Controlling

TOBACCO INSECTS

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Kentucky Agricultural
Extension Service

By H. H. JEWETT

CONTENTS

Agricultural Extension Division

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SUGGESTIONS FOR SPRAYING TO CONTROL TOBACCO INSECTS

1. Make frequent inspections of your tobacco to detect insects and apply insecticides when needed.

2. Apply insecticides at the concentrations and in the amounts suggested in this bulletin.

3. Use spraying machines that are adequate for spraying or dusting the amount of tobacco you are growing.

4. Several of the insecticides, as formulated, contain varying amounts of the toxic chemicals; for that reason the actual amounts of the toxic chemicals needed are generally stated in the recommendations.

5. Apply insecticides (especially in sprays) during the cooler parts of the day. Plants may be injured if the temperature is 90° F or warmer.

6. Be sure the insecticides you use have not been contaminated with 2, 4-D or other herbicide. This can happen when containers, measuring cans or other equipment has been contaminated with 2, 4-D. When possible buy your insecticides in unbroken packages.

CAUTION—USE CARE TO PREVENT INJURY

It must be remembered that all insecticides mentioned in this bulletin are toxic to warm-blooded animals and should be handled with care, especially when in the form of concentrates. Parathion is the most toxic of the insecticides recommended for use.

Persons who are handling or applying insecticides should practice all the precautionary measures considered necessary for safety. When necessary, precautionary measures are stated on the labels on the containers of insecticides. Injuries may be caused by absorption of insecticides by the skin, by inhalation, and by ingestion. Most injuries are caused by carelessness in handling and applying the insecticides.

Controlling Tobacco Insects

By H. H. Jewett

The tobacco plant may be attacked by insects from the early seedling stage until harvest. Thus it is necessary to provide some measure of protection for the plants in beds until they are pulled and, later, when they are transplanted and growing in the field. Control of the insects is mainly achieved by application of insecticides, but certain farm practices are often helpful. Frequent inspection of plants in the bed and field is necessary to detect which insects are present and to learn the extent of their damage.

The number of insects that attack the tobacco plant is not large, but some of them are capable of doing a great deal of damage. Sometimes the insects are referred to as either plant-bed insects or field insects, but several are destructive in both bed and field.

KEY TO INSECTS INJURIOUS TO TOBACCO PLANTS

Insects Injuring Plants in the Bed

1. Immature insects damaging plants by burrowing into and disturbing the soil.

(a) Large white grub burrowing into and working up the soil. The grub crawls on its back.

GREEN JUNE BEETLE GRUB (PAGE 10)

(b) Small worm-like whitish maggot that damages germinating seed in patches in the bed by loosening and pulverizing the soil, which interferes with the rooting of the seedlings.

MIDGE MAGGOT (PAGE 18)

(c) Tough, leathery, gray maggots, about 1 inch long, tunneling and working the soil near the surface.

CRANE FLY MAGGOT (PAGE 18)

2. Small jumping insects that feed on leaves.

(a) Very small globular, jumping insect, purplish or slate colored, spotted with yellow, 1/25 inch long. Attacks very small seedlings.

GARDEN SPRINGTAIL (PAGE 15)

(b) A jumping beetle 1/16 of an inch long, dark brown on the back with darker colored marks of irregular shape on the wing covers. Eats small round holes in the leaves.

TOBACCO FLEA BEETLE (PAGE 12)

3. A small, soft, greenish plant louse, found generally on the underside of the plant leaves.

GREEN PEACH APHID (PAGE 14)

4. Soft, moderately stout worms with rounded bodies, 1½ to 2 inches long. The worms vary in color from gray to grayish brown with dark spots or lines on their bodies. They eat large holes in the leaves and cut off stems close to the soil.

CUTWORM (PAGES 20, 21)

5. Pests other than insects.

(a) A slug about ¾ to 1½ inches long, yellowish to brown or black. It leaves a trail of slime when it crawls. Hides under clods, leaves, etc., in beds. Eats irregular holes in the leaves.

SLUG (PAGE 16)

(b) A round worm about 1 inch long with two pairs of legs on each apparent body segment. Feeds on leaves next to the soil and prefers damp or moist soil.

MILLIPED (PAGE 17)

Insects Injuring Plants in the Field

6. Larvae tunneling, girdling, or cutting off plants.

(a) Hard, yellowish to brown, shiny, slender, nearly round worms, ½ to 1 inch long, in the stalks of newly set plants or in the soil near the plants. Plant stalks are

tunneled out sometimes, causing the plants to wilt severely, usually within a day or two after having been transplanted.

WIREWORM (PAGES 22, 23)

(b) Very active worms, ½ to 1 inch long, accompanied by a silken web or tunnel. Worms make partial tunnels in young tobacco plant stalks or partially girdle the stems.

SOD WEBWORM (PAGE 32)

(c) Worms (as 4, above) which cut off young plants and eat parts of leaves. Sometimes the worms climb larger plants and cut off leaves.

CUTWORM (PAGES 20, 21)

(d) A brown worm, ¾ to 2 inches long, found tunneling in rather large tobacco plant stalks. All but the large worms have a white stripe down the back with broken white stripes on the sides.

COMMON STALK BORER (PAGES 30, 31)

7. Sucking insects on leaves of plants.

(a) A small greenish plant louse (as 3, above) found on under-surface of leaves and on the buds of plants.

GREEN PEACH APHID (PAGE 14)

(b) A large, flat, shield-shaped bug, about ½ inch long, grayish or greenish-yellow to brownish colored. It pierces the mid-rib of leaves, and causes them to wilt.

STINK BUG (PAGE 29)

8. Insects that eat holes in leaves.

(a) A small jumping beetle (as 2b, above) that eats small round holes in newly transplanted plants, sometimes completely riddling the leaves. Older plants not so seriously injured.

TOBACCO FLEA BEETLE (PAGE 12)

(b) Large jumping or hopping insects that eat small to large areas of the leaves, often doing a great deal of damage.

GRASSHOPPER (PAGES 33, 34)

(c) Worms about 1½ inch long, varying in color from light green to brown with light and dark stripes running the length of the body. They bore into the buds of plants that have made considerable growth, and when the buds expand the leaves have a ragged appearance. The worms also eat seed heads.

Corn Earworm (false bud worm) (pages 26, 27)

(d) Worms similar in shape and size to 8c (above), but the color of nearly mature worms is green with lighter stripes running the length of the body. Only an occasional worm found in central Kentucky. Plants injured as 8c above.

Tobacco Bud Worm (page 29)

(e) Large green worms with prominent horn-like appendages at the rear end of their bodies. These worms, when maturing, eat large holes or extensive areas of the leaves, sometimes leaving only the mid-rib.

Hornworm (pages 35, 36, 37)

INSECTS IN THE BEDS AND FIELDS

The insects most commonly found in plant beds in Kentucky include tobacco flea beetles, cutworms, green peach aphids, green June beetle grubs, springtails, crane fly maggots, and maggots of midges. Slugs are present nearly every year, and millipeds sometimes do considerable damage. Slugs and millipeds, however, are not insects.

Some of the insects that infest beds also attack plants in the field. Among these are the tobacco flea beetle, several kinds of cutworms, and the green peach aphid. In addition, several other insects attack tobacco and some, when numerous, may be very destructive. The more important ones are wireworms, budworms, hornworms, grasshoppers, and sod webworms.

Measures for Protecting Plants in Beds

A great deal of damage to plants in the bed may be prevented when measures are taken to kill insects in the soil and prevent other insects from entering the bed. These measures include:

(1) burning the bed, (2) steaming, (3) fumigation with methyl bromide, and (4) enclosing the bed with a frame covered with tobacco cotton. The first three measures kill grass and weed seed and many of the insects in the soil. Methyl bromide fumigation is more effective than either burning or steaming. A well-covered board frame around a bed will keep most insects from entering the bed.

The degree of control of white grubs and other soil insects accomplished by burning, steaming, or fumigation is affected by the mechanical condition of the soil and its moisture content and temperature. Also important, are the kind of wood used in burning beds, the pressure of steam in the boiler, and the length of time of exposure.

Burning

To kill insects and weed seeds near the surface requires the burning of fairly large wood for at least 30 minutes, even when the soil has been thoroughly prepared and is dry enough for good tillage. The heat should penetrate the soil to at least 3 to 4 inches. Burning may kill all white grubs and other insects to a depth of 6 inches, but generally to a depth of only about 4 inches.

Steaming

Applying steam at a boiler pressure of 100-125 pounds to well-prepared and fairly dry soil for 25 minutes has been known to kill insects to a depth of 10 inches.

Methyl bromide fumigation

To be effective, methyl bromide fumigation must be applied to thoroughly pulverized soil that is fairly moist. The soil temperature should be 50° F or warmer. Cover the bed with a gas-proof covering and seal the edges with soil; then release 1 pound of methyl bromide gas to 100 square feet into shallow pans or troughs, using a specially designed applicator. The cover should be removed after 24 to 48 hours. Methyl bromide gas is poisonous and will kill a good percentage of all insects to the depth of the plow line.

Cover for bed

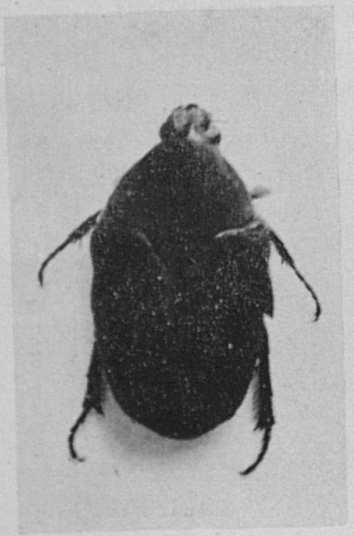
A frame of boards, 6 inches wide, covered with a good grade of tobacco cotton is an effective means of preventing re-infesta-

tion of a bed by insects and other pests. The boards are set on edge around the bed and held in place by pegs. All joints at the ends of the boards must be tight and the soil packed firmly to a height of about 2 inches on the outside of the boards. The cloth cover should be of 25 strands to the linear inch and wide enough to be drawn down 1 or 2 inches outside of the top edge of the boards where it can be fastened. The boards if cared for will be useful for 3 to 5 years.

DESCRIPTION AND CONTROL

Green June Beetle

The larvae of the green June beetle, *Cotinis nitida* (L.), often cause a great deal of damage to very young tobacco plants. They live in the soil and, by tunneling and burrowing in the soil of tobacco plant beds, uproot seedlings and prevent them from becoming established in the soil. When many grubs are present in the beds, the surface soil becomes loose and more or less pulverized. The grubs feed mainly on the humus in the soil and do little if any feeding on plant roots. Since the grubs live in soil rich in humus, the tobacco beds should be established in a field some distance from farm buildings because the soil near such buildings is nearly always infested by the grubs. Green June beetle larvae can be easily recognized because of their habit of crawling on their backs.



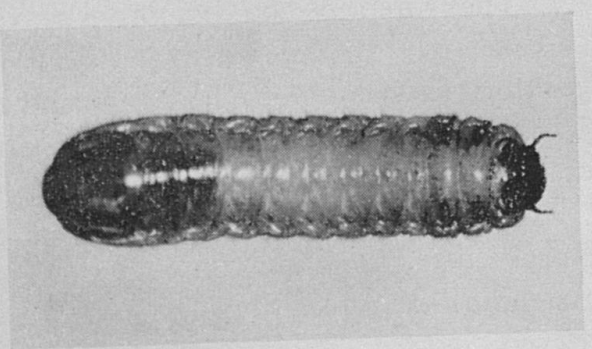


Fig. 1. (left) Green June beetle, X 1½.

Fig. 2. (above) Green June beetle grub, X 1½.

Life history and appearance

The green June beetle is a common and conspicuous insect in Kentucky. The velvety-green beetle (Fig. 1) attacks ripening fruits, such as grapes, peaches, and berries, and the large white grubs (Fig. 2) are often pests in soils of lawns, golf greens, gardens, and plant beds. The larvae complete their growth in late spring; the beetles begin emerging from the soil late in June and are most numerous the last half of July. Most of them will have died by August 15. They lay their eggs in soils rich in organic matter, generally near manure piles, old straw stacks, or piles of decaying vegetation. In open fields, the beetles frequently place their eggs near cattle droppings. The eggs hatch within 2 to 3 weeks, and the grubs grow rapidly and are two-thirds to nearly full-grown when cold weather arrives, at which time they move into the soil to a depth as great as 18 inches. Most of the grubs pupate in May.

Control in the bed

Parathion: (1) Dust with 2 pounds of 1-percent parathion dust to 100 square yards of plant bed. Apply the dust through the covering of the bed when dry or lift the covering on one side and apply the dust; or (2) spray or sprinkle the soil with 1 pound of 25-percent parathion wettable powder in 100 gallons of water at the rate of 10 to 12 gallons of water to 100 square yards of bed.

Tobacco Flea Beetle

The tobacco flea beetle, *Epitrix hirtipennis (Melsh.)*, is a small beetle approximately 1/16 inch in length. It is dark brown with darker colored marks of irregular shape on the wing covers. The beetle hops like a true flea, a trait which helps one in identifying the insect (Fig. 3).

Life history

The beetles hibernate in the adult stage under loose litter or other materials near plant beds or tobacco fields. They become active in early spring and feed upon wild solanaceous plants if available, but usually young tobacco plants appear in the beds as early or earlier than the wild host plants.

The beetles that live over winter begin laying their eggs

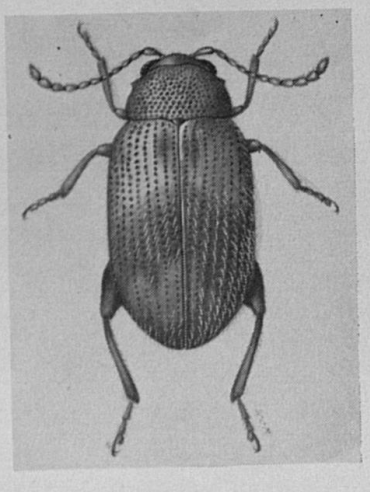


Fig. 3.— The tobacco flea beetle, *Epitrix hirtipennis*, X 20.

early in May, but eggs are laid at least until September 1 by the beetles that emerge from hibernation in the spring and by the broods of adults that develop during the summer. The adults appear in 23 to 45 days after the eggs are laid, and three broods may develop during the season.

Injury

The beetles attack the plants in the beds and eat small circular areas from the leaves, leaving small round holes. When numer-

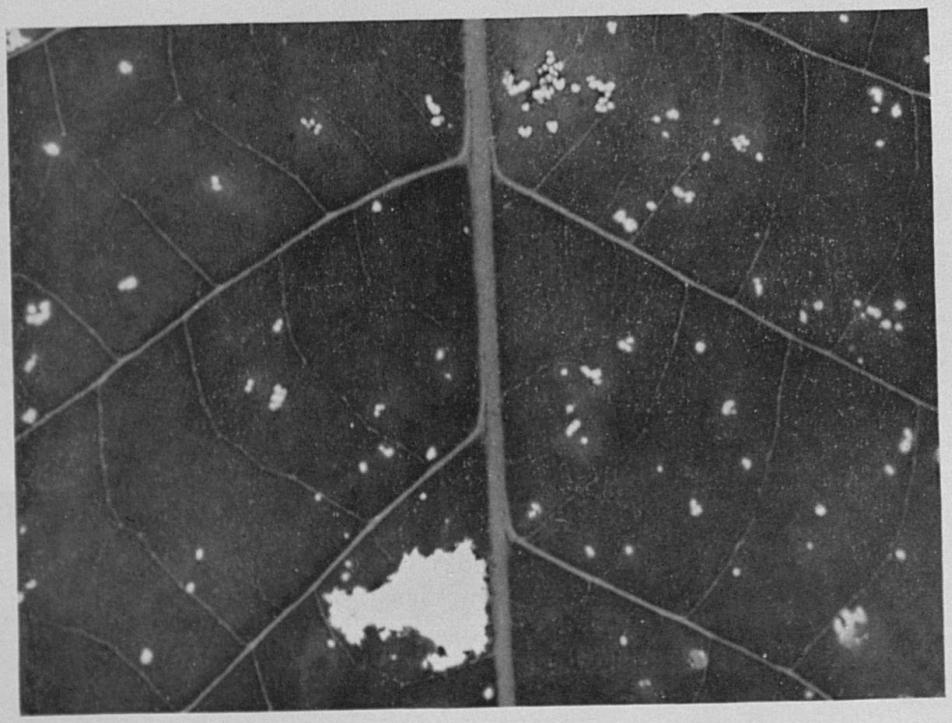


Fig. 4.— A leaf showing injury by the tobacco flea beetle.

ous, the beetles may destroy practically all plants in a bed. In central Kentucky, they are generally less destructive than in the western part of the state (Fig. 4).

Control in the beds

There should be little need for insecticides to control the tobacco flea beetle in beds that have been protected by a cloth-covered board frame, but when little or no protection has been provided some insecticide may be needed. Several of the newer organic insecticides will control this beetle, but none is better than DDT.

DDT: (1) Dust the plants with 1 pound of 10-percent DDT dust to 100 square yards of bed; or (2) spray with 2 pounds of 50-percent wettable DDT powder in 100 gallons of water at the rate of 3 to 5 gallons per 100 square yards.

Repeat the dusting or spraying in a few days if beetles are still present. Make the last treatment a short time before pulling the plants as this will protect them for several days in the field. Destroy the plants remaining in the bed soon after setting is completed.

Control in the field

The tobacco flea beetle sometimes injures newly transplanted plants so severely that the plants die or make little growth. Generally the entire field of tobacco is not injured severely, but areas up to one-half acre or larger may be completely ruined. The tobacco grower should not neglect to check newly transplanted plants for possible flea beetle injury. It is seldom necessary to apply control measures for flea beetles when the plants have made considerable growth.

DDT: (1) Dust with 10-percent DDT dust at the rate of 5 to 10 pounds per acre on young plants and 10 to 20 pounds on large plants; or (2) spray with 2 pounds of 50-percent wettable powder in 100 gallons of water for good coverage of the plants. If the plants are large, 50 or more gallons will be needed per acre, or (3) spray with 1½ pounds of DDT per acre in a diluted emulsion concentrate at the rate of 5 to 15 gallons per acre by a low-pressure sprayer.

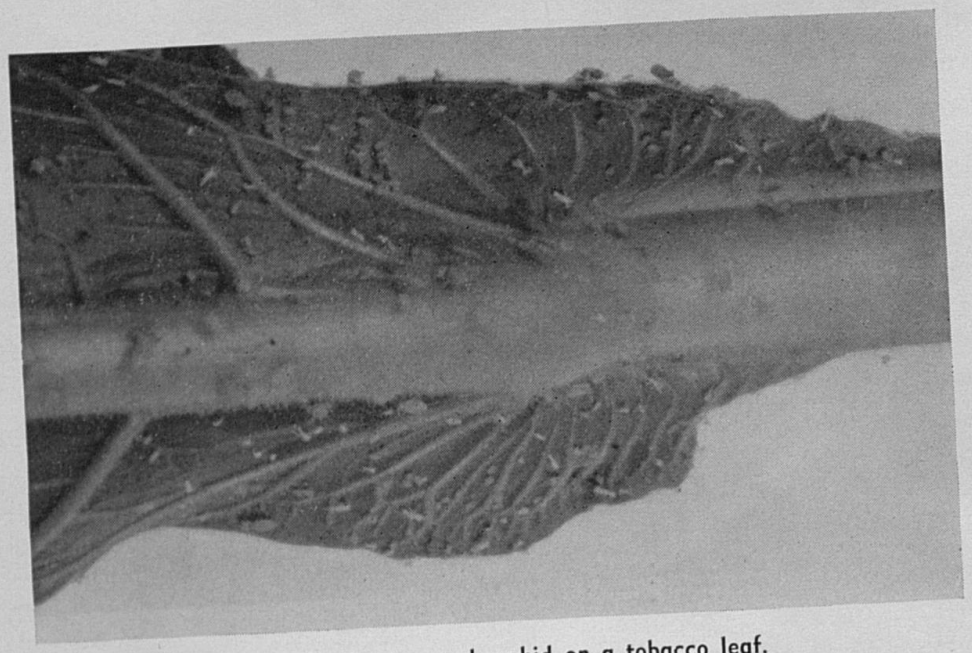


Fig. 5.— Green peach aphid on a tobacco leaf.

Green Peach Aphid

The green peach aphid, *Myzus persicae (Sulzer)*, has been known in the United States for many years and has been found on a wide range of plants, including some deciduous fruits, vegetables, flowering plants, and ornamental shrubs (Fig. 5). In 1946, moderate infestations on tobacco by this aphid developed in several states, but the reason for the sudden attack on tobacco is not clear. This aphid now does considerable damage to tobacco in several counties in Kentucky.

Tobacco plants in beds infested by this aphid are not injured greatly, but infested plants when transplanted in the field cause many colonies of the aphid to become established and a general infestation to occur.

The aphid injures plants (1) by sucking the juices of plants and (2) by depositing honeydew excretions upon the leaves. The extraction of juices from the leaves causes thin light-weight leaves, and the honeydew and the resulting mold that develops upon it cause the leaf to cure a dark off-color, of poor quality.

Control in the beds

Parathion: (1) Dust the plants in the beds with 2 pounds of 1-percent parathion dust to 100 square yards; or (2) spray

with 1 pound of a 15-percent wettable powder in 100 gallons of water at the rate of 3 to 5 gallons to 100 square yards.

Malathion: (1) Dust the plants with 4-percent malathion dust at the rate of 2 pounds per 100 square yards; or (2) spray with 3 pounds of 25-percent wettable powder in 100 gallons of water at the rate of 3 to 5 gallons per 100 square yards of plant bed.

Control in the field

Parathion: (1) Dust patches of plants that are infested or the entire field with 1-percent dust at the rate of 10 to 30 pounds per acre according to the size of the plants; or (2) spray with 1 pound of a 15-percent wettable powder in 100 gallons of water at the rate of 50 to 80 gallons per acre according to the size of the plants.

Malathion: (1) Dust with 4-percent malathion dust at the rate of 20 to 30 pounds per acre or with 5-percent malathion dust at 15 to 25 pounds per acre; or (2) spray with 1 to 1½ pints of the emulsifiable concentrate in 50 to 80 gallons of water per acre. Malathion is not so effective as parathion but may be preferred by some growers because it is less toxic to warm-blooded animals.

The Garden Springtail

The garden springtail, *Bourletiella hortensis* Fitch, is about 1/25 inch long and is slate colored, spotted with yellow. The body is globular with a rather large head and narrow back. Because of its jumping habit and its shape and color, farmers call this insect a flea (Fig. 6). It prefers rather damp places in which to live.

This insect does most of its damage when tobacco plants are in the two- or four-leaf stage; and when numerous, they some-

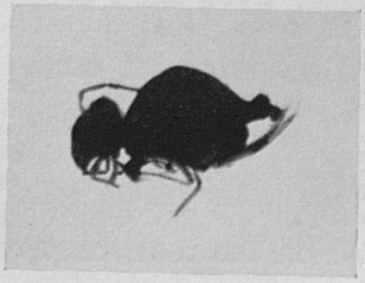


Fig. 6.— Garden spring tail, X 15.

times defoliate the young plants in considerable areas in the bed. Fortunately, they do not appear every year in destructive numbers.

Control

Parathion: (1) Dust with 1-percent parathion dust at the rate of 2 pounds of dust to 100 square yards of plant bed; or (2) dust with 1.5-percent lindane dust at the rate of 3 pounds to 100 square yards of plant bed.

Slugs in Plant Beds

Slugs are of considerable importance because of their attacks on tobacco in plant beds. They chew out irregular holes in the leaves of plants. They can be detected because they leave a trail of slime where they crawl. Their colors vary from whitish yellow, with shades of yellow, to black, with mottlings and spotting of shades of brown. Because slugs mainly feed at night, they come out of hiding from under boards, rocks, or various damp refuse in the evenings (Fig. 7).

Control

Hydrated lime: (1) Apply hydrated lime in a band 3 or 4 inches wide around a bed to prevent the slugs from entering the bed; or (2) dust the plants and surface of the soil in the evening with hydrated lime at the rate of 3 or 4 pounds to 100 square yards of plant bed. The soil and the plants must be dry for the lime to be very effective.

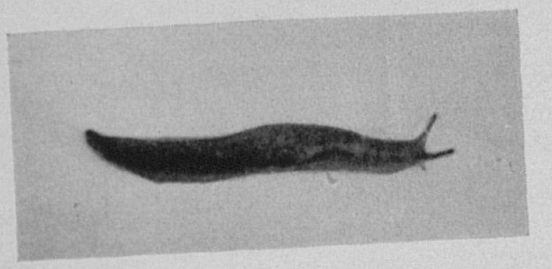


Fig. 7.— A slug found in plant beds.

Parathion: Dust the plants and soil with 1-percent parathion dust at the rate of 2 pounds to 100 square yards of plant bed.

Millipeds

Millipeds are sometimes mistaken for wireworms, but they do feed on the roots of plants and, like wireworms, tunnel into

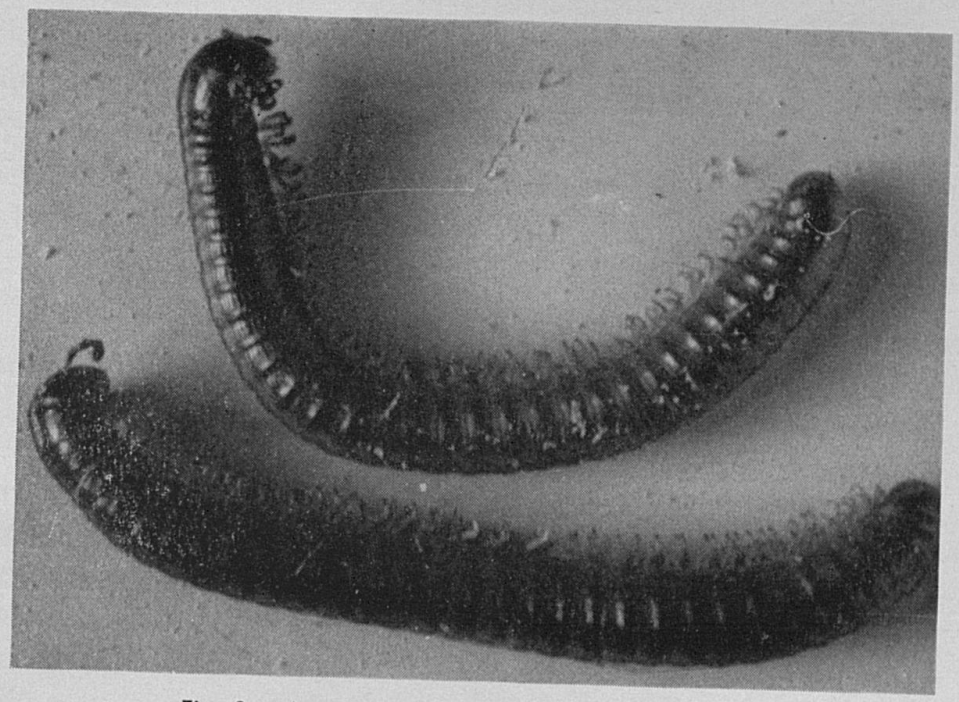


Fig. 8.— A milliped found injuring seedling plants.

roots of vegetables and tubers, eat planted seeds, and leaves of plants. One particular milliped, *Brachyiulus littoralis* Veroeff, is sometimes found in tobacco plant beds. Millipeds feed on small seedlings in plant beds, and sometimes destroy most of the plants in parts of the beds (Fig. 8).

Millipeds have a simple development. The eggs are laid in the soil and hatch into small worms which differ from full-grown adults by having fewer segments and legs. Full-grown worms of different species are 1 to 2 inches long and have two pairs of legs to each apparent body ring. As a rule, millipeds live in damp soil and feed on decaying vegetation.

Control

DDT. Apply a 10-percent DDT dust at the rate of 1 pound to 100 square yards of bed.

Chlordane: Apply a 5-percent chlordane dust at the rate of ½ pound to 100 square yards of plant bed.

Parathion: Apply a 1-percent parathion dust at the rate of 2 pounds per 100 square yards of bed.

Midges

Midge maggots sometimes infest tobacco plant beds. The small whitish worm-like maggots are sometimes numerous enough to cause damage by burrowing and disturbing the soil to such an extent that the plants dry out. The adults are sometimes mistaken for mosquitoes.

Control

DDT: A 10-percent DDT dust, applied at the rate of 1 pound to 100 square yards of bed, is an effective control measure.

Parathion: A 1-percent parathion dust, applied at the rate of 2 pounds per 100 square yards of plant bed, is also effective.

The cover of the bed must be dry as well as the plants when dusts are applied through the cover in order to get the insecticide on the surface of the soil.

Smoky Crane Fly

The crane fly larva, *Tipula cunctans* Say, has been found occasionally in tobacco plant beds in Kentucky, and other species have been reported in plant beds in other states. The general color of the larva is grayish brown, and the body is cigar-shaped, about 1/8 inch in diameter and 4/5 inch long. Some appendages are arranged radially on the ventral surface of the last segment. The larvae are often called leather jackets and live over winter partly grown. The flies have very long, slender legs, with the bodies being approximately 3/5 inch long. They resemble very large mosquitoes (Fig. 9).

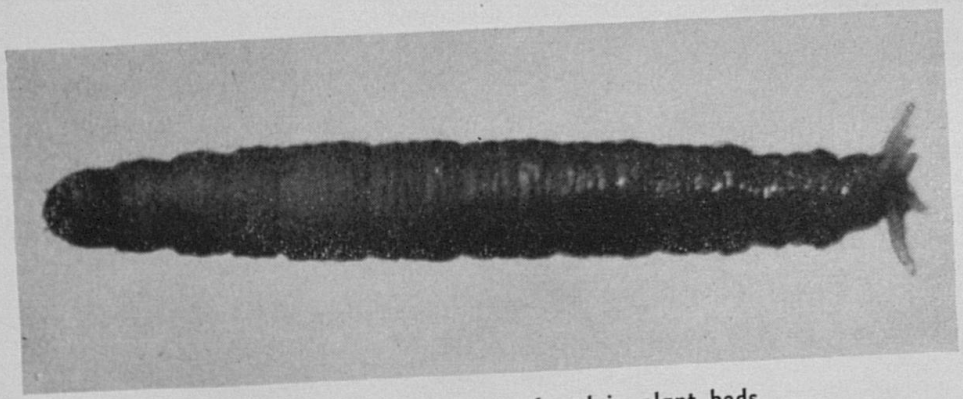


Fig. 9.—Crane fly maggot found in plant beds.

Injury

The larvae live mostly on humus in the soil but have been reported injuring lespedeza in Kentucky. In tobacco plant beds, the larvae loosen the soil at the surface, and in dry weather especially the very young plants do not become well-established in the soil and, consequently, many die. Also it is likely that the larvae cut out portions of the leaves and stems.

Control

A quick kill of the larvae is needed in plant beds, and parathion is effective.

Parathion: (1) Dust with 1-percent parathion dust at the rate of 2 pounds to 100 square yards; or (2) spray with 1 pound of 15-percent parathion wettable powder in 100 gallons of water at the rate of 5 gallons per 100 square yards of bed.

Cutworms

Tobacco in beds and fields is often injured by cutworms, of which approximately 2 dozen species have been reported as injuring tobacco. Cutworms are much more likely to be destructive to tobacco that follows crops that have occupied the land for several seasons, such as forage crops. Some adults, however, will lay their eggs on cultivated land.

Cutworms do their feeding late in the evening and at night, and hide during the day. A worm or two in a plant bed may destroy a considerable number of plants. They feed on the portion of the plants near the surface of the soil, consume portions of the leaves, and cut off stems; sometimes they climb the plants and feed on the leaves and buds, and cut off leaves.

Life history

Cutworms are the larval stage of moths often called "candle flies." The full-grown worms are from 1½ to 2 inches long, have rounded bodies, and are moderately stout. They are soft, and the different species vary from gray to brown, marked with dark lines or spots on the back.

The moths lay many eggs from which the young worms hatch and, after completing their growth, enter the ground to pupate; later the adults appear.

Some species of cutworms live over winter as larvae, others

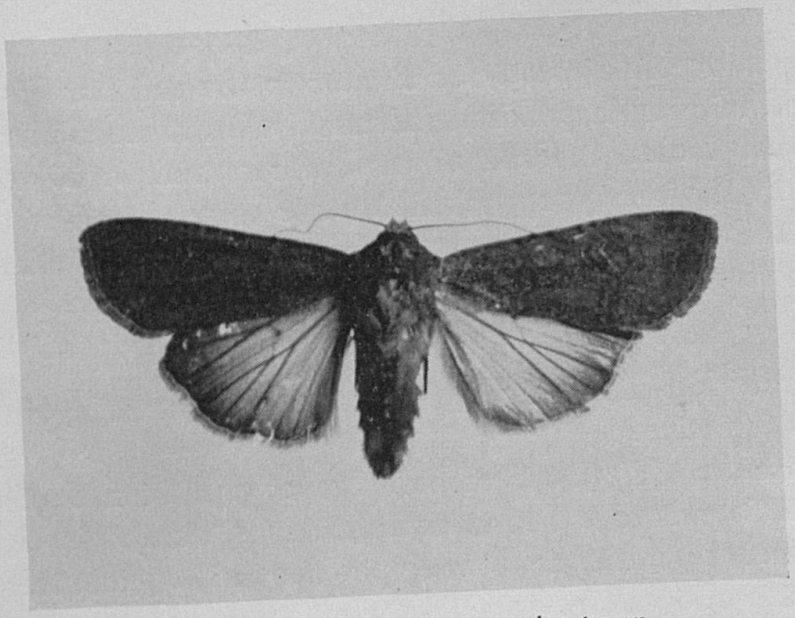


Fig. 10.— Moth of the variegated cutworm.

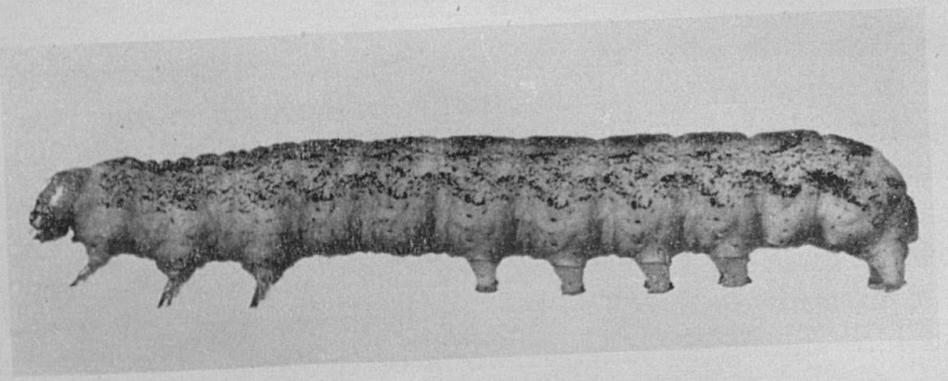


Fig. 11.— Variegated cutworm.

as pupae. Some produce three or four broods of worms a year; others require a year to complete development. The variegated cutworm, *Peridroma margaritosa* (Haworth), a common and destructive species, very likely lives over winter in the pupal stage (Figs. 10 and 11). It appears early in the spring as an adult, and four broods of worms may develop during a year. Another species, the greasy cutworm, *Agriotis ypsilon* Rott., lives over winter in the pupal stage from which moths emerge early in the spring; during the year probably four broods of worms develop. This is one of the most destructive cutworms (Figs. 12 and 13).

Control in the beds

DDT: (1) Dust the plants and soil with 10-percent DDT dust

at the rate of 1 pound to 100 square yards of plant bed; or (2) spray with 2 pounds of 50-percent wettable DDT powder in 100 gallons of water at the rate of 3 to 5 gallons per 100 square yards of plant bed; or (3) apply a bluestone-hydrated lime mixture composed of 3 pounds of bluestone and 4 pounds of fresh hydrated lime and 50 gallons of water to which has been added ½ pound of 50-percent DDT wettable powder. This is an effective control of cutworms when applied at the rate of 1 quart to 1 square yard of bed.

Control in the field

DDT: Dust the plants and the ground around the plants with a 10-percent DDT dust.

Endrin: Endrin at the rate of 0.2 pound per acre has been

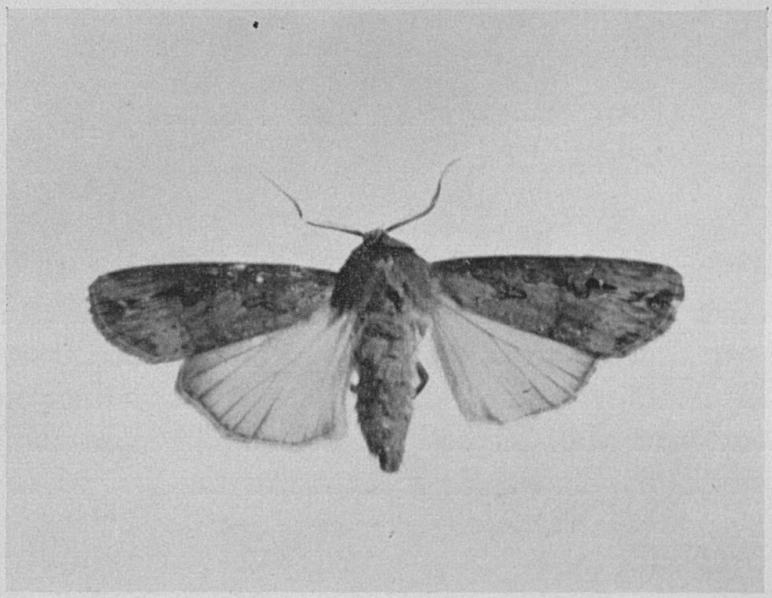


Fig. 12.— Moth of the greasy cutworm.

Fig. 13.— Greasy cutworm.

used to control armyworms. The manufacturers of endrin report excellent control of cutworms on some crops.

Wireworms

Several different wireworms attack tobacco plants in Kentucky, but the one responsible for about 90 percent of the injury to newly transplanted plants is *Aeolus mellillus* (Say) (Fig. 14). This wireworm attacks crops other than tobacco, including corn,

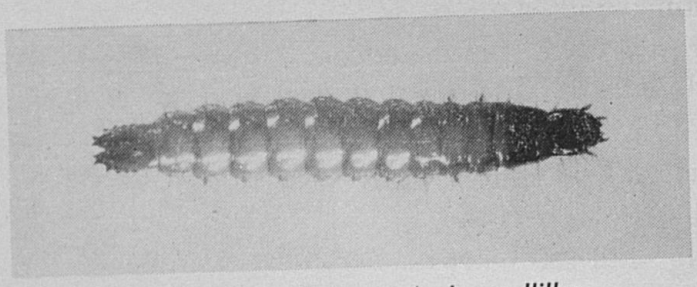


Fig. 14.— The wireworm, *Aeolus mellillus.*

different grasses, and vegetables. Bluegrass sod is the favorite habitat of *A. mellillus,* and any crop in the rotation that includes bluegrass or other grasses is subject to attack. Sod 3 or 4 years old usually contains about as many wireworms as does older sod. The second year after the sod has been broken the number will be only about one-half as large as it was the first year.

Injury to tobacco

Because of their long life-period wireworms may be found feeding on tobacco plants throughout the growing season. Their attacks on newly transplanted plants, however, cause the greatest concern. Newly transplanted plants are attacked almost immediately. The worms bore into and make tunnels in the plant stalks, sometimes through their entire length and through the buds if the stalks are short. The worms often make exit holes from the tunnels near the surface of the soil. The injury to the bud often causes a deformed plant (Fig. 15).

Tender plants are more severely injured than well-hardened plants, and slender plants do not withstand injury as well as do large plants. An obvious indication of severe injury is the more or less complete wilting of the plants. Severely injured plants are often dwarfed early in the season. While the percentage of plants fed on by wireworms may be as great as 75 percent, very few plants are really injured severely.

Stages of the insect

The beetles (commonly called click beetles) are small, about 1/5 inch long, and elongate-oblong in shape. The color is dull reddish brown, and there are spots and irregular black marks on the body and wing covers. The pupae are white when newly formed and have dark eye-spots when nearing maturity. The eggs are white and glossy when newly laid, nearly spherical in shape, and can just barely be seen. The larvae are small, about ½ inch long, and the body is slightly flattened, smooth, and yellow, with parts of the body marked with red or reddish brown.

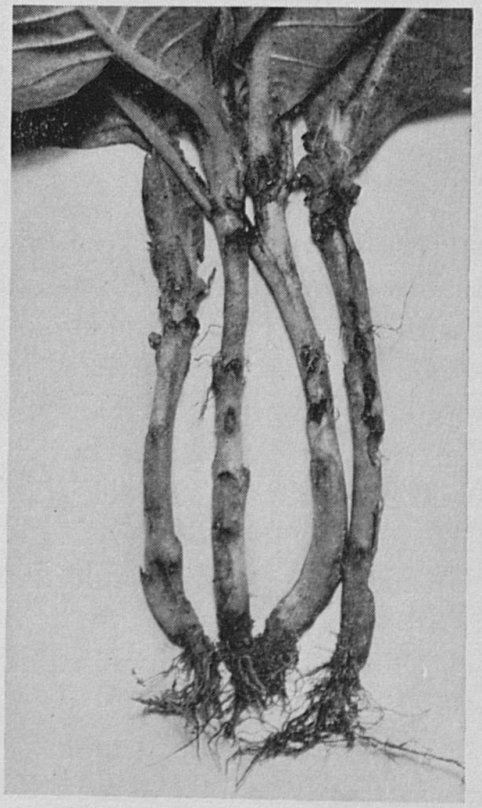


Fig. 15.— Young tobacco plants showing wireworm injury to the stalks.

Seasonal history

Adults and larvae live over winter. The adult group is composed of the first-generation adults of the previous season and the spring-brood adults. The spring-brood adults are those that develop from the overwintering larvae. The overwintering larvae are composed of first- and second-generation larvae of the previous season. Adults may live for several months. From part of the eggs laid in early spring, a brood of adults may develop in about 75 days, but from the rest of the eggs, a year or slightly more may elapse between egg-laying and appearance of the adults. Larvae that live over winter are the ones that attack newly transplanted tobacco plants, but larvae may be found around the roots the entire growing season.

Control

Control by Selection of Plants Resistant to Injury

The different varieties of tobacco that are in use are all subject to attack by wireworms, and no one variety seems to be attacked to a greater extent than any other.

The types of plants selected for transplanting, however, differ in their ability to resist injury by wireworms. One should select plants for setting (1) that have stems about the diameter of a lead pencil, (2) that have stems long enough so the bud will not be covered with soil when transplanted, (3) and which are well-hardened.

Control by Soil Insecticides

The practice of applying insecticides to soil where tobacco plants are to be set is not general in Kentucky and ordinarily is not necessary. However, if desired the insecticide may be applied to the soil in a dust or spray after the land has been prepared for the plants—but 2 weeks or more before the plants are transplanted. The soil should be disked lightly after the insecticide has been applied.

Chlordane: Apply chlordane in a dust or spray at the rate of 5 pounds per acre.

Aldrin: Apply aldrin in a dust or spray at the rate of 3 pounds per acre.

These insecticides should give control of wireworms and cutworms for 2 years when used as recommended. Application of

these insecticides to the soil has caused no apparent injury to the plants. Wireworms are difficult to find in the soil and are not present every year in numbers sufficient to cause damage; however, farmers who apply insecticides in setting water each year find the above-mentioned method of control to be a practical substitute for other measures.

Control by Use of Insecticides in the Setting Water

The convenience of applying insecticides in setting or transplanting water makes this process attractive. However, when mixed in water a wettable powder will settle to some extent, requiring the mixture to be stirred at frequent intervals. Where emulsion concentrates are used in setting water, there is much less settling of the insecticide but there is a build-up of strength of the mixture every time the tank is filled if it is not completely drained every time. However, wettable powders are less likely to injure the plants and are therefore to be preferred. Six ounces of setting water is sufficient if placed near the plant roots, but 8 ounces—sometimes a little more—is needed when the setting machine puts out a continuous stream.

A considerable number of insecticides in varying amounts have been applied to plants in the setting water. Tests were made on the Kentucky Agricultural Experiment Station farm on plots plowed out of long-standing bluegrass sod. When the insecticides were applied at the following rates, little if any injury to the plants was observed. However, in 1954 some injury was reported soon after the plants had been transplanted, but several weeks later after considerable rainfall the earlier injuries had practically disappeared. No specific cause of the earlier injuries was determined. Generally the lighter soils require a smaller amount of insecticide than the heavy soils—a fourth less of the insecticides may be used. The insecticides must be weighed carefully, in case dusts are used, or measured accurately if liquids are used.

Insecticides

Chlordane: Mix enough chlordane wettable powder or emulsion concentrate to contain 4 ounces of chlordane in 50 gallons of water.

Aldrin: Mix enough aldrin wettable powder or emulsion concentrate to contain 4 ounces of aldrin in 50 gallons of water.

Lindane: Mix enough lindane wettable powder to contain ½ ounce of lindane.

Corn Earworm

The corn earworm, *Heliothis armigera* (Hbn.), attacks tobacco in Kentucky and is sometimes called the false tobacco budworm (Fig. 16). The tobacco budworm, *Heliothis virescens* (F.), is seldom found attacking tobacco in Kentucky.

The corn earworm attacks tobacco plants in spring after the plants have made considerable growth and sometimes is destructive to the seed heads, late in the season. The worms eat or bore through the leaves when they are still in the bud, and as the leaves unfold the holes in the leaves become larger and the leaves ragged (Fig. 17).

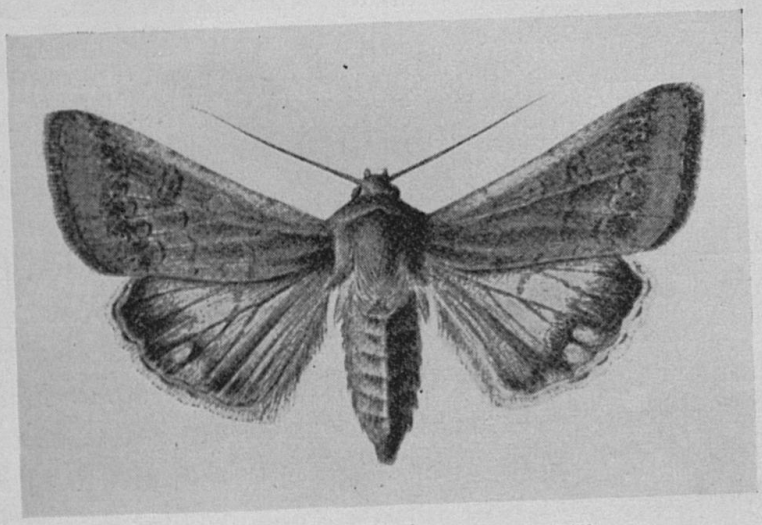


Fig. 16.— Moth of the corn earworm.

Life history

The worms vary greatly in color from light green to brown and the body is marked with light and dark stripes running lengthwise of the body (Fig. 18). The full-grown worms are about 1½ inches long. The moths have a wing expanse of nearly 1½ inches. The fore wings vary in color but generally are light grayish brown, marked with dark gray irregular lines often shaded with olive green, and with a dark area near the tip of the wing. The hind wings are white with dark markings.

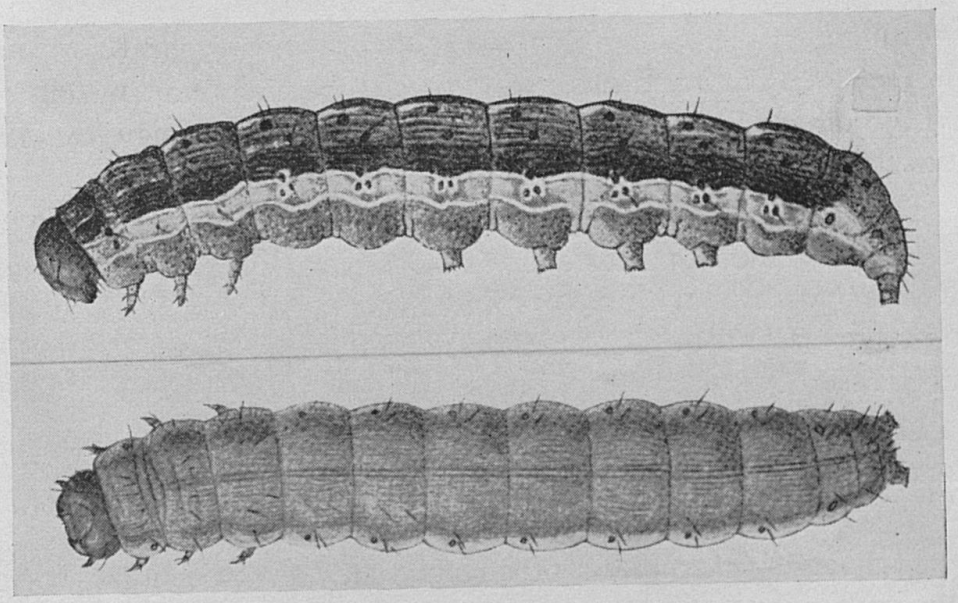


Fig. 17.— Corn earworm.

During its life each moth may lay several hundred eggs, which hatch in 3 to 5 days. The worms complete their growth in about 3 weeks and then enter the soil to pupate. The pupal stage lasts about 2 weeks, except for the pupae that live over winter. There are two or three generations of the insect each season.

Fig. 18.— Corn earworm injury to a tobacco plant.

Control

The corn earworm has not generally been found injuring extensive areas of tobacco. It frequently appears when the first hornworms are observed.

DDT or TDE: (1) Spray with 1 to 1½ pounds of DDT or TDE in an emulsion concentrate diluted with 5 gallons or more of water per acre with a low-pressure sprayer; or (2) dust with 10-percent DDT or TDE dust at the rate of 10 to 15 pounds per acre.

Endrin: Spray with 0.2 pound of endrin in an emulsion concentrate diluted with 5 or more gallons per acre; apply with a low-pressure sprayer.

The limits in amounts of endrin that can be applied to tobacco vary from 0.2 to 0.4 pound per acre per application.

Tobacco Bud Worm

This bud worm is of little importance as a pest of tobacco in Kentucky, but an occasional specimen is collected. The pattern of injury is similar to that of the corn earworm. When nearly mature the worms are generally green with lighter stripes running the length of the body, and when full-grown the coloration is sometimes somewhat darker. The worms are about 1½ inches long.

The moth has a wing expanse of about 1½ inches, and the front wings are light green and crossed by four oblique light bands. There are two broods of larvae a year.

Control

Control is the same as for the corn earworm.

Stink Bugs

The true stink bugs are shield-shaped bugs which, after piercing plant tissues with their beaks, suck the juices. Several species may be found on tobacco plants, of which the one found rather frequently is *Euschistus euschistoides* (Vollenhoven), a grayish or greenish yellow bug about ½ inch long (Fig. 19).

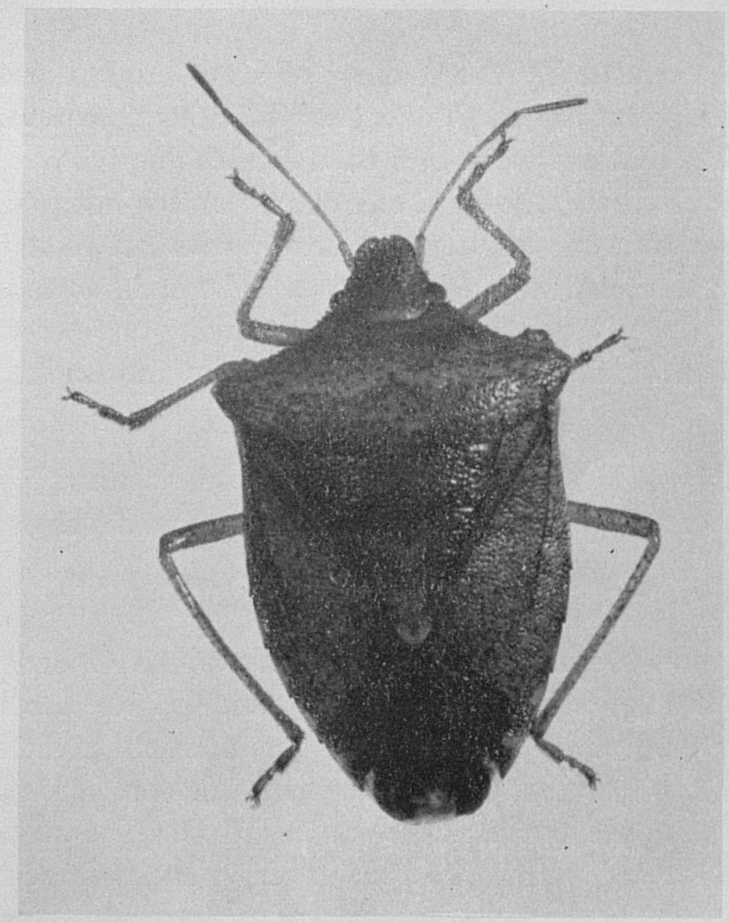


Fig. 19.—A stink bug that causes wilting of leaves.

Fig. 20.—Leaf showing wilting caused by a stink bug.

Injury

Damage caused by the feeding of stink bugs is not serious, but when feeding the bugs inject a poisonous secretion into the leaf or stalk that may cause it to wilt rather quickly. The leaf resumes its normal shape in a day or two and is not permanently injured, but on very hot days scalded areas between the large veins may develop on a leaf or two. The wilting of a leaf or two on a plant is generally observed during the warmest part of the day and is the occasion of a good many inquiries (Fig. 20).

Control

Chlordane: Dust with 5-percent chlordane dust.
Parathion: Dust with 1-percent parathion dust.

Common Stalk Borer

The common stalk borer, *Papaipema nebris* Guenee, attacks plants with large stems that are soft enough for the larvae to bore into. One of its favorite host-plants is the giant ragweed. Sometimes tobacco plants on borders of a field near large-stalked plants are attacked by the larvae of this moth. The larvae tunnel lengthwise of the stalks, and the plants may wilt. One larvae may attack several plants before completing its growth. The larvae are dark brown worms ranging from ¾ to 2 inches in length. All but the larger of the worms have a white stripe

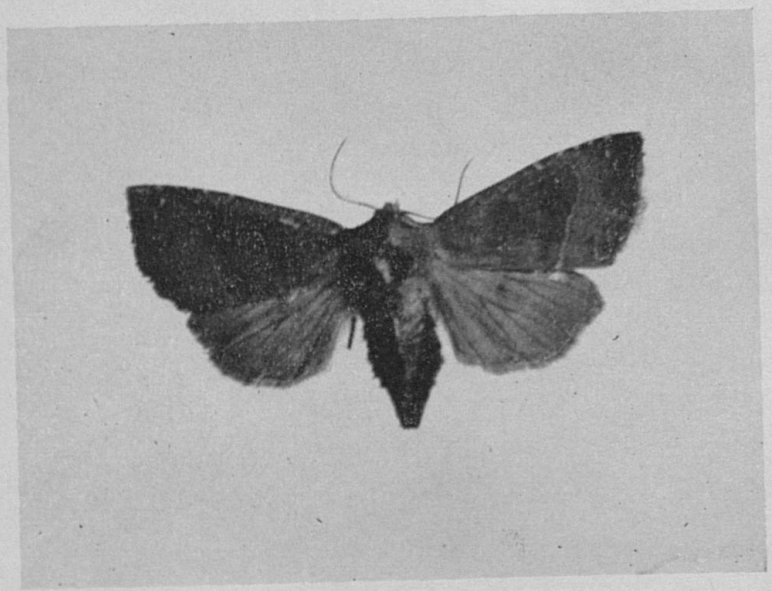


Fig. 21.— Moth of the common stalk borer.

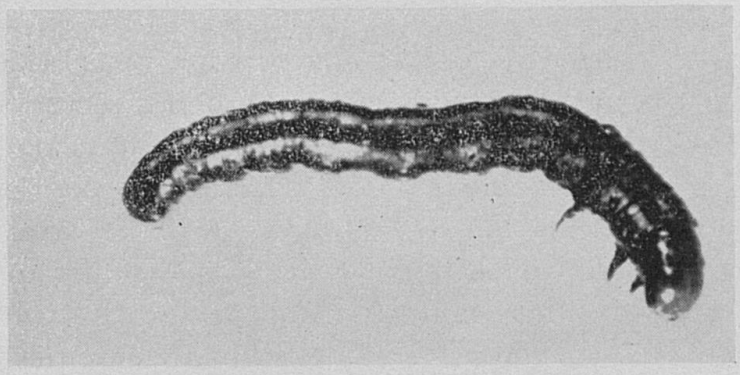


Fig. 22.— Larva of the common stalk borer.

down the back with broken white stripes on the sides. The mature worms are grayish colored (Fig. 21).

Life history

The insect hibernates in the egg stage, the eggs being laid in grasses and weeds. They hatch in early spring, and the worms feed or bore into the stems of various grasses and, later, bore into larger stalked plants where they complete their growth and pupate in July and August. The grayish-brown moths emerge from the pupae in September or later and lay their eggs on a number of different plants (Fig. 22).

Control

Generally only a few plants are injured in any field and only along the borders where weeds or other plants have been allowed to grow. Keeping the borders free of weeds should prevent any serious damage from this insect.

Sod Webworms

Sod webworms feed on grass plants, including corn, bluegrass, timothy, and various other pasture and field grasses. Some species of webworms attack tobacco plants when tobacco follows grass sod in rotation. The webworm, *Crambus mutabilis* Clemens (Fig. 23), attacks young tobacco plants in Kentucky, but another species, *Crambus caliginosellus* Clemens, is more often mentioned as a pest of tobacco plants in the southern states.

Life history

The moth or adult stage of *C. mutabilis* has a wing expanse

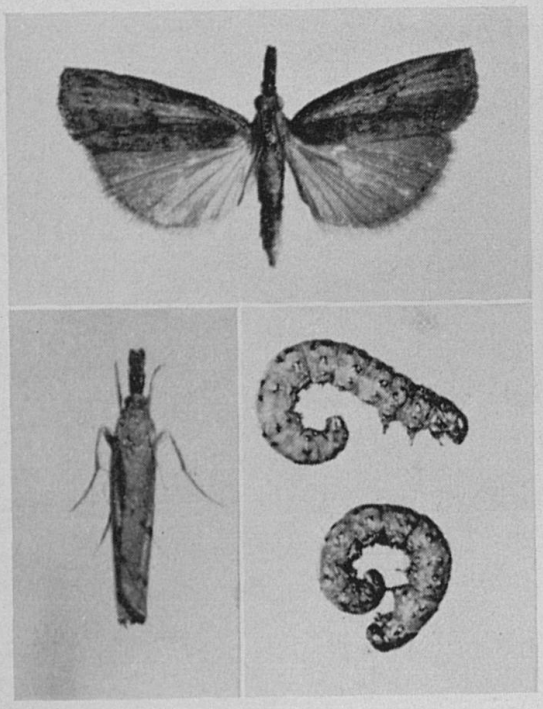


Fig. 23.— Moth and larva of a sod webworm.

of about 1 inch. The general color is gray with a dusky spot near the center of the fore wing. The head and thorax are reddish brown.

The larva is very active and twists and turns when touched. The body is striped and hairy, and the head has prominent dark markings. The worm is about ¾ to 1 inch long when grown. The larvae construct a loose silken web to a silk-lined tunnel in the earth with an opening at the surface. They feed on young plants and girdle and bore into the stalks. In the fall they construct tubular burrows above or partly above the ground and pass the winter as partly grown worms. The moths begin appearing about May 15, and observations of their flights indicate that there are two generations a year.

Control

Control of sod webworms is difficult, but they seldom attack many plants in the field and are not present in numbers every year. Their injury appears very similar to that of wireworm injury.

Chlordane: Spray with chlordane at the rate of 1½ pounds per acre in a diluted emulsion concentrate at 5 or more gallons of water per acre; apply with a low-pressure sprayer.

Grasshoppers

During some years grasshoppers do considerable damage to tobacco plants by eating irregular holes in the leaves and often practically destroying the plants. The hoppers feed on grasses and other crops and migrate into tobacco fields in midsummer by flying short distances from forage crops. Several species of hoppers may damage tobacco, but the three most common and destructive ones are the red-legged grasshopper, the two-striped grasshopper, and the differential grasshopper.

Life history and habits

The grasshoppers just mentioned pass the winter months in the egg stage. The eggs are laid in packet-like masses, about 1 inch long, and are placed ½ to 1½ inches below the surface of the soil. As a rule, the eggs are laid in uncultivated ground and begin to hatch in early spring.

The red-legged grasshopper, *Melanoplus femur-rubrum* (DeGeer), is reddish brown or brownish above and dull yellowish green beneath. The females have a body length af about 1 inch. This grasshopper is the most common and one of the most destructive in Kentucky. It is found everywhere in bluegrass pastures and meadows. It begins to reach adult stage about June 1 and may be found till late fall (Fig. 24).

The two-striped grasshopper, *Melanoplus bivittatus* (Say), is dull olive brown to brownish fuscous above and pale yellow to dull greenish yellow beneath. A narrow yellow stripe extends back from the upper angle of each eye along the sides of the disk of the pronotum nearly to the tips of the wing covers. The females are large, having a body length as long as 1 1/5 inches.

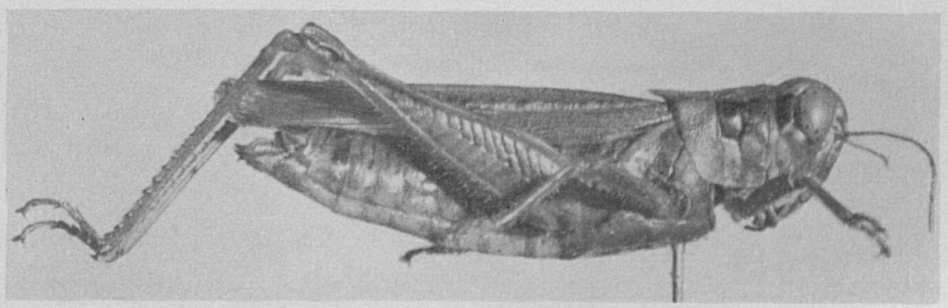


Fig. 24.— Red legged grasshopper.

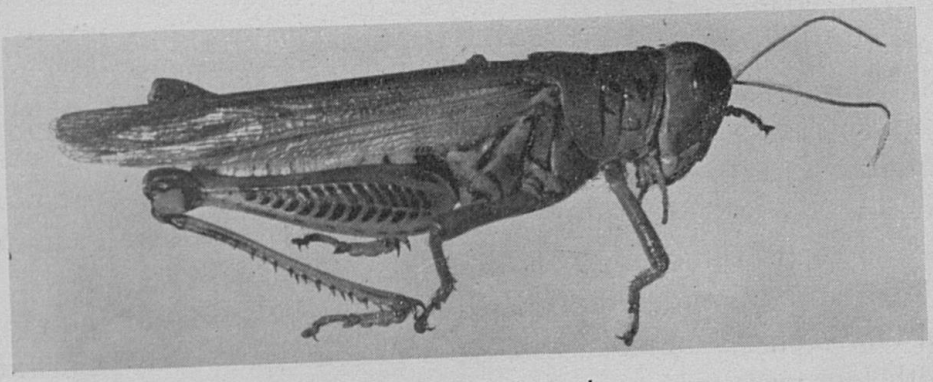


Fig. 25.— Two-striped grasshopper.

This hopper begins to reach maturity about June 15 and disappears in September (Fig. 25).

The differential grasshopper, *Melanoplus differentialis* (Thomas), is nearly uniform dark brownish green or olive green above, and bright to dull yellow beneath. This is a large and robust species, the females being larger than the males. The body length of the females may be as great as 1 4/5 inches. They reach maturity by mid-July and can be found till late fall (Fig. 26).

Control

Grasshoppers migrate into tobacco fields when they have developed wings, and they feed on the outside rows first and later move into the entire field. Practically all migration can be prevented if the farmer makes regular inspections in the fields and borders around his tobacco patch and applies an insecticide when the grasshoppers are immature. When an insecticide has been applied to forage crops or meadows near the tobacco patch, it will be necessary to keep livestock out of those fields for a period of 2 to 3 weeks.

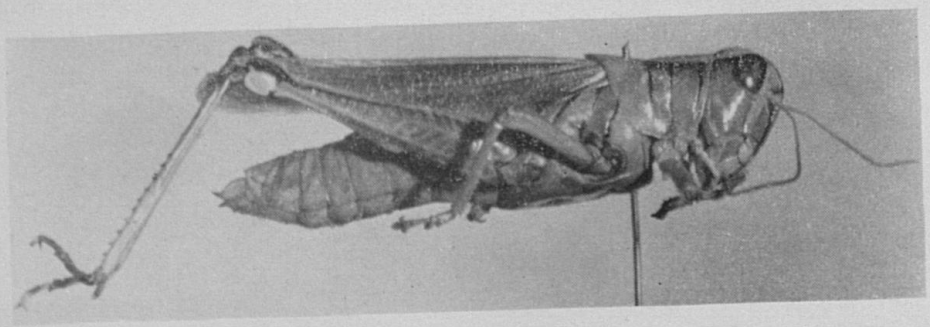


Fig. 26.— Differential grasshopper.

Chlordane: (1) Dust with a 5-percent chlordane dust at the rate of 10 to 20 pounds per acre; or (2) spray with 1 pound of chlordane (actual) in an emulsion concentrate in 5 or more gallons of water per acre with low pressure sprayers.

Aldrin: Spray with 4 ounces of aldrin (actual) in an emulsion concentrate in 5 or more gallons of water per acre with low pressure sprayers.

Endrin: Spray with 0.25 to 0.30 pound of endrin (actual) in an emulsion concentrate in 5 or more gallons of water per acre with low pressure sprayers.

Tobacco Hornworms

Hornworms may be found practically every year on tobacco plants in large enough numbers to make it necessary to apply insecticides. Two species of hornworms attack tobacco; the tomato hornworm, *Phlegethontius quinquemaculata* Haw., which is called the northern tobacco hornworm in the southern states and the southern tobacco hornworm, *Phlegethontius sexta* Joh. Each species is about equally destructive when present in comparable numbers. About 90 to 95 percent of the worms on tobacco in Kentucky are of the southern species.

Moths

The moth of the southern species is dark gray, the fore wings with a group of white irregular oblique whitish cross-bands. The abdomen is marked with six round, orange-yellow spots on each side (Fig. 27).

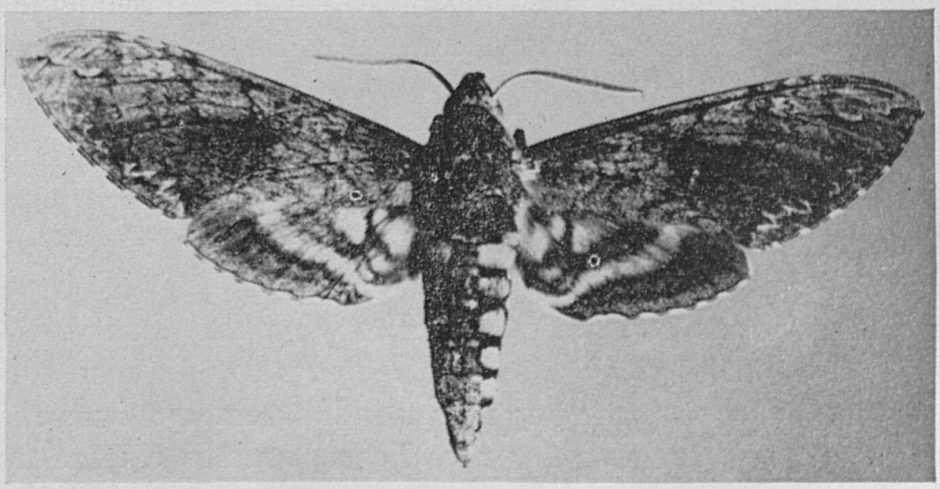


Fig. 27.— Moth of the southern tobacco hornworm.

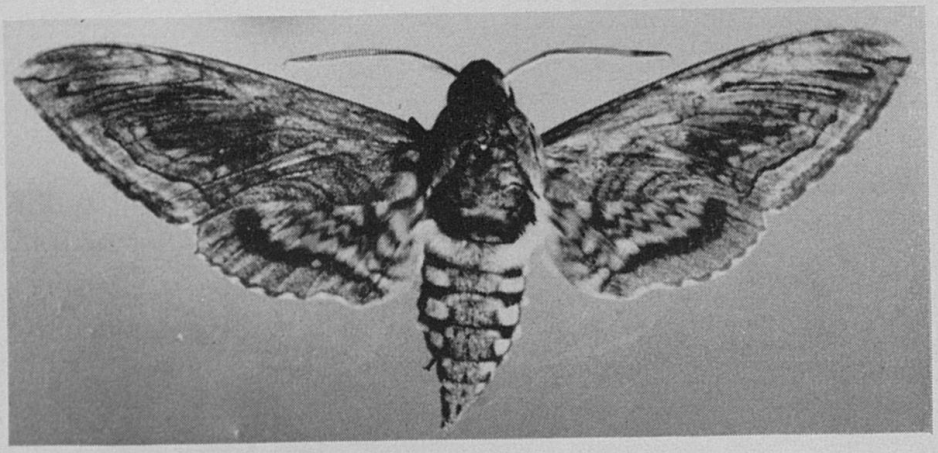


Fig. 28.— Moth of the tomato hornworm, also called the northern tobacco hornworm.

The moth of the northern species is light gray, and the hind wings are crossed with alternating black and whitish bands. The abdomen is marked with five orange-yellow spots on each side. The wing expanse of both species is about 4 inches (Fig. 28).

Worms

The body of the southern species is clothed with fine down. The general color is green with seven obliquely placed whitish lines, edged with black on both sides. The horn at the hind end of the body is red and curved (Fig. 29).

The body of the northern species is smooth and shiny, the general color varying from green to brownish. There are eight yellow or greenish white V-shaped marks, pointing forward on each side. The horn is black and nearly straight. Both species may grow to about 4 inches in length (Fig. 30).

Life and seasonal history

Adults emerge from hibernating pupae (those that carry over winter) June 1 to September 1. The time from egg laying to the adult or moth stage is about 45 days, the egg stage lasting about 4 days, the larval stage 20 days, and the pupal stage 21 days. The worms that enter the soil to pupate to about July 15 emerge as adults 3 weeks later and lay eggs for a second brood of worms. These worms pupate and adults emerge from them the following spring and summer. Because moths emerge from hibernating pupae through most of the summer, it is difficult to

Fig. 29.— Southern tobacco hornworm.

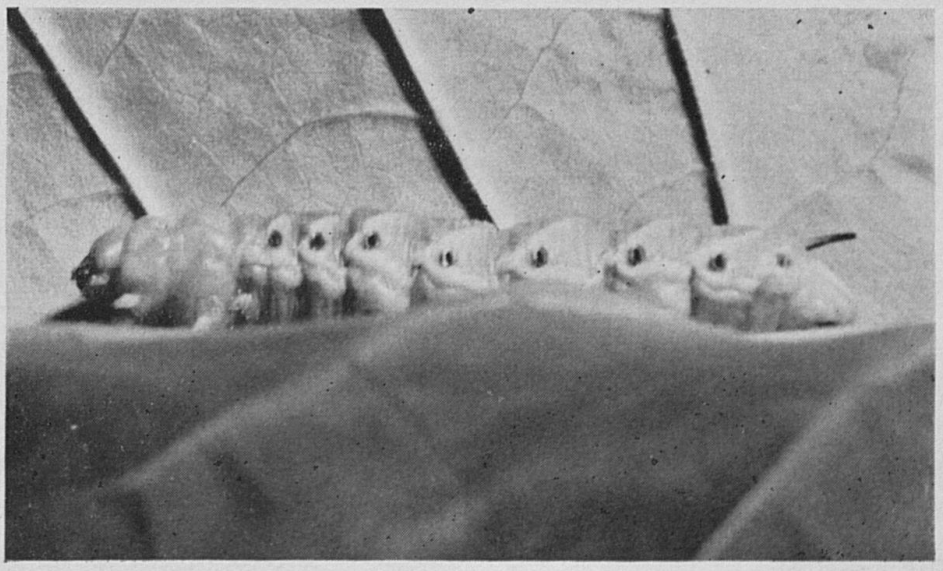


Fig. 30.— Tomato hornworm.

separate worms in definite broods. Both species have similar life and seasonal histories.

Control measures

It is a good practice to make frequent examinations of the tobacco plants to look for hornworms and other insect pests to determine their stages of development. Hornworms are much easier controlled when they are small. The first few worms found on the plants may be picked off, but as the season advances, the worms increase in numbers and it is generally necessary to apply an insecticide. Some farm practices help to reduce the worm population, but as a rule, an insecticide will have to be used before the tobacco is cut. One to four applications are necessary some years to protect the crop.

Farm practices

The practices generally useful are (1) hand-picking of worms where members of the family can do the work, (2) destroying the stubs of harvested plants to prevent the growth of suckers that furnish food for late-season worms, (3) fall plowing to destroy pupae in the soil, but fall plowing should be done only in localities where this practice is good procedure.

Insect traps

No kind of insect trap is recommended for catching tobacco moths to reduce hornworm populations on tobacco.

Insecticidal control

Arsenical sprays and dusts are not recommended for controlling hornworms or other insects on tobacco. The following insecticides will give good control if properly applied at the amounts suggested.

TDE: (1) Apply a dust containing 10 percent of TDE at 15 to 20 pounds per acre; (2) spray with 1 pound of TDE (actual) in an emulsion concentrate in 5 to 15 gallons of water per acre by low-pressure sprayers.

Endrin: (1) Spray with 0.20 pound of endrin (actual) in an emulsion concentrate in 5 or more gallons of water per acre by low-pressure sprayers; (2) spray with 0.25 to 0.30 pound of endrin (actual) in an emulsion concentrate in 5 or more gallons of water per acre by low-pressure when grasshoppers and hornworms are on the plants.