggs in clusters on the underside of the leaf. These soon hatch into oblong, blackish-red grubs having sides beset with spines. The full-grown larva suspends itself by its posterior end and transforms into a pupa. The adult is rounded, somewhat convex, and has dull reddish-yellow colored elytra, with a black head marked in front with white. The thorax is black bordered with white.

INSECT PESTS ON EGGPLANT.

TOBACCO FLEA-BEETLE (*Epitrix parvula*).

The presence of the tobacco flea-beetle may be detected by the appearance of small brown patches on the leaves on which they are feeding. In extreme cases the leaves are killed. During February, March, and April eggplants which were severely attacked by this pest wilted and died. It is thought that the flea-beetle transmitted an organism (*Bacillus solanacearum*) which caused the death of the plants. Flea-beetles have been taken from *Amaranthus* spp., purslane, hollow stock (*Leonotis nepetæfolia*), the fireweed (*Datura metel*), and tobacco, as well as from eggplants. The fireweed is probably the native host of *E. parvula*. Both larvæ and pupæ were found on the roots of this plant in April, 1922.

The egg.—The egg varies from 0.4 to 0.5 mm. in length and from 0.15 to 0.2 mm. in width. It is of grayish color, is deposited in the soil surrounding the roots of the plant, and hatches in about four days.

The larva.—The white or yellowish-white larvæ are small and threadlike. After feeding on the roots of the host plant for about 18 days they transform into pupæ.

The pupa.—The pupa is of white color and is formed in the soil. The pupal period covers from 6 to 10 days.

The adult.—The adult is of dull reddish-yellow color. The middle of the elytra of nearly all specimens found in St. Croix is crossed by a fuscous transverse cloud. The abdomen is brown and the legs and antennæ are pale reddish-yellow, with the exception of the hind femora and the four distal joints of the antennæ, which usually are darker. The thorax is not narrowed in front, is convex and lustrous, about twice as wide as it is long, and is covered with short, semierect hairs. The surface is distinctly punctate, although the punctures are fine and rather sparse. The elytra are slightly wider than the thorax and the punctures are rather coarse, but not crowded together. The dorsal surface bears short semierect hairs, which are arranged in a single row on each interval of the elytra.

INSECT PESTS OF LETTUCE.

LETTUCE LOOPER (*Plusia ni*).

The lettuce looper is occasionally present in such numbers as to cause considerable injury to lettuce. The larvæ are voracious feeders and have been taken from lettuce, kohl-rabi, tomato, and one species of cruciferous weed.

The egg.—The eggs are of pale yellowish-green color and are found scattered over the surface of the leaf. They hatch in from five to seven days.

The larva.—The larva is of pale-green color and travels over the leaves with a looping movement. It requires about three weeks for development and at maturity is 1 or 1½ inches long. The larva folds over the lettuce leaf and spins within the retreat thus afforded a strong, tough, white, semitransparent silken cocoon. It transforms into a pupa in from one to two days after making the cocoon.

The pupa.—The pupa is about one-half inch long and is inclosed in a cocoon. The dorsal side of the pupa is brown, and the ventral surface is light yellowish-brown. The pupal period covers from 10 to 12 days.

The adult.—The moth has a wing expanse of slightly more than 1½ inches. The forewings are gray, mottled with brown and white. A white spot, which varies considerably in shape with different individuals, adorns the center of the wing. The hind wings are mouse colored. The ventral surface of both wings is light brownish-gray and both the upper and lower surfaces glisten.

CONTROL.

The lettuce looper is parasitized by the tachinid fly (*Exorista pyste*).

INSECT PESTS ATTACKING MUSTARD, CHINESE CABBAGE, AND CHINESE MUSTARD.

MUSTARD LEAF-MINER (*Agromyza pusilla*).

The mustard leaf-miner is a very injurious pest to most of the cruciferous crops, especially to mustard and Chinese cabbage. The insects appear on the leaves about the first part of January, and practically every leaf is filled with larvæ by February and March. On January 31, 1921, 2,128 larvæ were taken from one leaf of elephant-ear mustard at the experiment station. The larva feeds within the leaf tissue. The full-grown worm is of pale-yellow color, very active, and when ready to pupate drops to the ground from the leaf in which it has been feeding. The larval period lasts from 10 to 15 days. The pupa is small and of light yellowish-brown color. The pupal period lasts from 8 to 10 days. The adult fly is small and of brownish-black color, with ventral surface and legs of lighter shade. At the experiment station adults have remained alive in jars for 10 days.

CONTROL.

The only methods used at the experiment station were those of picking and destroying infested leaves and the placing of trap pans, containing water having a kerosene film, between the rows. The former method was very satisfactory.

When they fall to the ground to pupate, the larvæ are frequently destroyed by ants.

MUSTARD STEM BORER (*Hellula phidilealis*).

The larvæ of the mustard stem borer have been taken from Chinese cabbage, mustard, cabbage, and kohl-rabi, the first two of which they severely damage.

The egg.—The grayish-white egg is flat and scale-like, and is deposited near the midrib of young leaves.

The larva.—The full-grown larva is about half an inch long and of a yellowish-gray color. A faint brownish-red stripe, flanked on each side by two conspicuous brownish-red wavy bands, runs along the center of the dorsal surface. After feeding for a short time on the surface of the leaf the larvæ tunnel the midrib of the leaf or eat the heart of the plant and bore into the stem. When tunneling the midrib they push the excrement toward the entrance hole, forming along the midrib a pile of frass which shows the location of the grub. The feeding period lasts from 14 to 20 days. The full-grown larva spins a rather compact white cocoon at the entrance of the tunnel and enters to pupate. After spinning the cocoon the larva becomes very sluggish, shrinks in length, and assumes a deep gray color, while the stripes on the dorsal surface practically disappear.

The pupa.—Pupation takes place in from one and one-half to two days after the cocoon is spun. The pupa is small, of light yellowish-brown color, and about three-eighths inch long. It is covered with a peculiar white flocculent coating. The pupal period lasts from 5 to 10 days.

The adult.—The moth has a wing expanse of from three-eighths to five-eighths inch. The upper surface of the forewings is grayish, much mottled with brown. An elongated black spot adorns these wings at about one-third the distance from the outer margin. The hind wings are a lustrous white bordered with gray. The ventral surface is a lustrous uniform brownish gray, except for the apical black spot adorning the upper surface. The eyes are dark brown.

CONTROL.

The larvæ of this moth are parasitized by a tachinid fly (*Exorista pyste*).

Pulling and destroying the infested leaves destroys the larvæ.

INSECT PESTS OF OKRA.

WEST INDIAN SUGAR-CANE ROOT-BORER (*Diaprepes abbreviatus*).

The West Indian sugar-cane root-borer is often very destructive to okra plants about the time they commence to flower. The adult beetles feed on the tender growth of the plant, destroying both leaf and flower buds. One large brood occurs from the last of September to the middle of October, but some adults are found every month in the year feeding on a large variety of plants.

The egg.—The eggs are oblong, of a shining white color, and are deposited on the surface of the leaf, usually on sugar cane or grass. They are concealed within the folds of the leaf or between two leaves that have been folded together by the female, and hatch in from 7 to 10 days.

The larva.—When the young larvæ drop to the ground they begin to feed on the roots of the okra plant or to tunnel under the sugar-cane plant. Having a white or slightly yellowish-brown body and a brown head, the larva gradually turns into a light yellowish-brown

grub which is curved and footless. From 8 to 10 months are required for development. During March larvæ measuring from 4 to 20 mm. were found at the experiment station.

The pupa.—Before pupating the larva forms an earthen cell in which transformation takes place. The pupa is very soft and of yellowish-white color. The pupal period lasts about a month.

The adult.—The adult is grayish-green, has a somewhat striated elytra, the striæ usually numbering four, a thick beak, and long and rather elbowed antennæ. The dorsal surface of the thorax and elytra are coarsely punctate. An ochraceous stripe passes backward along the lower margin of the elytra, on the lateral side of the thorax, posterior to the eye. The ventral surface and legs are slate gray.

CONTROL.

Picking the adult beetles by hand has given the most satisfaction as a control measure at the experiment station.

Among the important natural enemies are the gray kingbird and the black witch.

TOBACCO BUDWORM (*Heliothis virescens*).

The larvæ of the tobacco budworm were commonly found boring into okra pods during December, January, February, and March. They vary greatly in color, ranging from pale yellowish-green and grayish-green to light and dark brown, grayish-black, or almost black. They exhibit a marked cannibalistic tendency when confined in breeding cages. Of 25 larvæ placed in one breeding cage on March 24, only 6 remained two days later, the others having been eaten. These six were isolated and allowed to develop normally. The full-grown larva is about $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long and enters the ground to pupate.

The pupa is formed in from one to two days after the larva enters the soil and is of lustrous light-brown color. The pupal period normally lasts from 12 to 14 days, but may be extended. At the experiment station pupæ have been kept for two months before the adults emerged.

The moth has a wing expanse of from 1 to $1\frac{3}{8}$ inches. The forewings are greenish in color and are crossed transversely by three yellowish-white stripes, bordered on the outer margin with dark-green or reddish-brown lines. The hind wings are white, bordered with gray, blackish-gray, or reddish-brown. The head and thorax are similar to the forewings in color. The abdomen is gray or light brown and the ventral surface is pale gray.

INSECT ENEMIES OF PEPPER.

FLOWER-BUD MOTH (*Gnorimoschema gudmanni*).

The larvæ of this moth severely injure the flower buds of pepper, appearing about the time the plants begin to flower and increasing in numbers until about the middle of January. Fully 97 per cent of the flower buds were infested between January 3 and January 10, and larvæ were found in large numbers during December, January, February, March, April, May, and June.

The egg.—The eggs are small, of yellowish-white color, and are deposited singly on the flower buds, near the top of the calyx or in the sutures formed by the petals. They hatch in from four to six days.

The larva.—The young larvæ are minute, of yellowish-white color, and have a reddish-brown intestinal tract which shows through the body. They bore into the bud, eating out the embryo pepper and causing the bud to drop. The feeding period covers from 14 to 20 days, after which the bud drops and the larva enters the soil. The full-grown larva is from 4 to 6 mm. long, has a brownish-black head and a grayish-brown body. Only one larva is found in a bud.

The pupa.—The pupa is formed about one day after the larva enters the soil, pupation taking place in a tough, white, closely woven silken cocoon. The pupa is about 3 mm. long and of light yellowish-brown color. The pupal period lasts from 9 to 12 days.

The adult.—The adult is a small moth of lustrous dark gray mottled with yellowish-white color and has a wing expanse of from 7 to 8 mm. The forewings are narrow and have a fringed posterior. The hind wings are very narrow and have long fringes on the posterior margin and short fringe on the anterior margin. The ventral surface of the wings is lustrous and somewhat lighter in color than the dorsal surface. The legs and ventral surface of the body are yellowish.

CONTROL.

This species is best controlled by destroying infested buds that drop from the plants. A hymenopterous parasite has been reared from *G. gudmanni*. During the latter part of March, 1922, from 10 to 20 per cent of the specimens were found to be parasitized.

A MITE (*Tarsonemus latus*).

This mite is found commonly in the West Indies. When they are severely attacked by it the leaves of pepper assume a dwarfed, deformed, wrinkled, warty, and scabby appearance and the young terminal shoots show an excessive multiple bud formation. The mites are very abundant in dry weather, but are reduced in number by rain. They can readily be controlled by dusting flowers of sulphur with some force on the under surface of the leaves.

INSECT PESTS ATTACKING SWEET POTATO.

WEST INDIAN SWEET-POTATO WEEVIL (*Euscepes batatæ*).

The West Indian sweet-potato weevil is found distributed throughout the West Indies and Hawaii. It is the most serious pest of sweet potatoes in the Virgin Islands, but one that can readily be controlled.

The egg.—The small, white eggs are deposited on the vines and tubers and hatch within five or six days.

The larva.—The full-grown larvæ are about one-fourth inch long, of yellowish-white color, and have legless, curved bodies and a chitinous head. The larval stage is completed in from 14 to 18 days.

The pupa.—The pupa is very soft, small, and of yellowish-white color. Pupation takes place within the infested tuber. The pupal period lasts from 7 to 10 days.

The adult.—The adult is a small brown weevil which is covered with scales. A small yellow band runs across the posterior margin of the elytra. The weevil has a short beak which is concealed on the breast when the insect rests.

The West Indian sweet-potato weevil tunnels through the tissue of the potato, starting at the end nearest the top of the ground. Each succeeding generation of weevils tunnels deeper into the potato. Severe infestation results in the destruction of the potato tissue, and nothing remains except the skin, which is filled with a powdery dust. Infested potatoes have a disagreeable odor and are rejected by stock.

CONTROL.

In June and July, 1919, the experiment station carried on experiments to control the sweet-potato weevil, dipping all vines or drawn plants in kerosene-fusel oil emulsion,⁴ 1 part being used to 10 parts water. This treatment reduced the injury to sweet potatoes about 75 per cent. Untreated vines used as checks showed about 90 per cent infestation. Late-planted draws (December) were treated in the same manner. The injury to late-planted vines was reduced about 60 or 65 per cent. Untreated vines used as check showed about 98 per cent infestation.

Since sound sweet potatoes are subjected to attacks by weevil when stored with infested tubers, an experiment in fumigation was conducted to determine the effect on the weevils. The tubers were placed in a drum and fumigated with carbon bisulphid, 1 pound of the bisulphid being used to 350 cubic feet of space. The drum or compartment used for fumigation was kept tightly closed for 30 to 48 hours, and the weevils in the larval, pupal, and adult stages were killed.

SWEET POTATO LEAF-FOLDER (*Sylepta helcitalis*).

The sweet potato leaf-folder larvæ cause considerable injury to sweet-potato foliage during December, January, February, March, April, and May.

The egg.—Moths in captivity deposited eggs singly, usually on the cloth covering the jar. They were flat, scalelike, and of pale yellowish-white color. Incubation covered from 4 to 6 days.

The larva.—The young larvæ are pale yellowish-green in color and feed for two or three days on the surface of the leaf. They then fasten the edges of the leaf together with silken thread and retreat within the inclosure thus afforded. The larvæ drop from the leaves when disturbed, and have been seen to jump from 4 to 6 inches when attacked by ants. The full-grown larva is about 1 inch long and of a dirty green color. It has a yellowish-colored head and a body that is sparsely covered with stiff, erect hairs. The duration of the larval period is from 14 to 20 days.

The pupa.—The pupa is formed in a cocoon, made by the folding of a portion of the leaf together with silk thread. The period required for the transformation from larval to pupal state is about two days, during which time the larva becomes dormant, gradually turns

⁴ Made from 4.5 pounds whale-oil soap dissolved in 1,000 cubic centimeters fusel oil to which 8,000 cubic centimeters of kerosene has been added.

to yellowish-white, and shrinks in length. The young pupa is about three-fourths inch long and of a yellowish-brown color which changes to lustrous, smooth mahogany shortly before the adult emerges. The pupal period lasts from 12 to 15 days.

The adult.—The moth has a wing expanse of from seven-eighths to 1½ inches. The dorsal surface is light brown or tan colored, and some distinctly marked specimens have forewings which show a darker area extending from the middle third of the costal margin midway to the inner margin. An irregular white spot adorns the apical third of the forewing and a small white spot the center of the basal third. The hind wings are crossed transversely by two wavy, brown lines, the inner of which runs across the wing, and the outer midway across.

CONTROL.

Larvæ collected in the field have been found parasitized by the tachinid fly (*Exorista pyste*). The height of parasitism is reached from April 20 to May 10, during which period 33½ per cent of the field collections were parasitized.

Arsenicals are of little value in combating the larvæ since they are sheltered within the folded leaves.

RED SPIDER (*Tetranychus telarius*).

The spider mites or red spiders are found in Europe, England, North America, Mexico, South America, West Indies, South Africa, Australia, and Hawaii. In St. Croix they have been taken from a number of host plants, including the avocado, bean, castor bean, cotton, *Canavalia* spp., cowpea, *Datura metel*, eggplant, "hollow stock," lettuce, Lima bean, okra, pepper, rose, sweet potato, and several species of weeds.

The mites suck the cell contents of the plant and cause white spots to appear on the leaves. After becoming white or brownish-white the leaves soon wither and die. The underside of the leaf of the host plant is usually covered with a fine silken web which is spun by the mites.

The life of the red spider is short. Its history has not been worked out for St. Croix, but it thought that 8 or 10 days are required for its development. Red spiders are rather abundantly present in St. Croix from January to September, due to drought conditions.

CONTROL.

Probably clean cultivation is the best method of controlling red spiders, especially the destruction of *Amaranthus* spp., *Datura metel*, and "hollow stock."

GRASSHOPPER (*Schistocerca pallans*).

This grasshopper is never present in such numbers as to be considered a pest. Both nymphs and adults feed on the foliage of sweet potatoes and are found when the potatoes are planted on sugar-cane banks. The adult is a large brown grasshopper having wing covers mottled with black. No control measures are needed to combat this insect.

INSECT PESTS ATTACKING TOMATOES.

THE SOUTHERN GREEN STINK-BUG (*Nezara viridula*).

The southern green stink-bug, or stink-bug, as it is frequently called, severely damages fruits, cotton, and vegetables in the West Indies. It was described for the first time in 1758 by Linnæus from specimens collected in India and was undoubtedly introduced into the West Indies. It is now found throughout the West Indies, South America, Central America, Mexico, the southern portion of the United States, in Africa, Asia, Australia, and Europe. The name "stink-bug" is given to members of the Pentatomidæ family because they emit a malodorous substance for protection.

This bug punctures fruits, vegetables, and the tender growth of plants in order to extract the juices from them. The punctures cause hard, white patches to form beneath the skin of tomatoes, which become dwarfed as a result. When punctured, bean pods become dwarfed, malformed, and shriveled, and Lima-bean pods drop.

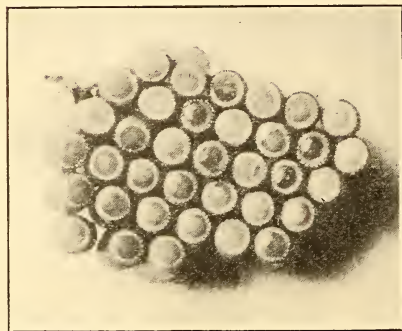


FIG. 18.—Southern green plant-bug: Egg-cluster, viewed from above. Enlarged about 6 diameters.

Okra and eggplants also become stunted and malformed. Nowell⁵ found that *N. viridula* transmits the fungus which causes internal disease of cotton bolls. Cucumbers and melons become malformed and seldom mature after being attacked by *N. viridula*. Tomatoes, Lima beans, and okra are the most severely injured of the truck crops.

The egg.—The eggs are deposited in compact, hexagonal clusters on the underside of the leaves of cotton, tomato, tobacco, okra, corn, and many weeds and are firmly attached to each other in very regular rows. (Fig. 18.) The number of eggs in a cluster varies considerably. Jones⁶ found that in Louisiana the clusters taken in the field contained from 60 to 116 eggs with the exception of one small cluster of 36 eggs. Drake⁷ found that in Florida the egg clusters taken in the field contained from 61 to 126 eggs, with the exception of one cluster containing 46 eggs. In St. Croix the clusters have contained from 42 to 97 eggs. One cluster, found February 3, contained 38 eggs.

The newly oviposited eggs are white or cream colored, but in about two days change to pink. Just before hatching time the red coloration of the inclosed nymphs is visible through the shell. Under St. Croix conditions the eggs hatch in from 3 to 10 days. Drought conditions extend the period of incubation.

The nymph.—On hatching from the egg the nymph is yellowish-orange colored, and the head, thorax, and abdomen are marked with

⁵ West Indian Bul. v. XVI, p. 203.

⁶ U. S. Dept. Agr., Bul. 689 (1918), p. 15.

⁷ Fla. Plant Bd. Quart. Bul., 4 (1920), No. 3, p. 59.

crimson. In many instances the thoracic abdominal markings are absent. The legs and antennæ are very light yellow. The nymphs remain inactive in groups for about two days and then begin to feed. Five molts occur during the nymphal period. Under the most favorable conditions the nymphs of the first instar molt in two and one-half days, but the period may be extended to six days. The second instar molt within 5 or 10 days, the third in from one and one-half to five days, the fourth in from 5 to 10 days, and the fifth in from 5 to 13 days. The minimum time required under laboratory conditions for development from the egg to the adult stage was 26 days, and the maximum period was 60 days.

The adult.—The adult is of light-green color, shield shaped, and in size may vary considerably. Female specimens may oviposit one or more clusters of eggs after they are parasitized. (Fig. 19.)

CONTROL.

Picking by hand has been found to be the most satisfactory method of controlling this insect where it occurs in large numbers. Natural enemies play an important part in the control of this species. The black witch and the gray king-bird eat both larvæ and adults. The most important natural control at the Virgin Islands is the parasitic fly (*Trichopoda pennipes*). (Fig. 20.)

An average of 24.17 per cent of adult specimens of *N. viridula*, collected at intervals of 14 days throughout the year, were parasitized by *T. pennipes*. The maximum number parasitized, 93 per cent, occurred in January, and the minimum number, 12 per cent, occurred in May. The pupal stage of the parasite under laboratory conditions at the station varied from 12 to 16 days.

In no case was a parasite reared from nymphs taken in the field, nor were parasitic eggs found on the host in any nymphal stage. Of the various species of Hemiptera collected, only one other species, a stink-bug (*Thyanta perditor*), taken from Lima beans, showed the presence of parasitic eggs.



FIG. 19.—Southern green plant-bug (*Nezara viridula*): Adult. Enlarged about 4 diameters.

TOMATO WORMS (*Protoparce* spp.)

The tomato worms, tobacco worms, or hornworms as they are sometimes called, are very destructive to tomato vines and tobacco. Destructive broods of both species (*P. sexta* (Fig. 21) and *P. rustica*), which are the most common of the hawk moths found on the island, occur in September, October, and November.

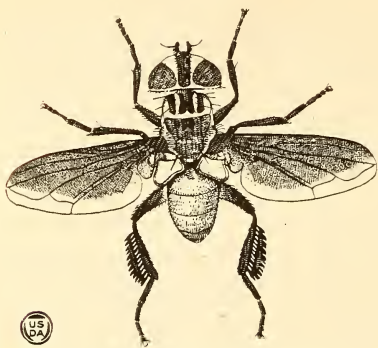


FIG. 20.—*Trichopoda pennipes*: Adult fly. Three times natural size.

The egg.—The eggs are of green or bluish-green color and are deposited singly on either side of the leaf. They hatch in from four to eight days.

The larva.—The young larva is pale green. It reaches maturity in about three weeks. The full-grown larva is about 4 inches long and of bluish-green color with white oblique bands along the sides. A short, stout horn projects from the tip of the abdomen at all stages of development.

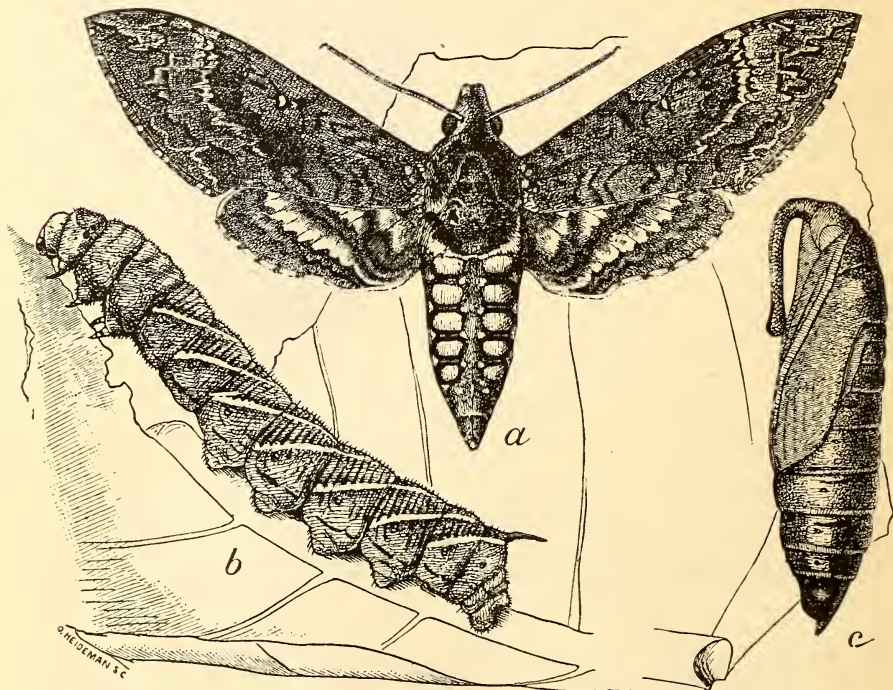


FIG. 21.—Tomato worm (*Protoparce sexta*): a, Adult moth; b, full-grown larva; c, pupa. Natural size.

The pupa.—When it is ready to pupate, the larva tunnels into the soil to a depth of from 6 to 12 inches and forms an earthen cell,

where it enters the chrysalis state. Transformation occurs in from two to five days. The pupa is about 2 inches long and of dark-brown color. The sheath of the proboscis on the pupa is free. The duration of the pupal stage normally is three weeks, but it may be extended. Pupæ were kept at the experiment station for more than three months before the adults emerged.

The adult.—The adult is a large, heavy-bodied moth having a wing expanse of from 4 to 4½ inches. The forewings are of brownish-gray color, and the hind wings have a pink area near their base. The abdomen is conspicuously marked with five pink spots on each side. The adult of *P. sexta* is similar to that of *P. rustica*, except that in the former the abdomen is conspicuously marked with five yellow spots on each side and the hind wings have no pink area.

CONTROL.

Picking by hand is probably the best method of controlling the larvæ of these species when they occur on tomato.

A PLANT BUG (*Phthia picta*).

P. picta ranks next to *N. viridula* in the amount of injury it does to tomatoes. Nymphs and adults feed on tomatoes, puncturing them to extract the juice. (Fig. 22.) Ripe tomatoes that have been punctured show hard, white spots on the skin, and young growing tomatoes become dwarfed and deformed.

The egg.—The eggs are deposited in a single or double row in numbers of from 25 to 30 to the row on either surface of the leaves of firewood (*Datura metel*), and hatch in from three to six days. They are of light-brown color, but become dark reddish-brown before hatching.

The nymphs.—The nymphs are very active, wingless insects of reddish-orange color. They become darker after the first molt and appear like the adult. They congregate in groups on the blossom end of young tomatoes. From two to three weeks are required for development.

The adult.—The adults are brownish-black in color and about half an inch long. The thorax has a narrow orange-red band on



FIG. 22.—*Phthia picta*: Adult male. Much enlarged.

the lateral margin and a broad yellowish or orange-red band on the posterior margin. This band is not present in all specimens. The basal portion of each leg is red and the ventral surface is mottled with black and red.

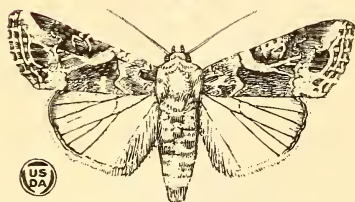


FIG. 23.—*Prodenia ornithogalli*: Dark form, male above; pale form, female below. Somewhat enlarged.

CONTROL.

Gathering the insects by hand is the only practical method of controlling *P. picta*.

No parasites have been found attacking this species. The black witch and gray kingbird have been observed eating both nymphs and adults.

COTTON-BOLL CUTWORMS (*Prodenia ornithogalli* and *P. latifascia*).

These larvæ are found throughout the year, but in great numbers from about July 15 to October 1. They were especially numerous in the summer and fall of 1920, when their attack resembled that of the

fall army worm. The cotton-boll cutworm feeds on grasses, sweet potatoes, cotton, numerous species of weeds, and the physic-nut (*Jatropha gossypifolia*), as well as on most of the truck crops.

The life history of the two species is almost identical, but that of *P. ornithogalli* only is given, as it is the more commonly found of the two. (Fig. 23).

The egg.—The eggs are deposited in irregular clusters of from 50 to 200 on the underside of the leaves of a number of kinds of plants, and are usually covered with a brownish-gray down from the body of the female. They hatch in from four to six days.

The larva.—The larvæ vary greatly in color, but two distinct forms—the light and the dark (Fig. 24)—are found in St. Croix. The dark form ranges from dark velvety brown to a rich greenish-black and has two rows of triangular velvety-black spots extending down its back. It is the more commonly found of the two. The light form is similar in appearance, with the exception that it is light velvety brown instead of black. The larvæ complete their development in from 17 to 20 days and enter the soil to pupate. They are from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long when full grown.

The pupa.—The pupa is dark brown and has a smooth, lustrous surface. The pupal stage lasts from 14 to 20 days.

The adult.—The adult is a brownish-gray moth having a wing expanse of from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches. The forewings are dark brownish-

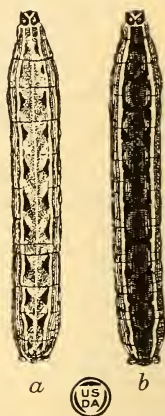


FIG. 24.—*Prodenia ornithogalli*: a, Pale form of larva; b, dark form of larva.

gray somewhat blotched with white. On the outer margin of the forewing there are five wavy lines which are white, brown, broken yellow, chocolate brown dotted with light gray, and light brown broken by yellowish-white marks, respectively. The hind wings are a lustrous pearly white, and have wavy light-brown lines extending inside the outer margin. The body is covered with brownish-gray down.

CONTROL.

Picking by hand is the most practical means of controlling the larvæ.

Arsenicals used on tomatoes cause a burning of the foliage which is more serious than are the attacks by the larvæ.

EGGPLANT-LEAF FOLDER (*Pachyzancla periusalis*).

The eggplant leaf-folder, or tomato leaf-webber, is found in South America, Porto Rico, Virgin Islands, and the southern part of the United States.

The egg.—The eggs are deposited singly and are somewhat flattened against the underside of the leaf. They are of yellowish-green color and hatch in from four to six days, depending upon drought.

The larva.—The young larva is yellowish-white in color, and the mature larva is yellowish-green or yellowish-white marked with brown. It is from three-fourths to 1 inch long and has a brown head with a black spot on each side of the posterior portion. The duration of the larval period is from 12 to 18 days.

The larvæ feed on the leaves of *Amaranthus* spp., eggplant, and tomato. After folding the leaves or webbing them together they enter the retreat thus afforded. Skeletonization of the leaves takes place later.

The pupa.—Pupation occurs within the folded or webbed leaves. The pupa is of light-brown color and about half an inch long. The pupal period lasts from 8 to 10 days.

The adult.—The moth is very active and has dark-gray or grayish-brown wings, which are crossed transversely by narrow wavy lines. The abdomen is somewhat darker than are the wings, and the ventral surface of the moth is much lighter than the dorsal surface. The wing expanse is about three-fourths to five-eighths inch.

CONTROL.

This insect has not been found in sufficient numbers to require the use of control measures. When control measures are needed the plants can be dusted with air-slaked lime and arsenate of lead in equal parts.

COMMON CRICKET (*Gryllus assimilis*).

The common cricket is a serious pest of ripe tomatoes. The nymphs and adults hide under the vines during the day and feed on the ripening tomatoes at night. They do not confine their attacks to one tomato, but injure numbers of them. In St. Croix the common cricket breeds throughout the year, laying its eggs in the ground or under rocks and trash. Nymphs and adults have the same appear-

ance except that in the latter the wings are developed. The color of the common cricket is brownish-black with lighter brown or yellowish legs.

CONTROL.

Pans containing molasses may be used as traps to catch crickets. Poison bait is not of any use as a control measure, because the insects prefer the pulp of the fruit.

Two important natural enemies are the gray kingbird and the black witch, which eat large numbers of the nymphs and adults.

SPINED STINK-BUG (*Arvelius albopunctatus*).

The spined stink-bug has been found feeding on beans, eggplants, and tomatoes. Its life history and methods of control are similar to those of *N. viridula*. *A. albopunctatus* is brown and the nymphs remain in clusters throughout the nymphal period, while the nymphs of *N. viridula* are green and do not remain in clusters. The adults of the former have thoracic spines and yellowish bodies marked with green on the thorax, scutellum, and wings, and the latter are uniformly pale green.

THYANTA PERDITOR.

Thyanta perditor is another member of the stink-bug family that is frequently taken from Lima beans and tomatoes. It is about half the size of *N. viridula* and is of dark olive-green color. The thorax is transversely crossed by a reddish-purple stripe, which extends to the tip of the spines. Like *N. viridula*, this species is parasitized by the tachinid fly (*Trichopoda pennipes*).

EUSCHISTUS CRENATOR.

E. crenator is a small, dark-brown stink-bug having lighter-colored legs and antennæ. It is occasionally found on the leaves of Lima beans and tomatoes, but not in such numbers as to be considered of economic importance.

No parasites have been reared from this species.

SNOWY TREE-CRICKET (*Ecanthus niveus*).

The snowy tree-cricket is often found on tomato plants, but is not considered a pest. Both adults and larvæ feed on plant-lice, which attack tomatoes during periods of drought. Control measures are not needed to combat this insect, and it may be considered a beneficial rather than an injurious insect.

INSECT PESTS OF TANNIA.

COTTON LACE-BUG (*Corythucha gossypii*).

The cotton lace-bug is occasionally found in colonies on the underside of tannia leaves, but rarely in such numbers as to cause severe injury to the plants.

The flask-shaped eggs of the cotton lace-bug are deposited within the tissue of the leaf. They hatch within a few days into wingless nymphs, which congregate in colonies with the adults. Both nymphs

and adults feed by inserting their beaks into the tissue of the leaf to extract the plant juices.

Lace-bugs have not been found in sufficient number on tannia to require the use of control measures. The favorite food plant is the castor bean. Severe infestation has been satisfactorily controlled by spraying the leaves with a whale-oil soap solution, made by dissolving 1 pound of whale-oil soap in 5 gallons of water.

INSECT PESTS OF YAM.

Yams are frequently attacked by the yam scale (*Targionia hartii*), which can be controlled by washing the infested tubers in whale-oil soap solution, made by dissolving 2 pounds of soap in 5 gallons of water.

Soaking the yam tubers in charcoal ashes and water before planting destroys a large number of the scales.



