VIRGIN ISLANDS AGRICULTURAL EXPERIMENT STATION,
ST. CROIX, VIRGIN ISLANDS, U. S. A.
BULLETIN No. 3.

Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

INSECT PESTS OF COTTON IN ST. CROIX AND MEANS OF COMBATING THEM.

BY

CHARLES E. WILSON, Entomologist.

Issued May 19, 1923

WASHINGTON:
GOVERNMENT PRINTING OFFICE,
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[Under the supervision of the States Relations Service, United States Department of Agriculture.]

A. C. True, *Director.*
E. W. Allen, *Chief, Office of Experiment Stations.*
Walter H. Evans, *Chief, Division of Insular Stations, Office of Experiment Stations.*

STATION STAFF.

John B. Thompson, *Agronomist in Charge.*
Charles E. Wilson, *Entomologist.*

INSECT PESTS OF COTTON IN ST. CROIX AND MEANS OF COMBATING THEM.[1]

CONTENTS.

INTRODUCTION.

When the writer came to St. Croix in June, 1919, the cotton industry was at its height. Production per acre had been stimulated by economic conditions brought about by the World War, cotton lint having increased in price from 40 cents to $1.80 and $2 a pound and the demand for cotton goods being greater than the supply in many parts of the world. With the increase in area devoted to cotton production, the control of insect pests of cotton became a problem of economic importance.

The purpose of this bulletin is to describe the life history of some of the insects thus far known to attack cotton in St. Croix and to suggest methods of combating the more destructive species. The insects are treated in the order of their importance as regards attack on the cotton plant, being grouped under two main headings, those attacking the leaf and the stem and those attacking the boll and the flower.

INSECTS ATTACKING THE LEAF AND STEM.

Cotton Worm (*Alabama argillacea*).

The moth of the cotton worm, sometimes called the cotton caterpillar, army worm, candle fly, and chenille, is a native of tropical America, being found in South America, Mexico, and the West Indies. The adult moth migrates as far north as Canada, but it does not breed outside of the cotton zone, because, so far as it is known, the larvæ feed on the cotton plant only. (Fig. 1.)

The egg.—The egg, which is about one-fortieth inch in diameter, is light green or light bluish-green, and can readily be distinguished from the leaf after one has become accustomed to seeing it. One or several eggs may be deposited on the underside of the leaf, usually at the top of the plant, but they are never found in clusters. The duration of the egg state is from 2 to 4 days. Low temperature,

[1] The writer acknowledges his indebtedness to the experts of the Bureau of Entomology for their courtesy in identifying many of the insects mentioned in this bulletin. The illustrations were supplied by the Bureau of Entomology.

however, retards development, and occasionally the period required for hatching may be from 6 to 10 days.

FIG. 1.—The cotton worm (*Alabama argillacea*): Stages and work.

The larva.—The egg hatches into a small, inconspicuous, pale yellowish-green worm that feeds for a time upon the underside of the cotton leaf. The color markings become pronounced as the

worm grows, and the back of the full-grown worm has a broad brownish or black stripe with a central fine, yellowish-green stripe. Similar yellowish-green stripes appear on each side of the black stripe. Each segment of the worm is dotted, four dots being on the back and four on each side. The lateral dots are smaller than the dorsal ones. Color may vary among the different individuals in intensity, but the markings described above are the most constant.

Five molts occur during the 10 or 14 days covering the larval stage. The larva is very voracious and ruins entire crops unless it is checked. After defoliating the plant and the supply of leaves becomes exhausted, it attacks the squares, bolls, and twigs. The larva is always active and travels over the plant by looping—that is, by bringing up the hind pro-legs to the true legs, causing arching of the back in a loop. When disturbed it protects itself by a series of jerks, often leaping 1 or 2 feet horizontally. Its presence in the cotton field can soon be detected by a rather strong odor resembling that of the four o'clock flower.

The pupa or chrysalis.—The larva transforms into the pupal stage on the cotton plant, such transformation usually being called "webbing up." The worm pupates in a leaf which it folds over with a light silken web to form a cocoon. Frequently the pupa is seen hanging from the plant by a thread, but in such cases the leaf in which it was spun has been eaten by other caterpillars. When it is first formed the pupa is green, but it soon changes to dark brown. The pupal stage lasts from 7 to 10 days.

The adult.—The moth may be brownish-gray, olive-brown, or olive-gray. It has a wing expanse of about 1½ inches. The upper surface of the anterior wing bears a distinct black spot at about one-third the distance from the anterior to the posterior margins, and the forewings are marked with a number of dark, reddish, wavy, transverse lines. The moths fly at night and hide during the day. Egg laying starts a few days after the moths emerge from the chrysalis, each female depositing from 300 to 600 eggs. The moths feed on nectar obtained from the leaf glands of cotton.

CONTROL.

Arsenicals.—Paris green mixed with eight times its weight of air-slaked lime has given great satisfaction as a control measure at the experiment station. After it has been thoroughly mixed the poison should be passed through a fine wire-mesh sieve, placed in a finely woven cotton sack, and slightly shaken over the plants. Yellow cotton cloth is splendid for this purpose. Burning of the leaves was not noticed to occur on plants that had been treated with Paris green and air-slaked lime. Powdered lead arsenate mixed with equal parts of air-slaked lime is not as effective as Paris green; and London purple, owing to its variable composition, can not be depended upon for dusting purposes.

Natural enemies.—Two birds, the gray kingbird (*Tyrannus dominicensis dominicensis*) and the black witch or Judas bird (*Crotophaga ani*), eat large numbers of the larvæ and adults and are of great value in controlling the cotton worm. The jack Spaniard (*Polistes annularis*) and the ground beetle (*Calosoma calidum*) also eat the larvæ. Dipterous and hymenopterous parasites, including *Chalcis robusta*, as well as ants and lizards, help to control this pest.

Blister Mite (*Eriophyes gossypii*).

The blister mite attacks all parts of the cotton plant except the root. When thoroughly infested the plant presents a distorted appearance, being only a mass of warts and nodules which are lined with a thick growth of fine hairs. The mites live and develop within the blisters. The adult is a minute 4-legged mite that can be seen only with difficulty without the aid of a magnifying glass. It severely injures and in extreme cases kills the cotton plant.

A closed season is the most effective means of keeping the pest in check. A period of from 2 to 4 weeks is sufficient, and if properly carried out, the law should prove beneficial in the shorter period. The law in St. Croix compels cotton growers to uproot and burn old cotton plants by a certain date fixed for each plantation by the Cotton Pest Commission, composed of four cotton growers and the agronomist in charge of the agricultural experiment station. A period of three weeks is generally designated during which no cotton can be planted. After the expiration of this period the cotton seed is planted as soon as the weather permits. The law gives the privilege of granting different periods for different plantations when no harm is likely to result by so doing. This variation in closed seasons can readily be allowed where a range of hills cuts off one plantation from another, or where each plantation is separated by the distance of a mile or more and the prevailing wind is not in a direction to convey mites from the old cotton plants.

Fall Army Worm (*Laphygma frugiperda*).

The fall army worm, or corn earworm, army cutworm, and southern grassworm, as it is commonly called, is indigenous to the Tropics, but has extended its range as far north as Canada. (Fig. 2.)

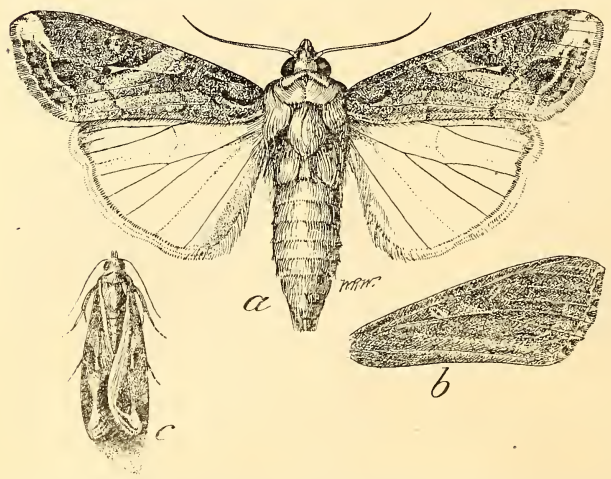


Fig. 2.—The fall army worm: *a*, Male moth; *b*, right front wing of female moth; *c*, moth in resting position; *a*, *b*, about twice natural size; *c*, very slightly enlarged.

The egg.—The eggs vary from light gray to pearly white and are for the most part covered with grayish down from the moth's body. They are deposited at night in clusters of 50 to 400 on blades of grass growing on low land. The eggs hatch in from 2 to 6 days. (Fig. 3.)

The larva.—The larva reaches maturity in from 7 to 12 days. Four molts occur during this period, the first taking place the first day, the second in from 1½ to 2 days, the third in from 2 to 4 days, and the fourth in from 2½ to 4 days. When first hatched it feeds upon its eggshell and later on grass blades. The newly hatched worm has a white body and jet black head, but as it grows and molts its body becomes darker. When full grown it is about 1½ inches long and varies from light-greenish yellow to almost black. A wavy, yellowish line is found on each side of the body and three narrow stripes run along the back. The dorsal surface of each segment shows four black dots, and the front of the head is marked with a white inverted ⅄.

FIG. 3.—The fall army worm: Newly hatched larva, or "worm." Greatly enlarged.

The pupa.—When it is full grown the larva enters the soil to a depth of from one-half to 2 inches to pupate. The pupal period lasts from 10 to 14 days. (Fig. 4.)

The adult.—The moth varies greatly in color but usually the forewings range from dark gray to brown mottled with black and white, and the hind wings have a white, brilliant sheen. The wing expanse is 1¼ to 1½ inches. The body is gray.

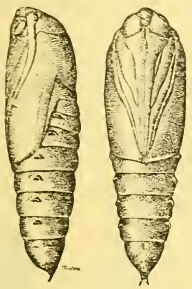


FIG. 4.—The fall army worm: Pupa. About twice natural size.

CONTROL.

Arsenicals.—The grass surrounding the cotton field should be dusted with equal parts of arsenate of lead and air-slaked lime before the fall army worm makes its attack upon cotton. Paris green and air-slaked lime should be used as a control measure after the cotton is attacked.

Natural enemies.—Natural enemies attacking the fall army worm include the gray kingbird, black witch, chickens, ground beetle (*Calosoma calidum*); hymenopterous insects, including *Chalcis robusta*, *Spilochalcis femorata*, *S. vittata*, and *Enicospilus concolor* and a dipterous parasite (*Exorista pyste*). Ants and lizards also destroy large numbers of the larvæ.

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

The cotton-boll cutworm, or cotton cutworm, is found throughout the year in St. Croix, and in great numbers from about July 15 to October 1. It attacks the cotton plant soon after the seeds sprout, and later injures the squares and bolls. (Fig. 5.) Cotton-boll cutworms were very numerous in the summer and fall of 1920 and their attack resembled that of the fall army worm. They feed on grasses, weeds, most of the truck crops, and the physic-nut (*Jatropha gossypiifolia*), in addition to the cotton plant.

Of the two species, *P. ornithogalli* is the more common in St. Croix.[2]

[2] Since the life history of the two species is almost identical, only that of *P. ornithogalli* is given.

The egg.—The eggs are deposited in irregular clusters of from 50 to 200 on the undersides of leaves of a number of kinds of plants. They are usually covered with brownish-gray down from the body of the female. They hatch in from 4 to 6 days.

The larva.—The larvæ vary greatly in color, but two distinct forms, the light and the dark, are found in St. Croix. (Fig. 6.) The dark form ranges from dark velvety-brown to a rich greenish-black, with 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, the exception being 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 $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long when full grown.

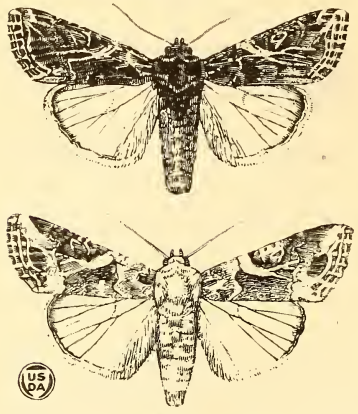


FIG. 5.—*Prodenia ornithogalli.* Dark form, male above; pale form, female below. Somewhat enlarged.

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

The adult.—The adult is a brownish-gray moth having a wing expanse of $1\frac{1}{2}$ to $1\frac{3}{4}$ inches. The forewings are dark brownish-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 glistening pearly white and have wavy light-brown lines extending inside the outer margin. The body is covered with brownish-gray down.

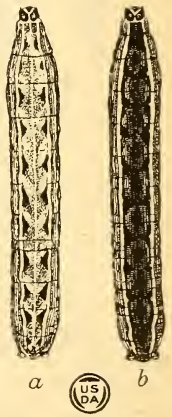


FIG. 6.—*Prodenia ornithogalli: a,* Pale form of larva; *b,* dark form of larva.

CONTROL.

Cotton-boll cutworms are controlled by the use of Paris green and air-slaked lime, the mixture being prepared and applied as in the case of the cotton worm.

Natural enemies play an important part in the control of this pest.

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

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

The egg.—The eggs are oblong, white, and glistening. They are deposited on the surface of the leaf, usually of sugar cane or grass, and are concealed by the fastening of two leaves together by the female, or within the folds of one leaf. The eggs hatch in from 7 to 10 days.

The larva.—As soon as they are hatched the larvæ drop to the ground and feed on the roots of the plant. They are white or slightly yellowish-brown, have a brown head, and a curved body which is footless. They require from 8 to 10 months for development, and feed during this time on the roots of the cotton and other plants. During March larvæ measuring from one-sixth to five-sixths of an inch were found at the experiment station.

The pupa.—The pupa is very soft and of yellowish-white color. Before pupating, the larva forms an earthen cell in which it transforms. The pupal stage lasts about a month.

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

CONTROL.

The adult beetles can best be controlled by hand picking. They do more damage to a cotton crop following cane than is the case when cotton follows cotton. Large numbers of the adults may be trapped by the planting of sunflowers among the cotton.

The gray kingbird (*Tyrannus dominicensis dominicensis*) and the black witch (*Crotophaga ani*) are among the important natural controls.

TROPICAL CUTWORM (*Xylomiges sunia*).

The tropical cutworm is seldom present in such numbers as to be of economic importance.

The egg.—The eggs are pale green and are deposited in clusters of 200 to 300 on the under surface of the leaves of the castor bean, cotton, beet, and chard. They are covered with a light-gray or white down from the body of the female. They hatch in four to eight days.

The larva.—The full-grown larvæ are from 1¼ to 1½ inches long. The dorsal surface of the larva is dark gray, marked with velvety-black patches. The sides are marked with a yellow band. The larval period lasts from 12 to 20 days.

The pupa.—Pupation takes place in the soil and lasts from 10 to 12 days. The pupa is brown, smooth, and glistening.

The adult.—The adult moth has a wing expanse of from 1¼ to 1½ inches. The forewings are grayish-brown and the hind wings are a glistening pearly white.

CONTROL.

Dusting cotton for the control of the cotton worm (*Alabama argillacea*) will also control the larvæ of the tropical cutworm. The parasitic fly, *Exorista pyste*, is a natural means of control.

Cotton Aphis (*Aphis gossypii*).

The presence of the cotton aphis, also known as the melon aphis, plant-louse, and cotton louse, can be detected by the curled and blistered appearance of the leaves. The insect occurs abundantly on young cotton in St. Croix, especially when the weather is dry. (Fig. 7.) The nymphs and adults seriously check the growth of the young plant by sucking its juice. No permanent injury has as yet been observed, probably because as the insects become abundant their natural enemies increase in number sufficient to destroy them.

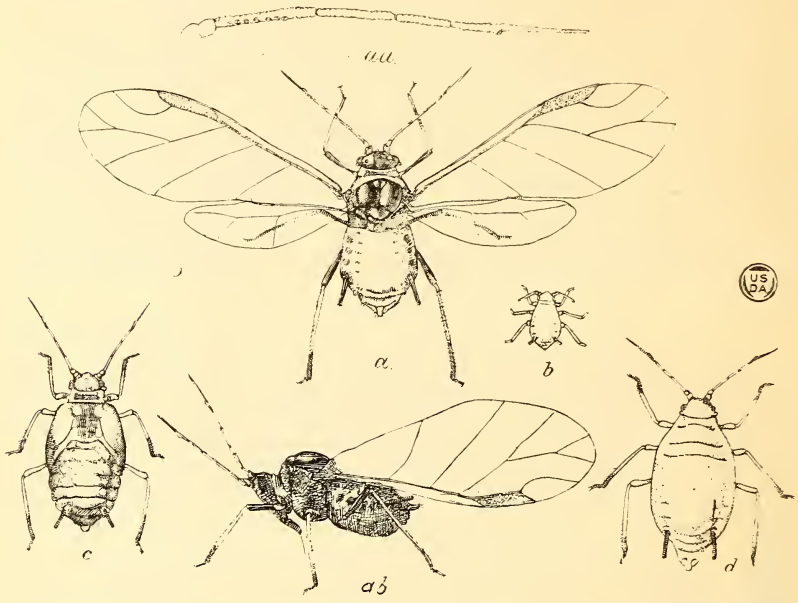


Fig. 7.—*Aphis gossypii: a,* Winged female; *aa,* enlarged antennæ of same; *ab,* dark female, side view; *b,* young nymph or larva; *c,* last stage of nymph; *d,* winged female. All greatly enlarged.

The adult is green or brownish-green, winged or wingless, and soft bodied. The nymphs, or young aphids, are similar in appearance, except that they are wingless. Nymphs and adults are found together in colonies on the underside of the leaf. They prefer tender growth and young leaves for food.

Control.

Measures are not necessary for the control of aphids on cotton. They are naturally controlled by two enemies, a parasitic hymenopteron (*Lysiphlebus testaceipes*) and a predacious ladybird beetle (*Cycloneda sanguinea*), usually called the "red ladybird." During February and March about 93 per cent of the aphid colonies were parasitized by *Lysiphlebus testaceipes.* Other enemies of the cotton aphis are the lace-winged fly larvæ and the syrphus-fly larvæ.

Cotton Lace-bug (*Corythuca gossypii*).

The common lace-bug rarely causes much damage to cotton, but very seriously injures the leaves of the castor bean (*Ricinus communis*).

The eggs of the cotton lace-bug are somewhat flask-shaped and are deposited within the tissue of the leaf. In a few days they hatch into wingless nymphs, which congregate in colonies with the adults on the underside of the leaf. Both nymphs and adults feed by inserting their beaks into the tissue and sucking the plant juices from the leaves. This causes the leaves to turn yellow and die.

Lace-bugs rarely become numerous enough on cotton to cause severe damage.

Red Spider (*Tetranychus telarius*).

The red spider, or spider mite, is of very slight economic importance in so far as its attack on cotton is concerned. It is found on the cotton plant during extremely dry weather only. Its native food plant is a weed (*Leonotis nepetæfolia*), locally known as "hollow stock." (Fig. 8.) It can best be controlled by the destruction of this weed.

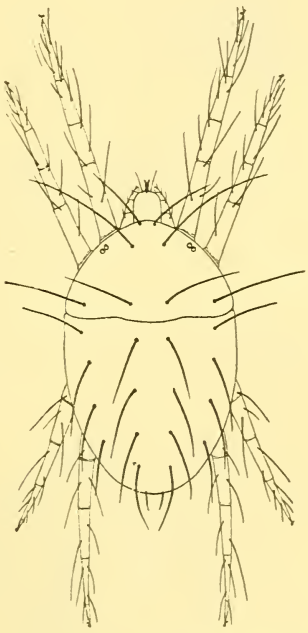


Fig. 8.—The red spider, *Tetranychus telarius:* Adult female. Greatly enlarged.

Scale Insects and Mealybugs.

Scale insects and mealybugs rarely become numerous on cotton until about the time the plants are to be destroyed.

The West Indian or white-peach scale (*Aulacaspis pentagona*) rapidly increases in number on old cotton plants and soon covers stalks and stems. This pest can best be controlled by the destruction of the plants.

The black-shield scale (*Saissetia nigra*) is commonly found on cotton from December to April, but can not be considered a serious pest, because it is controlled by a minute parasitic hymenopterous insect known as *Zaloph-thrix mirum*.

The black scale (*Saissetia oleæ*) attacks cotton too late in the season to be of economic importance. By a rigorous observance of the cotton-pest law this scale can be destroyed.

The hemispherical scale (*S. hemispharica*) has not been found on cotton in sufficient numbers to necessitate the use of control measures.

The destructor scale (*Aspidiotus destructor*) has been found only on old leaves. Measures for the control of this scale insect on cotton are not necessary.

The spotted mealybug (*Pseudococcus virgatus*) and the long-tailed mealybug (*P. longispinus*) are usually found inside the calyx and are controlled by natural enemies. The red ladybird beetle

(*Cycloneda sanguinea*) and its larvæ are among the important natural enemies.

Lesser Cotton Worm (*Aletia luridula*).

Larvæ of the lesser cotton worm are generally found with the larvæ of the cotton worm (*Alabama argillacea*), and on account of their habits, manner of feeding, and appearance they are usually mistaken for the latter. The larvæ of the lesser cotton worm differ from the cotton-worm larvæ in size and color, being smaller and reddish brown. The pupal stage is spent in the soil. The adult moth is smaller than the cotton-worm moth, and is a dull gray or reddish brown.

CONTROL.

The lesser cotton worm can be controlled at the same time the cotton worm is checked by the use of arsenicals.

Spotted Flea-beetle (*Homophœta æquinoctialis*).

The spotted flea-beetle is usually found feeding on cotton leaves from February to April, but is never present in such numbers as to attract attention. No control measures are required for this species.

Greenhouse Thrips (*Heliothrips hœmorrhoidalis*).

Greenhouse thrips have been taken from cotton, but never in sufficient numbers to warrant the use of control measures.

A small brown thrips (probably *Frankliniella gossypii?*) has been taken from young leaves surrounding dead flower buds.

Sick Cricket (*Amphiacusta caraibœ*).

The sick cricket is usually found beneath the calyx. It is an indiscriminate feeder, but has not been found in large enough numbers to necessitate the use of control measures. This species feeds at night.

Sphinx or Hawk-moths.

The sphinx or hawk-moth species that have been reared from cotton are the white-lined sphinx (*Deilephila lineata*), tomato-worm moth (*Protoparce rustica*), tobacco-worm moth (*P. sexta*), alope sphinx (*Erinnyis alope*), and ello sphinx (*E. ello*).

The presence of sphinx moths on cotton may be called accidental. They never occur in such numbers as to require the use of control measures.

Snowy Tree Cricket (*Œcanthus niveus*).

Few specimens of the snowy tree cricket are found on cotton. The female deposits her eggs on the cotton stalk in rows, forming long scars. The snowy tree cricket may be classed as beneficial rather than as injurious, since both young and adults feed on aphids.

INSECTS ATTACKING BOLLS AND FLOWERS.

Pink Bollworm (*Pectinophora gossypiella*).

The pink bollworm is very destructive to both cotton lint and to cotton seed. It stains the lint, causes it to be short and kinky, and

more or less cements the lint and seeds together. It greatly reduces the yield of lint and the amount of seed produced. The seed is also of light weight and germinates poorly. The pink bollworm may be found in one or several locks of the boll, but one worm seldom attacks more than one lock. (Fig. 9.)

FIG. 9.—The pink bollworm (*Pectinophora gossypiella*); Adult. Much enlarged.

Counts of bolls on plants taken at random from the field during January, February, March, and the early part of April, 1921, showed that from 5 to 25 per cent of the 1921 crop was a loss. On this account the old cotton plants were not removed from the fields and no new crop was planted. The bolls on old cotton plants showed 30 per cent infestation on February 14, 1922. (Fig. 10). This condition was reported to the Cotton Pest Commission, and within a few days the removal and destruction of all cotton plants was requested.

FIG. 10.—Exit holes of pink bollworms in cotton bolls.

The egg.—The eggs of the bollworm are deposited singly near the points of green bolls in the sutures marking the locks. A number of

eggs are often found on the same boll. They hatch in from 4 to 12 days.

The larva.—The white or yellowish-white larva bores its way into the boll almost as soon as it is hatched. After entering the boll it feeds upon the seeds, which it cements together. Cementing of the seeds is a characteristic feature of the work of the pink bollworm. The larva becomes pink as it develops within the boll and measures one-half inch when fully grown. (Fig. 11.) In St. Croix the larval period usually lasts from 12 to 14 days. Drought conditions apparently prolong the period.

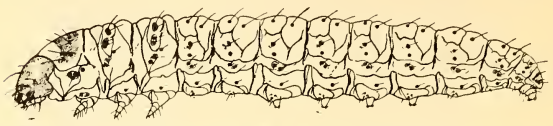


FIG. 11.—The pink bollworm: Outline drawing of larva, showing structure. Much enlarged.

The pupa.—Before passing into the pupal state the larvæ usually spend one day in a prepupal stage. The pupa is brown or reddish brown. The prepupal and pupal period lasts from 9 to 12 days during February and March. The pupal period of three specimens lasted 22 days in March, 1921. (Fig. 12.)

The adult.—The adult moth is dark brown or dark grayish brown and has a wing expanse of from two-thirds to seven-eighths of an inch. The forewings are somewhat narrow, pointed, and edged with long brown fringe. The hind wings are somewhat broader, more pointed, and edged with longer fringe. They are usually lighter in color than the forewings.

In St. Croix the minimum time required for development from the egg to the adult stage has been 28 days, and the maximum time under laboratory conditions has been 42 days.

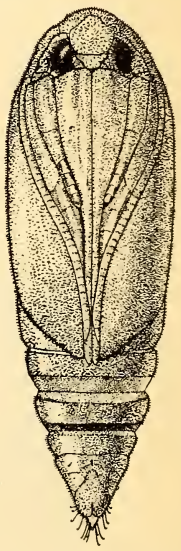


FIG. 12.—The pink bollworm: Pupa. Much enlarged.

CONTROL.

At the present writing cotton growing in St. Croix has been suspended. It is hoped that no cotton will be planted for a period of three years or more, as a closed season is the only practical means of control so far known.

Adult moths of the pink bollworm have been found infested with numerous predacious mites of the genus Pediculoides. When these mites crawl upon the hands and forearms of the pickers they cause severe irritation which results in dermatitis.

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

The southern green stink-bug, also known as the stink-bug, bush bug, green plant-bug, green soldier-bug, green bug of India, pumpkin bug, green bug of cotton, shield bug, and green shield bug, is now found in tropical and neotropical regions all over the world. The

southern green stink-bug inserts its beak into cotton bolls when feeding and thus introduces the fungus causing internal boll disease. (Fig. 13.)

The egg.—The eggs are deposited in compact, hexagonal clusters on the under surface of tomato, tobacco, okra, corn, and many weeds, the individual eggs being firmly glued together in very regular rows. The egg clusters are white or creamy-white when first deposited and later become brownish-pink. Shortly before they hatch, the eggs present a reddish appearance, the color of the nymphs being visible through the shell. The egg clusters contain from 48 to 118 eggs. Under laboratory conditions the eggs hatch in from four to eight days. (Fig. 14.)

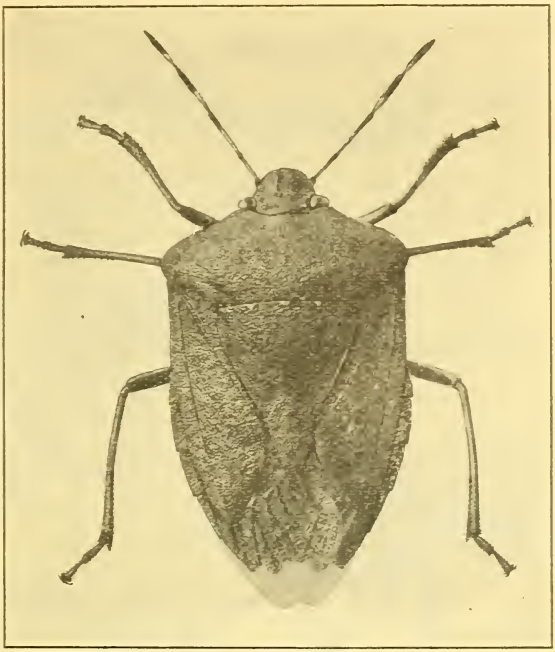


FIG. 13.—Southern green plant-bug (*Nezara viridula*): Adult. Enlarged about 4 diameters.

The nymph.—Five molts occur during the nymphal period. The nymphs of the first instar molt in from 2½ to 4 days; those of the second, in from 5 to 12 days; those of the third, in from 2 to 8 days; those of the fourth, in from 5 to 10 days; and those of the fifth, in from 5 to 20 days. (Fig. 15.) The most rapid development takes place from September to January.

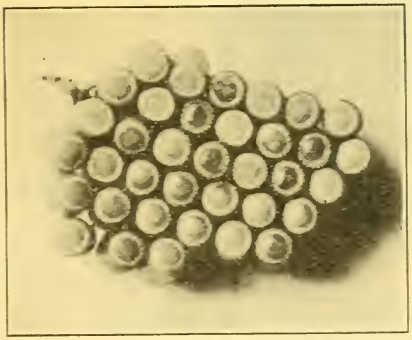


FIG. 14.—Southern green plant-bug: Egg-cluster, viewed from above. Enlarged about 6 diameters.

The adult.—The adult is light green, shield-shaped, and varies considerably in size in both male and female. Both adults and nymphs emit a malodorous substance for protection.

CONTROL.

Hand picking.—Picking by hand is the most satisfactory method of control of the southern green stink-bug on cotton.

Natural enemies.—A dipterous parasite (*Trichopoda pennipes*) is the most important natural control for the green stink-bug in St. Croix. Field collections of *Nezara viridula* show that the largest amount of parasitism occurred in January, when 93 per cent of the

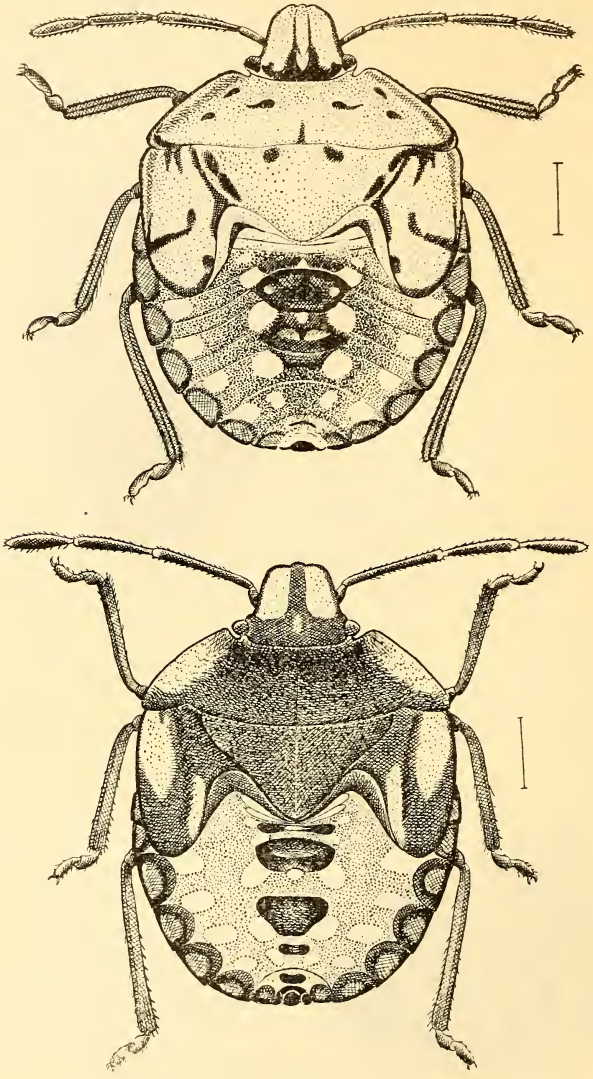


FIG. 15.—*Nezara viridula:* Nymph, fifth instar; light and dark types. Enlarged 6 diameters.

specimens were parasitized. The smallest amount of parasitism occurred in July, when field collections showed 12.28 per cent of the specimens parasitized. (Fig. 16.) The black witch and the gray kingbird eat both nymphs and adults of the southern green stink-bug.

Cotton Stainer (*Dysdercus andreæ*).

Cotton stainers are always abundant on cotton bolls during the winter and early spring months. Only one species is found in St. Croix. The insect is called the cotton stainer because it injures the cotton by staining the lint.

The egg.—The eggs are laid in clusters on the ground or dropped into opening cotton bolls. They are small, yellow, and glistening.

The nymph.—The nymphs are red in color. The development of the nymph is gradual.

The adult.—The adult cotton stainer is red, black, and white. The head and the thorax are red. The latter has a white line on the anterior and posterior margins. Just inside this margin there is a black line. When the wings are folded the dorsal surface is marked with a large white X. Between the upper arms of the X the color is red or reddish-black, while between the lower arms of the X the color is black. A red triangle containing a black spot is found on each wing cover. The lower surface is red and the legs are black red.

Both nymphs and adults live by sucking the juices from the bolls. The staining of the cotton lint takes place when the insects feed.

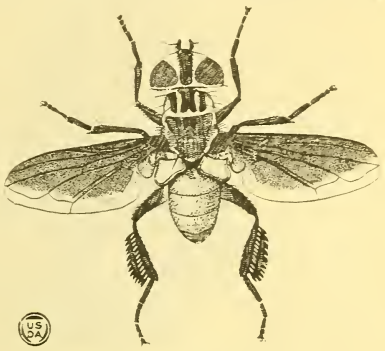


Fig. 16.—*Trichopoda pennipes.* Adult fly, three times natural size.

Control.

Cotton stainers can best be controlled by picking by hand and by trapping. The stainers congregate in groups on the cotton bolls and can be brushed from them into pans containing a little water and kerosene. Handfuls of cotton seed, dropped on the ground between rows of cotton, attract large numbers of the stainers.

Bollworm (*Heliothis obsoleta*).

The bollworm, cotton bollworm, corn earworm, tomato fruit worm, and budworm, as it is called, is found in most of the temperate and tropical regions of the world. (Fig. 17.) The larvæ feed on a large variety of plants, but severely injure corn, cotton bolls, tomatoes, and tobacco.

The egg.—The eggs are small, white in color, and are oviposited on the leaf or fruit of the host plant. They hatch in from 2½ to 7 days.

The larva.—The larva, upon hatching, feeds upon the eggshell and then upon the host plant. At this time it has a yellowish-white body and a black head. Six molts occur during the larval period. The adult larvæ vary greatly in color, ranging from pale green to pinkish, gray green, light and dark brown, grayish black, and almost black. The full-grown larva is about 1½ inches long, and pupates in the ground at a depth of from 2 to 4 inches. (Fig. 18.)

The pupa.—The pupa is incased in an earthen cell. The pupa is a smooth, shining brown in appearance. The pupal stage lasts from 14 to 18 days. (Fig. 19.)

The adult.—The adult moth has a wing expanse of from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches. The adult ranges in color from pale grayish green to almost brown. (Fig. 20.)

FIG. 17.—Cotton boll with full-grown bollworm eating into tip.

CONTROL.

Large numbers of the bollworm larvæ are killed by the use of Paris green when it is applied to the cotton plant for the control of the cotton worm (*Alabama argillacea*).

The bollworm is parasitized by the following hymenoptera: *Chalcis robusta*, *C. annulata* (?), *Spilochalcis femorata*, *S. vittata*, and *Enicospilus concolor*, and by the fly *Exorista pyste*. The preda-

ceous ground beetle *Calosoma calidum* eats the larvæ when they drop from the plant to pupate. The adult moths are caught by the gray kingbird and the black witch.

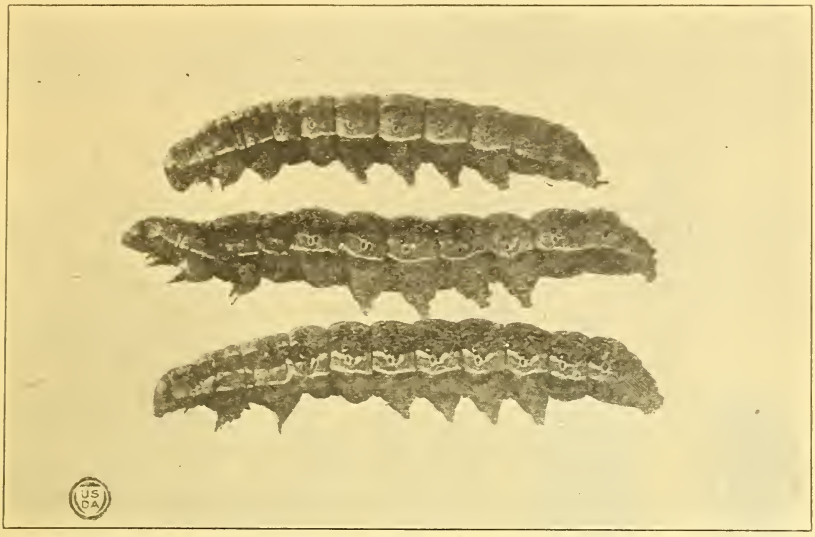
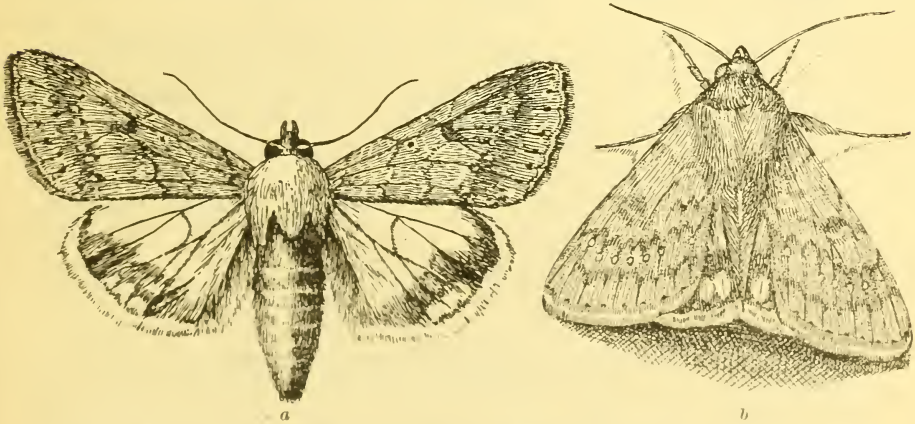


FIG. 18.—Three cotton bollworm larvæ, seen from the side, showing color types. Upper larva, green; middle larva, rose colored; lower larva, dark brown.

FLOWER-BUD MAGGOT (*Contarinia gossypii*).

The flower-bud maggot occasionally attacks cotton flower buds in St. Croix. Its presence may be noted by the flaring of the bracts of



a *b*

FIG. 19.—Adults of cotton bollworm: *a*, With wings spread; *b*, in resting position, wings folded. Twice natural size.

the flower buds. This worm causes the squares to drop, resulting in a small crop.

The eggs are laid in the young flower buds of cotton. On hatching, the larvæ feed inside the flower bud, causing the death of the bud.

The larvæ are yellowish-white or pinkish in color and when full grown are about 2 millimeters long. Pupation takes place in the soil. The adult fly is a minute insect, about one-sixteenth of an inch long. The face is fuscous, and the eyes are large. The scutellum is yellowish and the abdomen greenish-yellow.

The flower-bud maggot has not been found generally distributed in the cotton fields during the past three years, and control measures have not been needed.

Bollworm (*Heliothis virescens*).

The bollworm, also known as the tobacco budworm, is usually found with the cotton bollworm (*H. obsoleta*). The habits of the two species are the same. Only a few larvæ have been taken from cotton bolls in St. Croix, but they have been present in some numbers in okra pods and tobacco-seed pods. The life histories of *H. obsoleta* and *H. virescens* are almost identical.

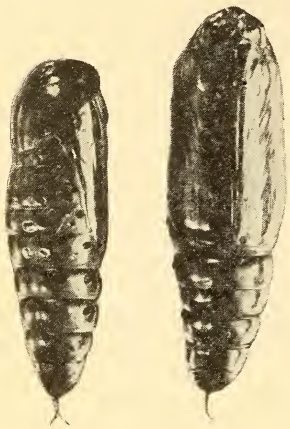


Fig. 20.—Pupæ of cotton bollworm. Twice natural size.

The full-grown larvæ are usually yellowish-green and pupate in the soil. The adult moth has a wing expanse of 1¼ to 1½ inches. The forewings are olive green crossed transversely by three lighter colored lines. The hind wings may be a shining white or white with the outer third brown or pink.

Control.

This species is controlled by the same method used to combat the cotton bollworm (*Heliothis obsoleta*).

Pink Scavenger Worm (*Pyroderces rileyi*).

The larvæ of the pink scavenger worm or pink cornworm has been found only in diseased bolls or bolls in which pink bollworms (*Pectinophora gossypiella*) have worked. It can not be considered a pest of cotton.

The egg.—The eggs are small, pearly white and shining. They are deposited singly or in groups of 3 or 4 between rows of grain, on ears of corn, and on corn silks.

The larva.—When they are first hatched the larvæ have creamy or yellowish-white bodies and a dark head. The body soon changes to pinkish color, but the head remains dark. When they are full grown the larvæ measure about one-third of an inch in length.

The pupa.—The pupa is a light yellowish-brown and is smooth and shining.

The adult.—The adult moth has a wing expanse of one-third to one-half inch. The forewings are banded and mottled with yellow, light brown, and black. About two-thirds of the basal margin has long fringe. The hind wings are very narrow and have very long fringe on the basal portion and shorter fringe on the anterior mar-

gin. The color of the hind wings is grayish-brown. The adult moth is very active.

Control measures are not necessary for this species on cotton.

Zenodochium citricolella.

This moth is found only in diseased bolls or in bolls that have been attacked by the bollworm. It can not be considered of economic importance to the cotton crop.

Plant-bug (*Phthia picta*).

This plant-bug is commonly found in St. Croix, but seldom attacks cotton. Its favorite food plant is the fireweed (*Datura metel*). Unless the field is kept free of this weed, *P. picta* may be expected to attack cotton bolls.

The eggs are brown and are deposited in clusters of 10 to 90 on either surface of the leaves of fireweed (*Datura metel*). They hatch in from 4 to 8 days. The nymphs are red and congregate in groups. The adult is dark brownish-black, with a narrow orange-red line on the anterior and lateral margins of the thorax, and a broad yellowish or orange-red band on the posterior margin. This band is absent in some specimens. Both adults and nymphs feed by sucking the juice from the plant. (Fig. 21.)

Fig. 21.—*Phthia picta:* Adult male. Much enlarged.

Control.

Picking by hand is probably the best method of controlling *P. picta* on cotton. The bugs can easily be knocked into receptacles containing water and kerosene if the plant is jarred.

Spined Stink-bug (*Arvelius albopunctatus*).

The spined stink-bug has not been found in sufficient numbers to be of economic importance. Its habits and life history are almost identical with those of the southern green stink-bug (*Nezara viridula*). In its nymphal stage *A. albopunctatus* is dark reddish-brown in color. Measures are not needed to control this insect.

Large Squash Bug (*Leptoglossus gonogara*).

The large squash bug is more frequently found attacking guava (*Psidium guava*) than any other plant. These bugs rarely become numerous enough on cotton to attract attention.

The eggs are laid in a single row, usually on the stem of the plant. They hatch into red and black wingless nymphs, which molt several times before reaching the adult stage. The adult is a large brownish-black bug. Both nymphs and adults feed by sucking the juices from the plant.

CONTROL.

The large squash bug is best controlled by hand picking. The nymphs and adults are easily brushed into a receptacle containing water and kerosene.

MISCELLANEOUS NOTES.

The writer has made no effort to systematically collect the Orthoptera, Hymenoptera, Diptera, and Neuroptera that frequent the cotton plant. The three species of economic importance are the assassin bug (*Zelus longipes*), a praying mantis, and a lace-winged fly or aphis-lion. These insects are predacious on insects attacking cotton. *Z. longipes* is found feeding on lepidopterous larvæ and nymphs of other Hemiptera. The praying mantis feeds on a number of different species, and the lace-winged fly in both larval and adult stages feeds upon aphids.

Aphids and coccids are always found attended by the fire-ant (*Solenopsis geminata*).

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