

**arizona**

**cotton**

**insects**

**Bulletin 286**

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# Arizona Cotton Insects

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## INTRODUCTION

Cotton, the most important agricultural crop in Arizona, is attacked by numerous insect pests. It is estimated that these pests cause an annual loss to Arizona cotton growers of from 10 to 12 million dollars, as measured by reduced yields, reduced grades and costs of insecticides and their application.

This bulletin has been designed to help readers (1) identify the injurious cotton insects, (2) recognize the damage caused by these insects, (3) identify the common beneficial insects found on cotton and (4) evaluate insect infestations, particularly in relation to the necessity for control measures.

The text is a compilation of the available information. It has been assembled from scattered and usually fragmentary published sources and from previously unpublished notes and field observations of entomologists familiar with cotton insects in Arizona. Many details relating to

the life history and habits of these insects, and to the effective control of the injurious species, are still unknown, and await further investigation.

As a result of remarkable progress in the chemical industry since World War II, new and more efficient insecticides are continually being developed. Because control recommendations change frequently as better insecticides become available, specific control recommendations are not included in this bulletin. The most recent recommendations will be found in the latest edition of University of Arizona Agricultural Extension Circular 179, "Cotton Insect Control," which is revised annually.

Reference is frequently made to sweep counts for evaluating infestations. In all cases, sweep counts are made with a standard insect sweep net. This net has a 26-inch handle and a circular hoop 15 inches in diameter. The bag is made of heavy muslin, and is 24 inches deep.

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**Table 1. Principal kinds of insect injury found on cotton in Arizona.  
MAJOR PESTS IN CAPITALS**

<i>Plant Part</i>	<i>Injury</i>	<i>Pest</i>	<i>Page</i>
Seeds (in ground)	eaten; poor germination	seed corn maggot	47
Seedling roots	eaten; plants wilted and deformed	wireworms	45
Stalks	of seedlings cut off just above ground	cutworms ants	22 47
	of seedlings gouged at ground	darkling beetles crickets	42 48
	deeply punctured	cicadas	31
	deformed; plant stunted	APHIDS thrips	31 13
Cotyledons (seed leaves)	ragged, eaten	beet armyworm cabbage looper crickets	14 17 48
Leaves	LEAVES ESSENTIALLY ENTIRE, OCCASIONALLY TORN		
	cupped and torn; seedlings stunted	thrips	13
	deformed, covered with honeydew	APHIDS mealybugs	31 32
	deformed, covered with honeydew, with waxy scales on lower surfaces	whiteflies	33
	deformed, scarred; plants whip-like	cotton fleahopper	34
	discolored, yellow to red or brown above, usually webbed beneath	SPIDER MITES	50
	webbed together, chewed beneath webbing	webworms	23
	rolled and webbed; terminals chewed	omnivorous leaf roller	25
	irregularly mined, often with many small "windows"	cotton leaf perforator	19
	with long, twisting mines	leaf miners	46

Plant Part	Injury	Pest	Page		
Leaves	LEAVES SKELETONIZED, SOMETIMES WITH "SHOT" HOLES OR "WINDOWS"				
	skeletonized or with small "windows"	cotton leaf perforator	19		
	with "shot holes," skeletonized, occasionally ragged	cucumber beetles	42		
		Colaspis beetles	40		
	with upper or lower surfaces skeletonized	various young caterpillars (feeding in groups):			
		beet armyworm	14		
		fall armyworm	14		
		yellow-striped armyworm	30		
		cotton leafworm	18		
		salt-marsh caterpillar	27		
Leaves	LEAVES RAGGED OR TOTALLY CONSUMED				
	ragged; plants occasionally defoliated	various older caterpillars:			
		beet armyworm	14		
		yellow-striped armyworm	30		
		cabbage looper	17		
		cotton leafworm	18		
		cutworms	22		
		salt-marsh caterpillar	27		
		white-lined sphinx caterpillar	29		
		grasshoppers	50		
		crickets	48		
		Squares	punctured, disfigured, flared, eventually dropped	STINK BUGS	36
			punctured, disfigured, flared, with shiny excrement spots, eventually dropped	LYGUS BUGS and relatives	35
			with holes, hollowed out, eventually dropped	BOLLWORM	15
				beet armyworm	14
cotton square borer	21				
yellow-striped armyworm (rarely)	30				
with bracts rolled and webbed, bracts and squares chewed	omnivorous leaf roller	25			

<i>Plant Part</i>	<i>Injury</i>	<i>Pest</i>	<i>Page</i>
Flowers	punctured, disfigured, flared, —	STINK BUGS	36
	eventually dropped		
	“warty,” disfigured, flared, with shiny excrement spots, —	LYGUS BUGS and relatives	35
	eventually dropped		
	with holes, eaten out, — eventually dropped	BOLLWORM	15
		beet armyworm	14
		cotton square borer	21
		yellow-striped armyworm (rarely)	30
	with petals rosetted, — eventually dropped	PINK BOLLWORM	23
		cotton leaf perforator (occasionally)	19
	ragged, with large beetles — in “cup”	June beetles	43
Bolls	with slightly depressed reddish brown spots; injured —	STINK BUGS	36
	small bolls turn yellow and drop		
	with smaller reddish-brown specks, shiny excrement spots, —	LYGUS BUGS and relatives	35
	injured small bolls turn yellow and drop		
	with holes, eaten out, — small bolls drop	BOLLWORM	15
		beet armyworm	14
		cotton square borer	21
		yellow-striped armyworm (occasionally)	30
	bored at tips, — often chewed	cotton leaf perforator (occasionally)	19
	with short tunnels (1 inch) and (or) exit holes in carpels, holes thru lint —	PINK BOLLWORM	23
	and between locks; small pink larvae within seeds of large bolls		
	with small and large holes in carpels, holes thru lint between —	thurberia weevil	44
	locks; weevil pupae or adults within hollow cells in lint		
	honeydew on lint —	APHIDS	31

Table 2. Field guide to recognition of insects commonly associated with cotton in Arizona.

MAJOR PESTS IN CAPITALS. *Beneficial insects in italics.*

I. INSECT EGGS OFTEN FOUND ON COTTON PLANTS.		Page
Laid in groups or clusters	White to cream, round, variously sculptured; usually on underside of leaves and near top of plant.....salt-marsh caterpillar	27
	Pearly white to gray, with purplish bands and definite ridges, clusters indiscriminately placed.....cutworms	22
	Pale green covered with velvety hair.....armyworms	14
	Pale blue-green, flat, overlapping, on upper surfaces of leaves.....omnivorous leaf roller	25
	Nearly transparent, overlapping, on underside of leaves.....webworms	23
Laid singly	Mostly white to gray, like little barrels.....STINK BUGS	36
	Orange, cigar-shaped, standing on end..... <i>lady beetles</i>	57
	Greenish to red, oval, ridged like a peanut, at bases of bolls and on inside of bracts.....PINK BOLLWORM	23
Laid singly	Yellow to white, flattened "domes," depressed on top, covered with small hexagonal depressions, on foliage.....cotton square borer	21
	Blue-green to dirty white, flattened "saucers," ribbed, usually on undersides of leaves.....cotton leafworm	18
	Pearly white inverted "cups" with brownish band on upper third soon after deposition, as tall or taller than width at base, usually in terminals on upper third of plant.....BOLLWORM	15
	White, never with brownish band, shorter than width at base, on foliage.....cabbage looper	17
	White to green, on silken stalks, mostly single but occasionally in groups, on foliage..... <i>green lacewings</i>	54

## II. CATERPILLARS (WORM-LIKE IMMATURE STAGES OF BUTTERFLIES AND MOTHS)

Descriptions apply most accurately to nearly mature caterpillars.

In soil (during day)	Mottled gray to brown, smooth, fat, "greasy;" curl up when disturbed; usually feed at night	cutworms	Page 22
Exposed on foliage	Very hairy	salt-marsh caterpillar	27
	Black with yellow and brown stripes	yellow-striped armyworm	30
	Pale yellow to black with white stripes and dark spots on back and head; false leg on 6th segment not fully developed	cotton leafworm	18
	Yellowish to green, tubular, only two pairs of legs under middle of body, moves with looping gait	cabbage looper	17
	Large, pale green to black, with white lines on body and yellow horn at rear	white-lined sphinx caterpillar	29
	Greenish with faint lighter stripes, with black spot on each side behind head	beet armyworm	14
	Light to dark brownish gray, with three white lines on dark plate behind head; sometimes with lighter inverted "Y" on head; paired dark spot on each segment along back	fall armyworm	14
	Small ( $\frac{1}{4}$ inch long when mature), dull amber-green with gray-black spots and lighter "bumps" over body	cotton leaf perforator	19
Within webbed or rolled leaves and bracts	Small, active, olive-green, with chalky spots on each segment; in rolled and webbed leaves or bracts	omnivorous leaf roller	25
	Dark green to pale green with black spots on each segment; in loose, webbed shelter	webworms	23
Within leaf mines	Minute (one-sixteenth inch), white	young cotton leaf perforators	19



	Velvety green, slug-shaped .....	cotton square borer	21
	Greenish to rose brown, with light and dark stripes on sides: bolls with entrance hole; excrement pellets usually visible.....	BOLLWORM	15
	Greenish with faint lighter stripes, with black spot on each side behind the head .....	beet armyworm	14
Feeding on	Black with yellow and brown stripes; rarely enters bolls.....	yellow-striped armyworm	30
or in bolls	Pink on back and sides, lighter beneath, relatively stubby, bolls with short mines (no entrance holes) .....	PINK BOLLWORM	23
	Small ( $\frac{1}{4}$ inch long when mature), dull amber-green with gray-black spots and lighter bumps over body, occasionally bore into tips of bolls and chew outside of carpels.....	cotton leaf perforator	19
<hr/>			
III. OTHER LARVAE			
	White to cream, $\frac{1}{4}$ inch long, in soil and on seed or underground parts of seedling (maggot) .....	seed corn maggot	47
Legless	White to cream, about $\frac{1}{8}$ inch long, in leaf mine (maggot).....	leaf miner fly	46
	Usually pale green, $\frac{1}{4}$ - $\frac{1}{2}$ inch long, found near aphids (maggots).....	<i>syrrhoid flies</i>	59
	White to cream, about $\frac{1}{4}$ inch long, in bolls .....	thurberia weevil	44
	Tan to yellow, up to one inch long, in soil .....	wireworms	45
	Black with orange and (or) white marks, about $\frac{1}{4}$ inch long, active, usually associated with aphids on plant .....	<i>lady beetles</i>	57
With legs	Mottled brown and cream, tapering at both ends, sickle-shaped "jaws," active on plants .....	<i>lacewings</i> ( <i>aphid lions</i> )	54
<hr/>			
IV. PUPAL SHELTERS			
	Portions of leaves or bracts rolled and tightly webbed .....	omnivorous leaf roller	25
	Portions of leaves loosely webbed, pupa sometimes exposed and hanging by a silken thread .....	cotton leafworm	18
	Loosely-webbed protective coverings on leaves .....	cabbage looper	17
	Silvery, round, pea-sized cocoons .....	green lacewing	54

Shield-shaped, $\frac{1}{4}$ - $\frac{1}{2}$ inch long	STINK BUGS	36
Oval-shaped		
Larger than $\frac{1}{8}$ inch		
$\frac{3}{10}$ inch long, straw-green to dark brown, rear half of wings bent downward	LYGUS BUGS (adults)	35
$\frac{3}{8}$ inch long, dark brown or black, reddish triangle behind head with two dark spots, outer wing margins orange to red, (resembles large lygus bug)	superb plant bug	39
$\frac{1}{8}$ - $\frac{3}{8}$ inch long, oval to round, wingless, various colors	STINK BUGS (nymphs)	36
$\frac{1}{2}$ inch long, green and wine or brown, legs long and thin, neck narrow, spines prominent	assassin bugs	54
$\frac{3}{8}$ inch long, gray to buff, almost cigar-shaped, spines not conspicuous	damsel bugs	55
Pale green with black specks over body, or black; about $\frac{1}{8}$ inch long; resemble small lygus bugs	flea-hoppers	34
Buff to dark brown or black, $\frac{1}{8}$ inch long or smaller, with dark protruding eyes and a silvery triangle where wings cross on back	big-eyed bugs (adults)	56
Shiny gray to brown or black, wingless with protruding dark eyes	big-eyed bugs (nymphs)	56
Black with three silver-white areas on back, tiny ( $\frac{1}{16}$ inch long)	minute pirate bugs (adults)	57
Amber to orange, wingless, $\frac{1}{16}$ inch long or smaller	minute pirate bugs (nymphs)	57
Bright green or shiny tan, wingless, with spots on abdomen (resemble aphids but are more active)	LYGUS BUGS (nymphs)	35

# VI. OTHER SMALL TO MINUTE INSECTS AND MITES

				Page
Body round or oval, often in colonies	Body with <i>white</i> , waxy filaments — or "powder"	Body naked	Oval, $\frac{1}{8}$ inch long, covered with powdery wax, seldom moves.....	mealybugs 32
			Oval to round, scale-like, bordered with white, waxy filaments.....	whiteflies (nymphs) 33
			Like tiny white moths.....	whiteflies (adults) 33
			Almost globular, most with less obvious waxy covering, $\frac{1}{16}$ inch long, six legs, slow-moving, associated with honeydew.....	APHIDS 31
Slender, not in colonies	Usually greenish, wedge-shaped $\frac{1}{16}$ to $\frac{3}{16}$ inch long, wings held roof-like over body.....	Usually yellow to straw-colored, 1/25 inch long, two pairs of fringed wings held flat over back, move actively.....	Round, green to reddish, almost invisible to the naked eye, eight legs, active.....	SPIDER MITES 50
			Usually greenish, wedge-shaped $\frac{1}{16}$ to $\frac{3}{16}$ inch long, wings held roof-like over body.....	various leafhoppers 33
			Yellow to straw colored, wingless, similar in habit to adult thrips.....	thrips (adults) 13
			Yellow to straw colored, wingless, similar in habit to adult thrips.....	thrips (immature) 13

# VII. BEETLES (SMALL TO RELATIVELY LARGE INSECTS, OFTEN PILL-SHAPED, HARD, VARIOUSLY COLORED)

$\frac{1}{2}$ inch or larger	Rust to dark brown with buff wing covers, $\frac{1}{2}$ inch long.....	desert June beetles 43
	Metallic green with irregular buff margin on wing covers, robust, 1 to 1½ inches long.....	Texas June beetles 43
Less than $\frac{1}{2}$ inch	Rust, with sparse golden hairs, prominent snout, $\frac{1}{4}$ inch long.....	thurberia weevil 44
	Yellow to buff, with fine longitudinal ridges on wing covers, $\frac{1}{4}$ inch long.....	Colaspis beetles 40
	Dull brown to black, robust, $\frac{1}{4}$ inch or longer, hidden during day.....	darkling beetles 42

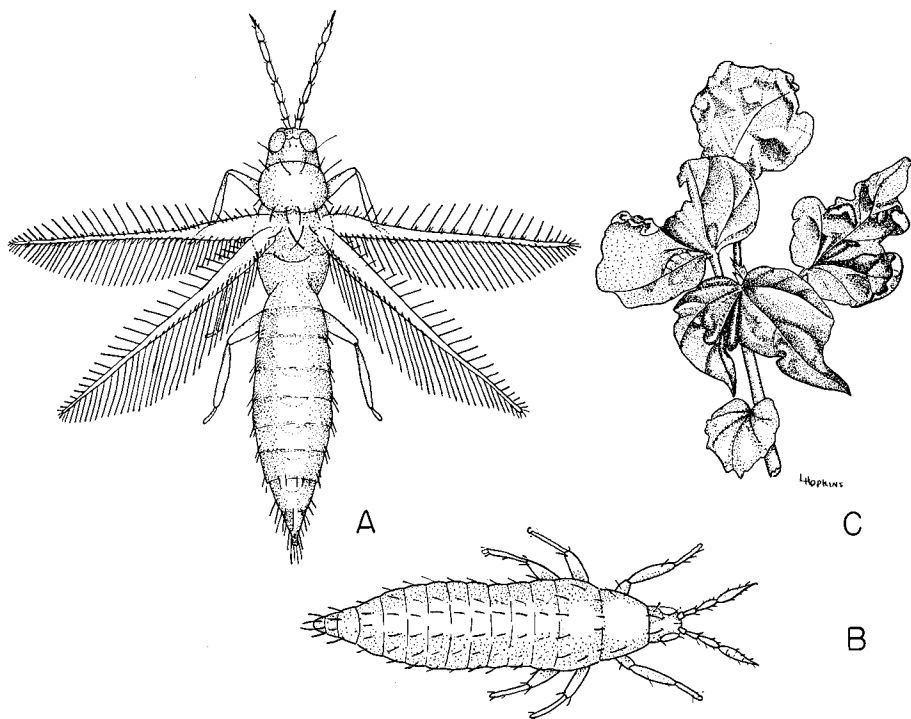
Green with black spots, or yellow to cream with black stripes, $\frac{1}{4}$ inch long .....	cucumber beetles	Page 42
Orange or pink with black spots, circular to oval, $\frac{1}{4}$ inch long.....	<i>lady beetles</i>	57
Usually orange with two longitudinal, metallic blue bands on wing covers, $\frac{3}{8}$ to $\frac{1}{4}$ inch long .....	<i>striped collops beetle</i>	59
Black, slender, wing covers short, abdomen conical, $\frac{3}{8}$ inch long.....	fruit bud beetle	45
Pale rust with darker bands across wing covers, horn-like process projecting forward over head, $\frac{3}{8}$ inch long .....	notoxus beetles	46

# VIII. GRASSHOPPERS AND CRICKETS (LARGE LEATHERY INSECTS, ACTIVE JUMPERS)

Wings held roof-like over body, short antennae .....	grasshoppers	50
Wings held flat over body, long antennae .....	crickets	48

# IX. OTHER CLEAR-WINGED INSECTS

Body slender, pale green or brown, with large, net-veined wings held roof-like over the back, about $\frac{1}{2}$ inch long .....	<i>lacewings</i>	54
Body a long, thin tube, variously colored, eyes very prominent, wings narrow, clear, net-veined, about 1 inch long, resemble dragonflies .....	<i>damselflies</i>	56
Bee-like flies, usually brightly marked with yellow and black or white and black .....	<i>sympid flies</i>	59
With only two clear wings, many sizes and colors .....	various flies	60
With four clear wings, many sizes and colors .....	<i>various bees and wasps</i>	60



**Figure 1.—A Frankliniella thrips. A) Adult; B) Mature nymph; C) Cupping and tearing of leaves caused by thrips feeding on a young cotton plant.**

## THRIPS

Thrips found on cotton in Arizona are predominantly of the genus *Frankliniella*. They are small, slender insects about one twenty-fifth inch long. The adults are a brownish straw color and have fringed wings. Immature individuals are usually lighter in color and wingless.

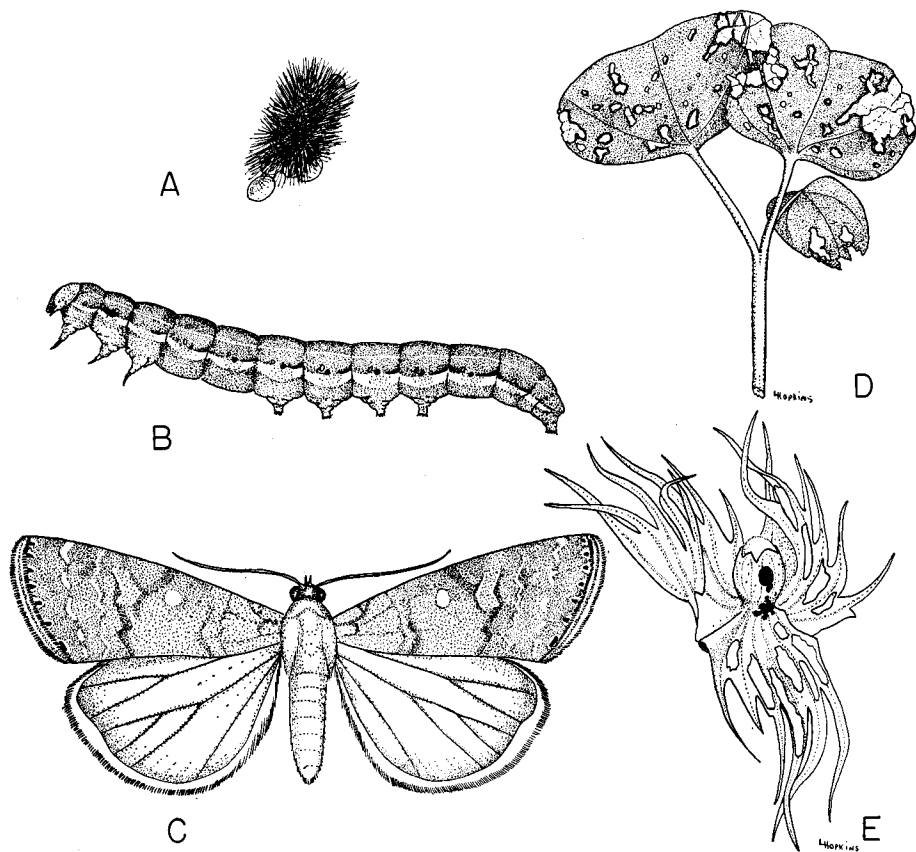
Thrips overwinter as pupae in the ground. In the spring, enormous numbers of newly emerged adults feed and reproduce on the flowers and new growth of numerous cultivated and wild plants. During the seedling and early leaf stages, young cotton plants are particularly attractive to emerging thrips. Females in-

sert their eggs into the tissues of the young plants. After hatching, the young thrips take approximately three weeks to mature. Pupation occurs in the soil. These insects are present in cotton throughout the growing season, but are harmful primarily in the spring.

Thrips puncture the cells of young cotton leaves and consume the escaping juices. Injured areas do not grow normally and cause the leaves to twist, become distorted and tear as they increase in size. The outer edges of affected leaves usually curl up and in, causing "cupping." This damage generally differs from aphid injury,

which most often causes the leaves to curl down at the edges. Severe infestations can kill the terminal buds and may kill the seedlings outright. In areas with an ample growing season, healthy plants ordinarily recover

from moderate thrips injury without the aid of insecticides. In areas with an early frost date, thrips infestations which severely retard plant growth may require control measures.



**Figure 2.—Beet armyworm. A) Egg cluster; B) Mature larva; C) Adult; D) Damage to cotyledons by young larvae; E) Damage to square by nearly mature larva. Note the characteristic injury to the bracts.**

### **BEET ARMYWORM** *Laphygma exigua* (Hbn.)

This insect is found throughout the Southwest and frequently becomes destructive in Arizona. It is particularly harmful to sugar beets and attacks cotton as well as numerous vegetable and forage crops.

The pale to olive green caterpillars grow to an inch or more at maturity. A darker stripe is evident down the middle of the back and pale stripes run along the sides. There is a characteristic small black dot on each side

just posterior to the head and above the second pair of true legs. The moths are about three-fourths inch long with a wing span of one to one and one-fourth inches. They are dusky, mottled gray with distinct lighter markings on the fore wings.

Eggs are laid on the plants in small or large masses. They are covered with a velvety material from the body of the female moth. After hatching, the young larvae skeletonize the leaves before dispersing. Larger caterpillars may rag the leaves or, when numerous, may completely defoliate plants. They frequently feed within the fruiting structures and consequently are often mistaken for bollworms. Mature caterpillars pupate in the soil. There are five or more generations each year. The rate of development varies with the temperature and, un-

der favorable conditions, a generation may be completed in less than three weeks. The winter is passed in the pupal stage in the soil.

Winter plowing and land conditioning destroy many overwintering pupae and therefore reduce the number of adults which emerge in the spring. Effective parasitism often holds populations of this pest at sub-economic levels throughout an entire season.

The fall armyworm, *Laphygma frugiperda* (J. E. Smith), is similar to the beet armyworm. It survives the winter in tropical areas and the moths migrate northward each season. Its preferred hosts are grasses and other forage crops. The fall armyworm is an incidental pest of cotton in Arizona and is most likely to cause damage in poorly managed, weedy fields.

## **BOLLWORM**

*Heliothis zea* (Boddie)

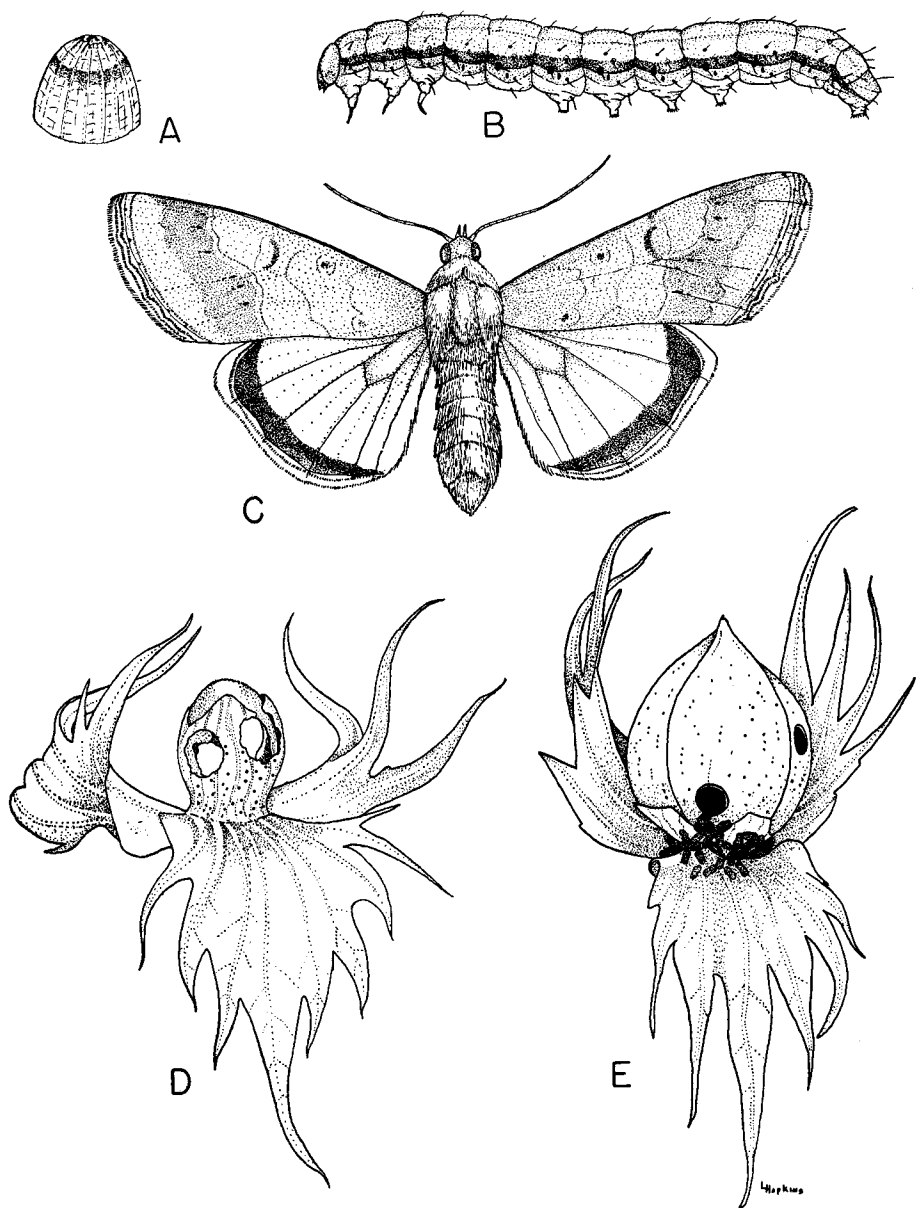
The bollworm is the primary insect pest of cotton in southwestern United States. It is also commonly known as the corn earworm and the tomato fruitworm because of its serious damage to these important crops. Alfalfa, beans, lettuce and soybeans are among the many other crops also attacked.

One female moth may lay from 1,000 to 3,000 eggs, normally during a period of from one to two weeks. The eggs are minute and are placed singly, usually on the tender terminals in the upper third of the cotton plant. A bollworm egg is characteristically taller than its width at the base and resembles a small, finely ribbed, inverted cup. Each egg is pearly white when first laid but within 24 to 36 hours a purplish brown band appears on the upper third. Ordinarily, hatching occurs in from two to four days.

The young larva is at first cream to tan colored with conspicuous black dots, each of which bears a single

hair. As the larva grows, these dots become less conspicuous. Mature bollworms are approximately one and one-half inches long and vary in color from pale green through rose to dark brown. Light and dark bands extend along the back and sides. The head of an older larva is usually yellowish-brown in color. The spiracles (breathing pores) along the sides of the body are usually conspicuous. Slight magnification reveals numerous tiny spines arising from the skin. These spines, or spicules, are found only on the bollworm and its nearest relatives.

The bollworm passes through six larval stadia, or growth periods, in from 17 to 21 days during the summer. The mature larva drops from the plant and burrows a few inches into the ground where it pupates. The dark brown pupa resembles a hard, compact mummy upon which various features of the developing moth may be recognized. Normally



**Figure 3.—Bollworm. A) Egg. Note characteristic dark band; B) Mature larva; C) Adult; D) Damaged square; E) Damaged boll.**



the pupal stage extends from one to two weeks in mid-summer.

The moth has a wing span of one and one-half inches. The fore wings are buff to tan, marked with irregular dark lines and spots. A rather large, dark crescent near the center of each forewing helps to identify the species. The hind wings are light gray with a dark band at the trailing edges. These moths are most active at dusk. The entire life cycle requires from 25 to 30 days during mid-summer. In Arizona, approximately six to eight generations are produced annually, three to four of which occur on cotton. The pupae of the last generation hibernate in the soil until the following spring, when a new generation of moths emerges. In Arizona, after three to four generations have developed on other host plants, bollworm moths invade cotton at the time when the first squares appear.

Young larvae feed primarily in tender terminal growth but also feed on the flower petals, occasionally boring into the bases of the blossoms. As bollworms grow, they attack squares, flowers, and bolls. Older larvae bore into the larger bolls, which they may completely hollow out in two to four days. During its development, a single bollworm can destroy from eight to fourteen squares and bolls. Although bollworms damage primarily the fruiting structures, they occasionally attack other parts of the cotton plant. Larvae infrequently rag the foliage and bore into the stems.

To adequately detect bollworm infestation, fields should be examined

at least weekly from mid to late season. The presence of eggs indicates that feeding larvae may follow in two to four days. When eggs are found, fields should be rechecked in four or five days. Beneficial insects such as minute parasitic wasps, minute pirate bugs and lacewing larvae frequently eliminate infestations by destroying bollworm eggs. Consequently, **control measures should not be applied solely on the basis of egg counts.**

Once the eggs are hatched it is necessary to examine the plants closely for bollworms. Approximately 100 plants should be examined in every 20 acres. A minimum of five 100-plant checks per field is desirable. In each area of inspection examine plants from several rows and at least 15 to 30 feet apart in each row. Small bollworms are usually located in the upper third of the plant, primarily in the terminals. Larger bollworms are usually located on the fruiting structures. When injury is found, carefully examine the plant to determine whether larvae are still present. Frequently natural enemies may have eliminated the bollworms even though their injury remains. **Do not apply insecticides unless a careful inspection reveals living larvae.**

When an average of four larvae is found per 100 plants an insecticide should be applied. **Treatment as well as field inspection should be timed as nearly as possible to eliminate small larvae, up to one-half inch in length.** Larger bollworms feeding within the bolls are very difficult to kill.

## **CABBAGE LOOPER**

*Trichoplusia ni* (Hbn.)

The cabbage looper is commonly found on cotton in Arizona during most of the growing season. It is generally distributed and also attacks lettuce, alfalfa and other crops.

Mature loopers attain a length of

approximately one inch. They vary from light to dark green, generally with a paler head. These caterpillars have but two pairs of legs under the mid-section of the body and move about with a looping gait. The moth

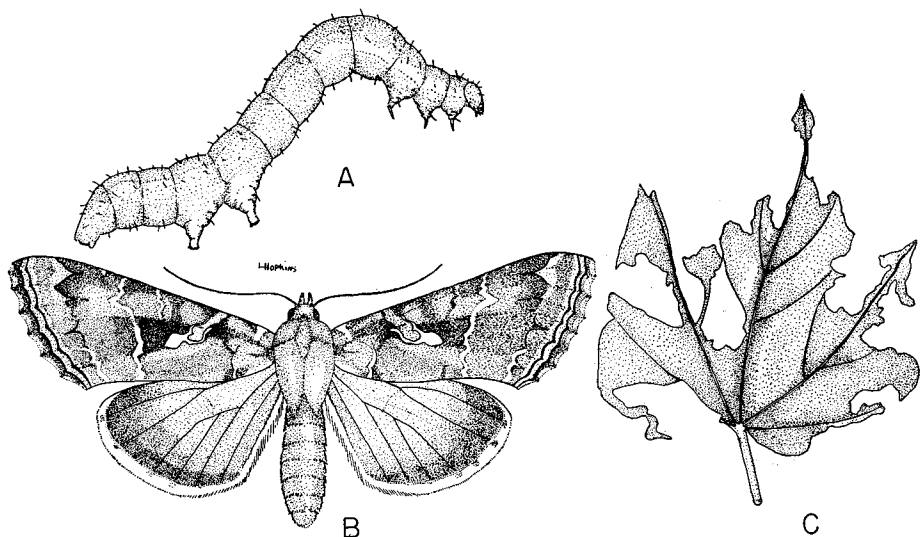


Figure 4.—Cabbage looper. A) Mature larva; B) Adult. Note “Y” shaped markings on fore wings; C) Typical leaf injury.

is about an inch long, with a wing span of one and a fourth to one and a half inches. Its body and hind wings are dull gray or brown. The fore wings are mottled gray or brown, each with a conspicuous silver mark near the middle.

Eggs shaped like shallow, inverted cups are deposited individually on the leaves and other tender parts of

the plant. During the growing season it takes approximately three weeks for the newly hatched caterpillars to reach maturity. The mature caterpillars pupate beneath a loose web covering, usually on a leaf. In Arizona there are several generations annually on cotton.

Feeding loopers rag the foliage. Severe infestations can defoliate the plants.

### **COTTON LEAFWORM** *Alabama argillacea* (Hbn.)

In the United States the cotton leafworm is frequently injurious in the humid Southeast but is seldom a pest in the arid Southwest. In Arizona injurious populations rarely develop, and harmful infestations have not been reported since 1944. The cotton leafworm cannot survive the winters in temperate United States, but infestations occur when the moths migrate north from the tropics.

Full grown cotton leafworm larvae are slender and about one and one-half inches long. They vary in color from light yellowish-green to nearly black. There are three narrow white stripes along the back and a white line along each side. In addition, two parallel rows of black spots extend along the back. Each spot bears a black spine surrounded by a white ring. On the dark forms, the black

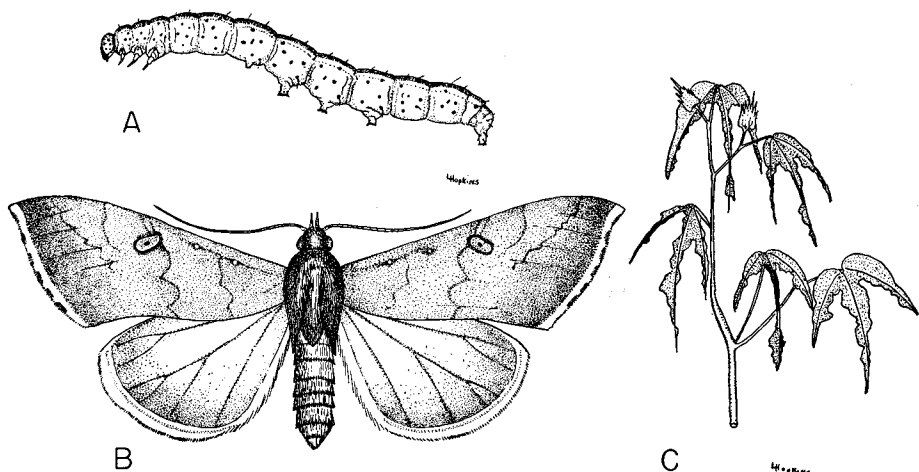


Figure 5.—Cotton leafworm. A) Mature larva; B) Adult; C) Leaf injury.

spots are joined together. The moth has a wing span of one and one-eighth to one and one-half inches and is light brown, tinged with olive and red. The fore wings are crossed with wavy, reddish lines. Each wing has a distinct spot near its center and three equidistant white specks near the base. The posterior edges of the fore wings are fringed with a narrow white stripe broken by dark spots.

Cotton is the only host plant upon which this insect can complete its development. Eggs are laid individ-

ually on the undersides of the leaves. After hatching, the young larva feeds on the under surface of the leaf. Upon molting it moves to the tender terminals. Larger larvae feed upon all parts of the plant. Pupation occurs on the plant in a loose cocoon which usually incorporates a folded corner of a leaf.

Some observers believe that earlier varieties of cotton and numerous applications of improved insecticides have eliminated the cotton leafworm as a serious pest in Arizona.

## COTTON LEAF PERFORATOR

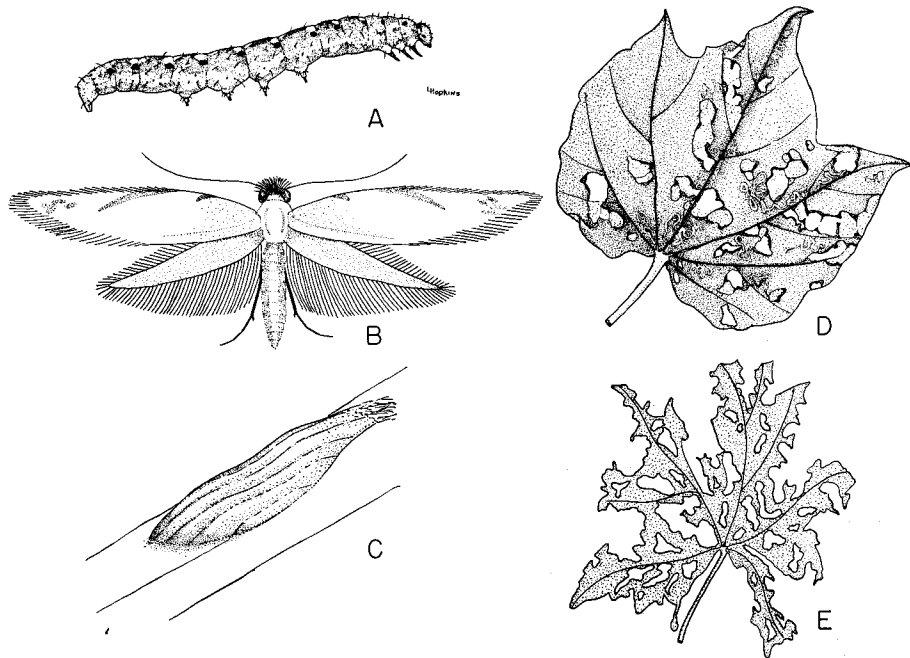
*Bucculatrix thurberiella* Busck

The cotton leaf perforator has been present in Arizona for many years but it has recently become more prominent as a pest. Particularly severe infestations were reported in Yuma County during September of 1954, 1955 and 1956 and in Maricopa and Pinal Counties in 1956.

Adult cotton leaf perforators are tiny white moths about one-eighth inch long. The females lay minute,

vertically ribbed, bullet-shaped eggs singly on the leaves, bracts and bolls. The eggs are at first milky, but change to a rust color before hatching. Because of their small size, these eggs are seldom noticed on the plants.

The small, white, newly hatched caterpillars make irregular mines in the foliage. After molting once, they leave the mines to feed externally. During the second molt they are pro-



**Figure 6.—Cotton leaf perforator. A) Mature larva; B) Adult; C) Cocoon; D) Cotton leaf showing mines of first instar larvae and “window” made by older larvae; E) Cotton leaf severely damaged by mature larvae.**

tected within a white, U-shaped, silken covering. This is frequently referred to as the “horseshoe stage.” The second stage and mature larvae are dull amber-green with gray-black spots and lighter “bumps” over the body. Full-grown larvae are about three-sixteenths inch long. The mature caterpillars pupate on the plant in small, white, ribbed cocoons. Although generations tend to overlap as the season advances, at least five distinct broods were reported at Yuma between June 30 and August 20, 1955.

Cotton leaf perforator infestations are characterized by small “windows” or perforations in the leaves. Severe

infestations may skeletonize the leaves and can cause partial or complete defoliation. Squares, flowers and small bolls then fall from the plant. Larger bolls open prematurely and produce inferior fibers. When populations are large, larvae have been observed to enter the tips of the bolls and feed internally.

The insect is known to attack only domestic and wild cotton. Stub cotton and unplowed fields harbor the pest during the winter, providing a source of reinfestation the following year. Early removal of post-harvest stubble will discourage the cotton leaf perforator and other injurious insects that overwinter in standing cotton.

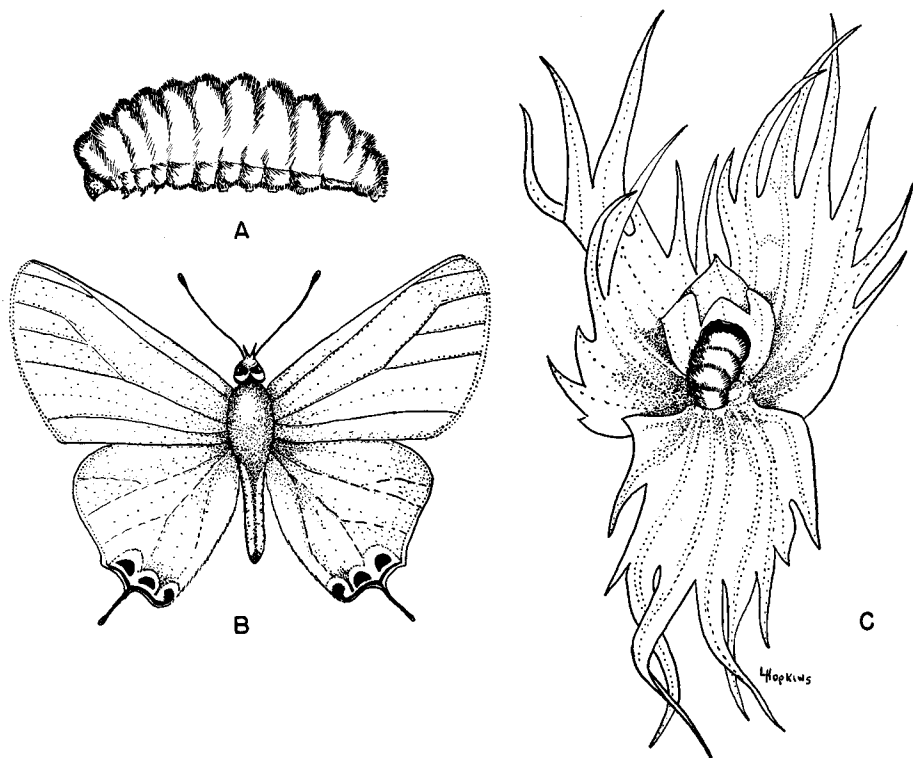


Figure 7.—Cotton square borer. A) Mature larva; B) Adult; C) Nearly mature larva feeding in a square.

### COTTON SQUARE BORER *Strymon melinus* (Hbn.)

The cotton square borer has a wide range of hosts throughout the United States and is generally considered to be of minor importance on cotton. The adult is a small, bluish butterfly with a wing span of about an inch. The upper surfaces of the wings are velvety brownish blue; the under surfaces are silvery gray. The posterior margin of each hind wing has a conspicuous tail-like projection with an orange spot near its base.

The mature caterpillar is slug-shaped, about half an inch in length

and less than half as broad. It is green and covered with fine, short hairs which give it a velvety appearance. The brown pupa is attached to the plant.

The small, round, whitish-green eggs are laid upon young foliage. The young larvae feed primarily upon the leaves but, when older, attack the squares and bolls in the manner of the bollworm. Heavy parasitism and chemicals applied to control other insects usually prevent the cotton square borer from becoming a serious pest in Arizona.

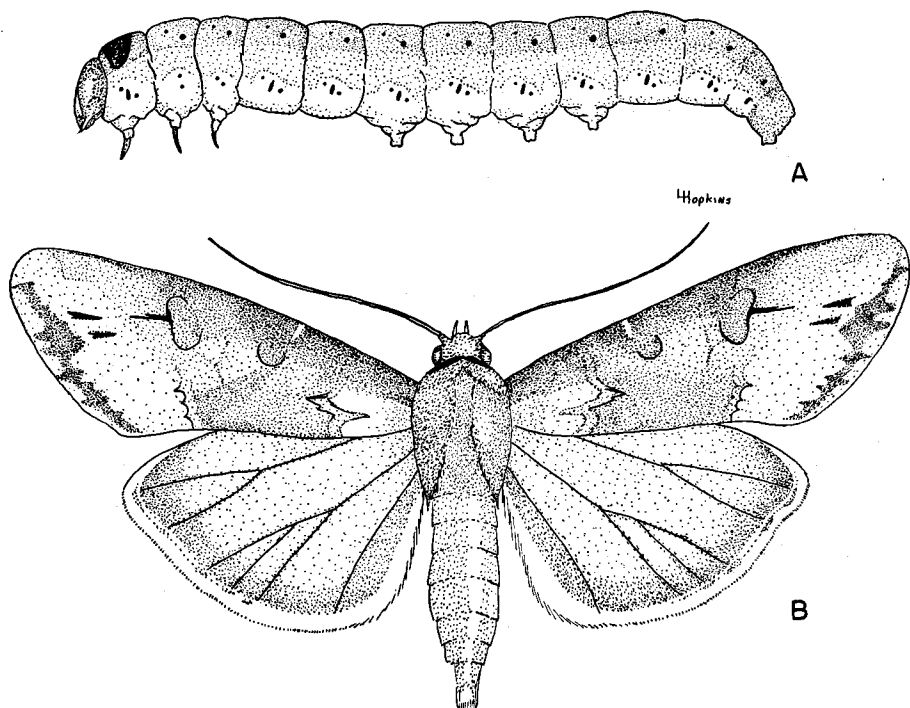


Figure 8.—Black cutworm. A) Mature larva; B) Adult.

### CUTWORMS (Various Species)

Each year in Arizona a great number of cotton seedlings are lost to these insects. However, because they are not usually concentrated, these losses attract little attention. Occasionally cutworms are locally abundant and cause serious damage in restricted areas.

The soft, fat, greasy-looking caterpillars are approximately an inch long when fully grown. They are mostly gray-brown or mottled above and lighter beneath. The moths are approximately an inch long with a wing span of one and a fourth to one and a half inches. They are mottled grayish brown with lighter, more uni-

formly colored hind wings.

Cutworms hide in the soil during the day but surface at night to feed. When disturbed they curl up and remain motionless. They are particularly injurious to seedling cotton and may completely devour the young plants or cut them down by severing the stem at ground level. Minor cutworm injury leaves seedlings vulnerable to damping-off fungi.

Cutworms are often abundant on cotton that follows alfalfa, grain or similar crops. Winter and spring plowing, disking and other cultivation will reduce the number of overwintering larvae and pupae.

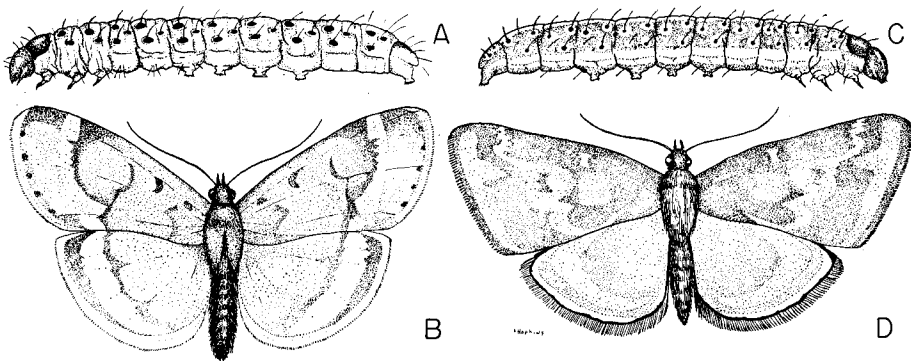


Figure 9.—Webworms. A) Garden webworm, mature larva; B) Garden webworm, adult; C) Sugar beet webworm, mature larva; D) Sugar beet webworm, adult.

## WEBWORMS

The garden webworm, *Loxostege similalis* (Guen.), and the sugar beet webworm, *Loxostege sticticalis* (L.), have a wide range of weed hosts and attack many crops in the Southwest. They are not major pests of cotton but injurious populations are occasionally found, particularly in weedy and poorly managed fields.

The garden webworm ranges from yellow to pale green with three black dots on the upper portion of each segment. The moth varies from yellow to buff, with darker markings on the fore wings, and has a wing span of approximately one inch.

The sugar beet webworm is pale to dark green with three longitudinal

stripes and many black and white tubercles. The moth, although similar to the garden webworm, is purplish brown with paler wing bands.

The eggs of these species are laid singly or in clusters on the host plants. The caterpillars feed within loosely webbed leaves or leaf parts, but frequently abandon these shelters to move from plant to plant. After growing to approximately one inch in length the mature caterpillars pupate in the soil.

Keeping fields free from weeds will do much to prevent webworm infestations. Fall plowing destroys many overwintering pupae.

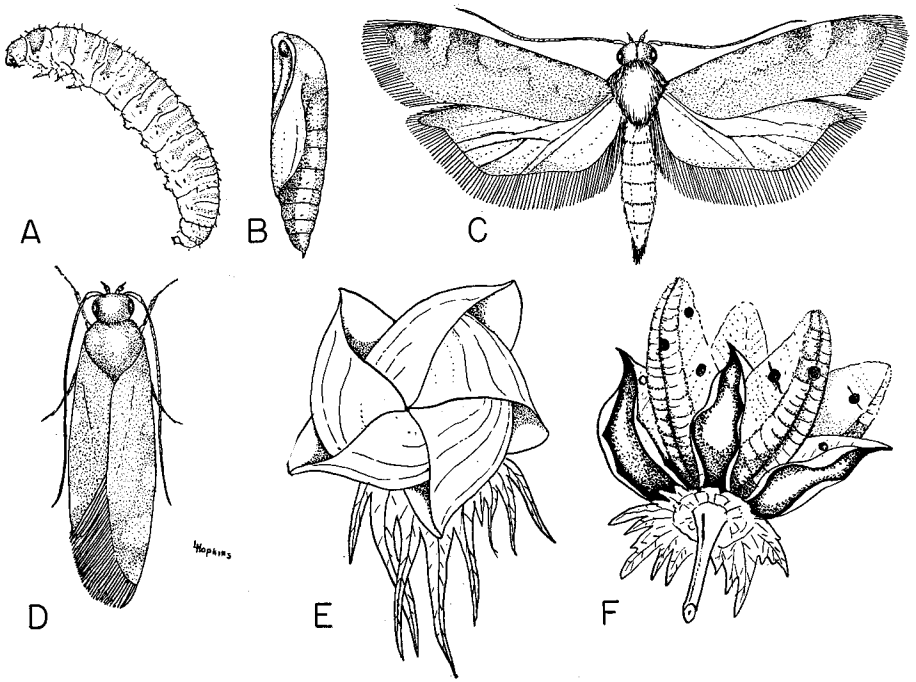
## PINK BOLLWORM

*Pectinophora gossypiella* (Saunders)

The pink bollworm is native to southern Asia and is a major pest in the cotton-growing areas of the Old World. It was introduced into Mexico in 1911, into the United States in 1917, and is now found in Texas and adjacent states. It causes serious losses throughout most of Texas and in Mexico. In Arizona it is frequently

found in Cochise, Graham, Greenlee, Pima and Santa Cruz Counties. Diligent efforts by quarantine officials have restricted the pink bollworm to these southeastern counties, where thus far it has constituted a threat rather than a source of loss.

The full-grown caterpillar is about one-half inch long and is pink on the



**Figure 10.—Pink Bollworm. A) Mature larva; B) Pupa; C and D) Adult; E) Rosetted cotton blossom; F) An open boll showing tight locks and damaged lint.**

back and sides. Younger caterpillars are glossy white and difficult to see against the maturing lint. The adult is a small, mottled, grayish-brown moth. It is approximately three-eighths inch long with a wing span of one-half to three-fourths inch. The fore wings are more slender than the hind wings; both pairs are relatively pointed at the tips. The moths may be carried long distances by air currents.

The oval, greenish to red eggs are laid on all parts of the plant, but the bases of bolls and the insides of bracts seem to be preferred. Immediately upon hatching, the young caterpillars search for food. Without food they die within 24 hours. It is estimated that 90% of the newly hatched young die before feeding. Although larvae

prefer to attack nearly mature bolls, they will also feed upon squares and flowers. Pupation normally takes place within the bolls but may occur in ground litter or in the soil. In the summer the pink bollworm completes development in three to four weeks. It can have as many as five or six generations a year.

There are two types of pink bollworms: (1) short cycle larvae that pupate when mature and (2) long cycle larvae that remain inside the bolls, usually within the seed, to overwinter. Long cycle larvae may remain dormant as long as two years before pupating.

Injured squares and flowers usually drop from the plant. The larvae cut the lint by mining through the maturing bolls. Lint from infested bolls is



short, discolored and of low grade. Oil content of the seed and its germination are greatly reduced.

Infestations can be detected by a number of signs. Caterpillars in the squares web the tips of the flower petals together. When these squares bloom, the **flowers are rosetted**. (Fig. 10E). Before entering the bolls, the caterpillars tunnel in the surface for about an inch. These **tunnels in green bolls** are a good sign of pink bollworms. The larvae make **clean-cut holes** as they move between the locks or leave the bolls. Late in the season they often web two seeds together before overwintering. **Double seeds** are characteristic of the pink bollworm.

Because this insect tunnels into the bolls and enters the seeds, it is very difficult to control. The prolonged dormancy of long-cycle larvae adds to the problem of yearly reinfestations. In infested areas the following precautionary measures should be employed. Check fields frequently shortly after blooming starts. At this time, rosetted flowers indicate the presence of pink bollworm. After larger bolls develop, larvae show a preference for them and fewer rosetted flowers are found.

To evaluate pink bollworm infestations collect all the infested squares, flowers and bolls found in one row over a distance of 100 steps. Collections should be made at a minimum of five representative locations in the field. To estimate the number of

worms per acre, multiply the number of infested squares, flowers and bolls found in 500 steps by 10. If 100 or more infested fruiting structures are computed to the acre, chemical control measures are recommended.

Pick cotton as soon as possible and destroy the stalks and trash as soon as harvesting is completed. Stalks should be destroyed with an efficient shredder that will spread the residue evenly on the ground. Many overwintering larvae are killed during shredding and by exposure of the residue to the sun. The shredded residue should remain on the surface for several days before plowing under. Plowing to a depth of six inches or more is preferred. The deeper the plowing, the fewer the surviving larvae. Follow plowing by an irrigation that will wet the soil to the depth of the residue. Irrigation in dry areas helps to decay the residue more rapidly. If it is not possible to shred the stalks, pasturing with sheep and cattle is recommended.

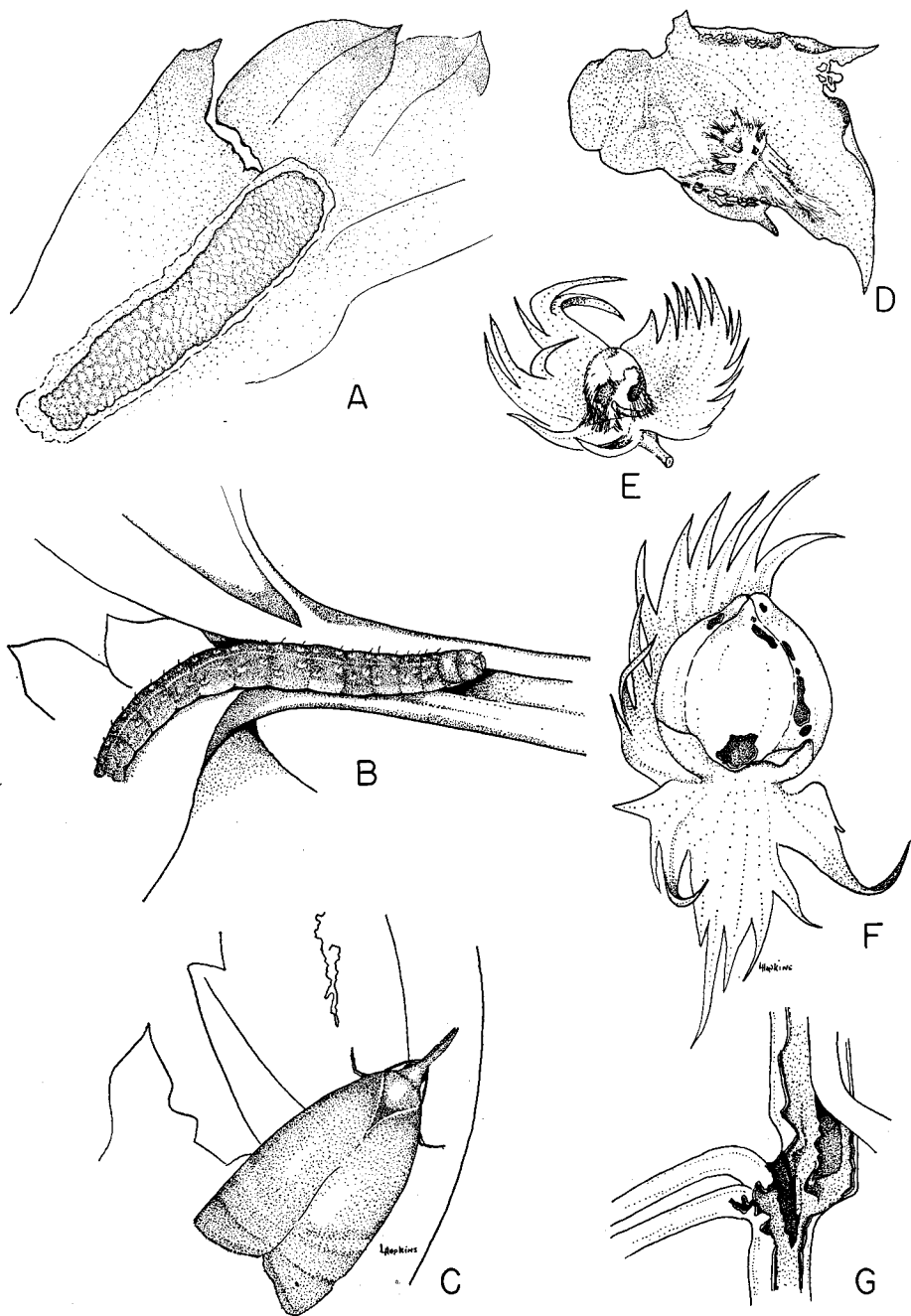
The growing of stub cotton in the southeastern counties of Arizona encourages pink bollworm survival. Plants standing throughout the winter afford excellent protection for the dormant larvae. Growing stub cotton is, therefore, not recommended in infested areas. Planting non-infested certified seed, early planting, proper fertilization, clean cultivation and early harvesting are all practices that aid in controlling the pink bollworm.

## OMNIVOROUS LEAF ROLLER

*Platynota stultana* (Wlsm.)

This insect has a wide distribution on alfalfa, celery, sugar beets and many other host plants. It has been reported as a cotton pest in Arizona, New Mexico and the Imperial Valley of California. In Arizona it was first recorded on cotton at Buckeye in

1952. Recent cotton insect surveys report harmful infestations primarily in Maricopa County and moderate infestations in Yuma County. Leaf rollers have been observed in fields from early July until September and are probably distributed throughout the state.



**Figure 11.—Omnivorous leafroller. A) Egg cluster; B) Mature larva; C) Adult at rest; D) Damaged leaf with webbing; E) Injured square with young larva feeding beneath a web shelter; F) A large green boll showing typical surface injury; G) A stem cut away to show internal damage by larval boring.**

Eggs are laid tightly cemented in smooth, usually irregular masses about five-sixteenths inch long and are located primarily on the upper surfaces of the newer leaves. The egg masses are at first a pale green color similar to that of the cotton leaf but become increasingly darker with age. The eggs of each cluster overlap one another, like scales on a fish. On cotton, the number of eggs per mass usually ranges from 50 to 125.

Upon hatching, young larvae crawl to the top of the plant or to the tip of a branch where they may conceal themselves in a leaf or flower bud. These larvae may commence feeding immediately or may wander about over the plant for several hours. Usually leaf roller larvae molt once or twice before constructing their characteristic shelters of rolled leaves and bracts. Pupation occurs on the plant within the protection of these shelters. The caterpillars feed in the terminals, on the leaves, bracts and bolls and may frequently enter the stems. Because they are protected by web structures and plant parts, immature leaf rollers are generally difficult to

control with insecticides.

The moths are generally tan or rust-colored and are triangular or bell-shaped when at rest. The females are nearly one-half inch long; the males are slightly smaller and darker in color. Their heads are prolonged anteriorly into distinctive scaly snouts.

The omnivorous roller produces numerous generations each season. Although developmental time varies considerably between individuals, on cotton approximately one month is required from egg to adult during mid-season.

Recent investigations in Southern California indicate that the most practical means to evaluate omnivorous leaf roller populations in cotton is the time-search-basis method. All the living larvae found anywhere on the plants during a given period of time are counted. If living larvae are found at an average rate of 100 per hour (or 25 per 15-minute-search period) control measures are indicated. It is advisable to take numerous counts at different locations in a field in order to adequately evaluate omnivorous leaf roller infestations.

## **SALT-MARSH CATERPILLAR**

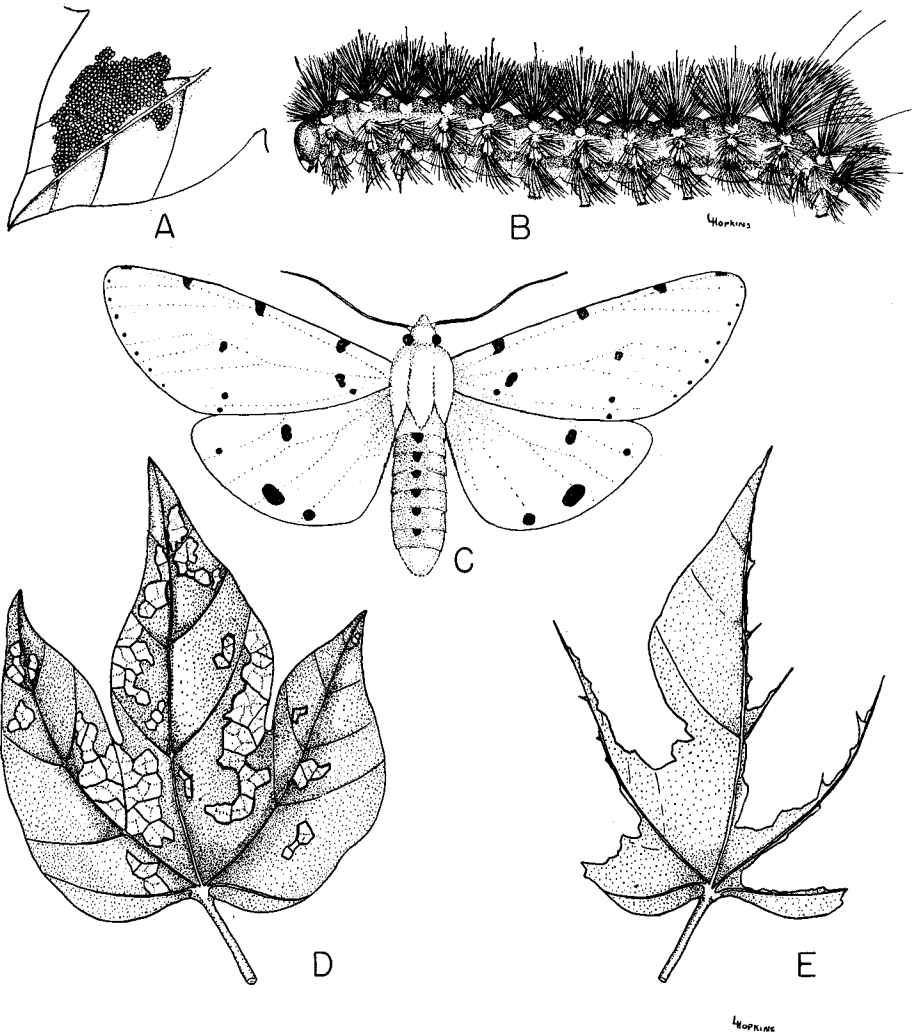
*Estigmene acrea* (Drury)

The salt-marsh caterpillar is a pest in all cotton-growing areas of Arizona. The caterpillars usually appear on cotton in early August, are most abundant from late August to mid-September, and usually decline in numbers after the first of October.

Young caterpillars are light buff with clusters of long, dark hairs over the body. With an increase in size, the larvae become more hairy. For this reason they are called "wooly worms." Mature caterpillars are approximately two inches long and are mottled yellow, orange and black beneath a dense covering of long buff to black hairs. Moths are about one

inch long with a two-inch wing span. They are predominantly white with the abdominal segments orange on top, each with a black spot at the middle. The wings of both sexes are spotted with black. The hind wings of the males are orange. Both wings of the female are white.

Each female may lay as many as a thousand eggs in masses on the under surface of the leaves. After hatching, the young caterpillars feed in a group until they have molted twice. They then separate to become independent feeders. After two additional molts, mature caterpillars hide in the ground litter to pupate.



**Figure 12.—Salt-marsh caterpillar. A) Egg cluster; B) Mature larva; C) Adult female; D) Cotton leaf skeletonized by gregarious young larvae; E) Cotton leaf damaged by a nearly mature larva.**

Within a few days the moths emerge to renew the cycle. A single generation may take three weeks or longer, depending upon the weather. Mature caterpillars or pupae pass the winter in ground litter.

Young larvae, feeding gregariously on the lower surfaces of the leaves, leave the leaf veins and upper surface intact. Damaged leaves then have the appearance of fancy lace

work. Older larvae, feeding independently, eat through the leaves and consequently rag the foliage. Extensive injury causes reduced plant vigor and exposes the bolls so that they open prematurely. Severe infestations can defoliate the plants. Fortunately, parasites and predators significantly reduce the number of potentially destructive salt-marsh caterpillar populations each year.

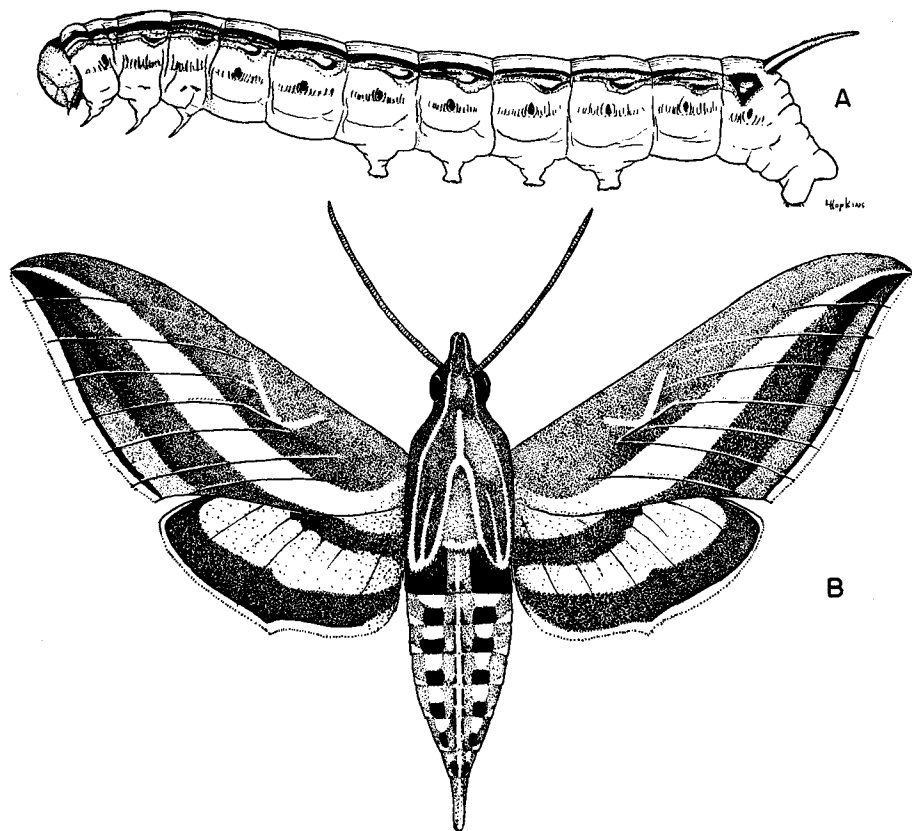


Figure 13.—White-lined sphinx moth. A) Mature larva; B) Adult.

### WHITE-LINED SPHINX MOTH *Celerio lineata* (F.)

White-lined sphinx caterpillars are very common on grasses and other weed hosts throughout the state during the growing season. In July and August when populations occasionally become large, these caterpillars sometimes invade neighboring cotton fields.

Full-grown larvae attain a length of three inches. They vary from pale green to black, displaying dusky spots and narrow longitudinal white stripes.

A characteristic yellow horn is found at the posterior end.

Because of their characteristic shape and habit of darting and hovering in flight, the large moths are said to resemble hummingbirds. They are robust, with a wing span of three inches or more. The fore wings are dark with broad white lines; the hind wings have a wide, purplish to rose colored band.

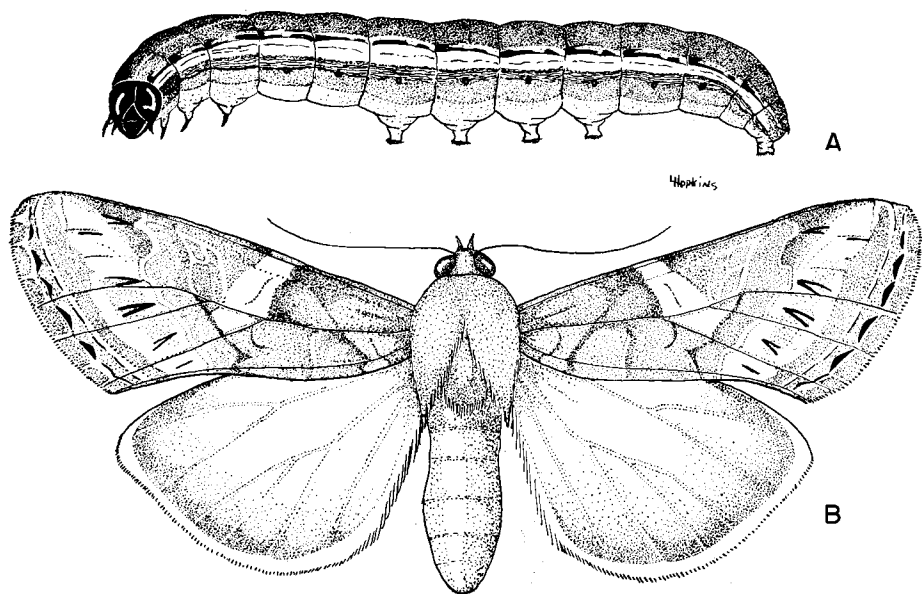


Figure 14.—Yellow striped armyworm. A) Mature larva; B) Adult.

### YELLOW-STRIPED ARMYWORM

*Prodenia ornithogalli* Guen.

In Arizona the yellow-striped armyworm is a common alfalfa pest and frequently causes serious injury to cotton, vegetables and other crops.

The caterpillars are velvety black to brownish with yellow stripes along the sides and are reddish beneath. Full grown, they range from one and two-thirds to two inches in length. The gray-brown moths have a wing span of about one and a half inches. The fore wings have lighter markings which give them a marbled appearance; the hind wings are silvery gray. These moths fly at night and may become abundant about lights during the summer.

Infestations in cotton may be caused by mass movements of armyworms from nearby crops and weeds or may originate from eggs laid on plants within the field. Serious damage to border rows is often caused by an invasion of nearly mature caterpillars. Harvesting nearby alfalfa fields con-

taining large larval populations is the most common cause of these mass invasions. When a food source is depleted or removed, yellow-striped armyworms are capable of traveling a considerable distance in search of a new food supply.

Female moths often deposit velvety egg masses on cotton plants. The newly hatched caterpillars at first skeletonize the leaves by feeding in groups. They then slowly radiate from the hatching site as they grow larger and eventually feed independently. Larger caterpillars feed upon all parts of the cotton plant, defoliating, cutting off stems and occasionally entering or entirely consuming the bolls. Injurious populations are frequently localized within a field near their hatching sites. When alfalfa fields near cotton are known to be infested, it is advisable to take protective measures before the hay is cut.

## CICADAS

(Various Species)

Cicadas are medium to large robust insects with tubular, sucking mouth parts and two pairs of membranous, net-veined wings. The shrill song of the males is a familiar sound during sunny summer afternoons. Wingless immature cicadas inhabit the soil where they feed upon the roots of various plants.

Female cicadas make deep, slit-like, egg punctures in the stems and branches of cotton plants. When these punctures are particularly deep and numerous, the plants may be broken over, especially during periods of strong winds. This injury is of only sporadic importance.

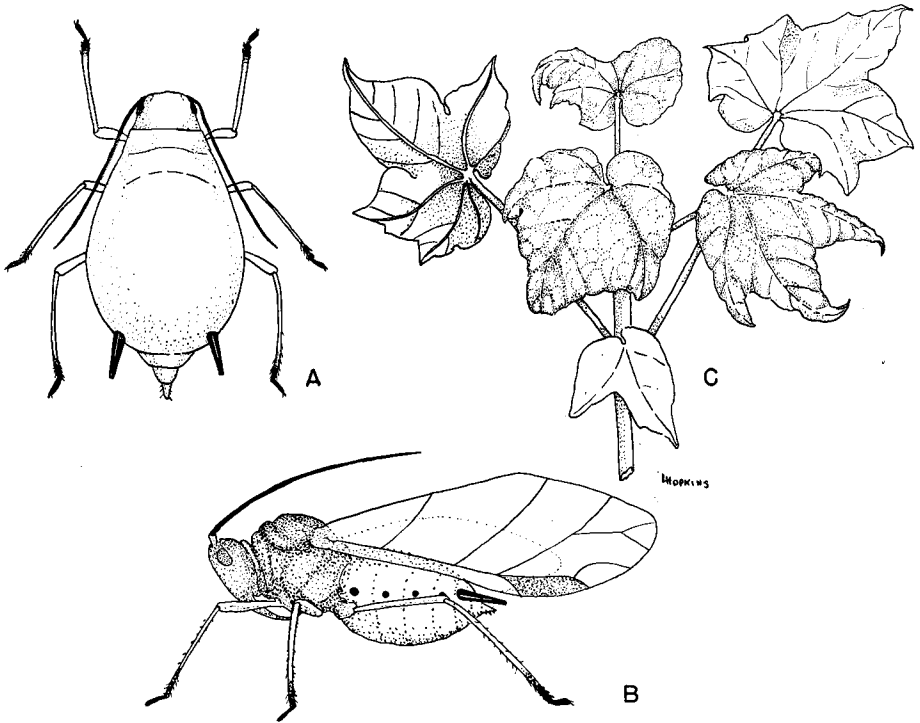


Figure 15.—Cotton aphid. A) Wingless adult; B) Winged adult; C) Damaged cotton leaves, typically deformed and curled down at the edges.

## COTTON APHID

*Aphis gossypii* Glover

The cotton aphid attacks many plants throughout the world and in southwestern United States is a serious pest of cotton and cucurbits. In Arizona spring infestations frequently

cause considerable damage to cotton seedlings. As the seedlings grow larger, early aphid populations are greatly diminished. A tiny parasitic wasp of the cotton aphid is, at least

in part, responsible for this late spring reduction. It is not until late in the season, when the bolls begin to mature and open, that large colonies of cotton aphids reappear. These late season infestations are generally more widespread and severe.

Cotton aphids are small, slow-moving, soft-bodied insects. The winged adults are usually dark green with black legs. Wingless forms vary from yellow to green, brown, black, pinkish, and mottled.

Migrating winged adults distribute the species from host to host. After settling on a host plant, they give rise to winged or wingless generations. In regions with a mild climate, these aphids reproduce throughout the winter on hosts other than cotton.

To feed, aphids insert their long, narrow beaks into the plant and suck out the juices. Spring infestations can stunt, retard and occasionally kill the young cotton plants. The leaves of infested plants become characteristically distorted, curving down at

the edges. In early fall, colonies may again become large and abundant. The cotton aphid secretes honeydew, a sticky, sweet liquid excrement, which covers the leaves. Slick, shiny, honeydew-covered leaves are easily recognized from a distance. Open bolls often become covered with honeydew which makes picking and ginning difficult and may lower the grade of the lint. Sooty mold frequently grows upon the honeydew, causing a blackened lint.

Melons and other cultivated or wild cucurbit plants constitute a source of cotton aphid infestation. If possible, they should not be grown in and around cotton fields.

The cowpea aphid, *Aphis medicaginis* Koch, is a minor pest of cotton in Arizona. It is a shiny, black species with white legs and white markings at the base of the antennae. It is occasionally harmful to cotton early in the season; however, parasites and predators usually prevent it from causing serious injury.

## MEALYBUGS

*Phenacoccus* sp.

Mealybugs are small, oval, soft-bodied insects covered with a powdery white wax which gives them a "mealy" appearance. Immature mealybugs resemble the adults except for their smaller size. Because these insects are gregarious and sedentary, the white colonies are easy to see on the green cotton foliage. The young, or crawlers, are active and move about in search of a favorable feeding site. Crawlers may disperse to nearby plants where they start new colonies.

Like aphids, mealybugs prefer to feed on the tender tissue. Infestations frequently occur in fields stressed for water. Large colonies deform the foliage, stunt and eventually kill the plant. These pests also secrete honeydew which may lower the grade of affected lint. Parasites and predators ordinarily keep infestations below the economic level.

Mealybugs are generally a minor pest of cotton in Arizona. Restricted outbreaks have been periodically reported from the Salt River Valley.



## WHITEFLIES

mainly *Trialeurodes abutilonea*  
(Haldeman)

These insects are frequently seen in great numbers on the lower surfaces of cotton leaves, particularly in the spring. Wingless, immature whiteflies are about one-twenty-fifth inch long and look like little oval caps surrounded by waxy fringes. The adults are about one-sixteenth inch long and resemble tiny white moths.

Immature whiteflies feed on plant juices like aphids and scale insects. They seldom, if ever, cause significant damage to healthy cotton plants. Insect parasites and predators are important in suppressing potentially larger whitefly populations. A fungus parasite which becomes active when the humidity is high is also instrumental in reducing these pests during rainy periods.

Each year the initial increase of whiteflies occurs primarily on small weeds found along road sides and ditch banks. The adults leave their wild hosts to infest young cotton plants in the spring. Elimination of weed hosts before seedling cotton appears will help to reduce the spring increase.

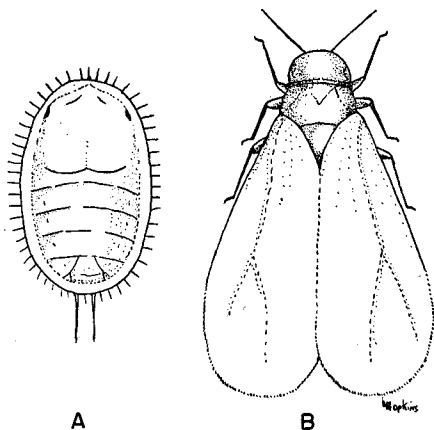


Figure 16. — Whitefly. A) Nymph; B) Adult.

Whiteflies are undesirable because they secrete honeydew. However, because infestations are not considered economically injurious to healthy plants, control measures are seldom suggested.

## LEAFHOPPERS

*Empoasca* spp. and others

Leafhoppers are frequently found in Arizona cotton fields but are not considered to be serious pests. Most of the adults are slender, green, wedge-shaped insects about one-eighth inch long. Their longer, more powerful hind legs enable them to "hop" with great agility. The nymphs are similar but smaller and wingless. Adults overwinter on native plants and in plant debris. Each spring they migrate into various cultivated crops, including cotton. Although leafhoppers have been reported to lay

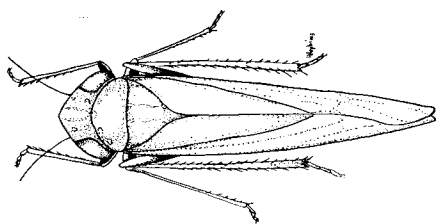
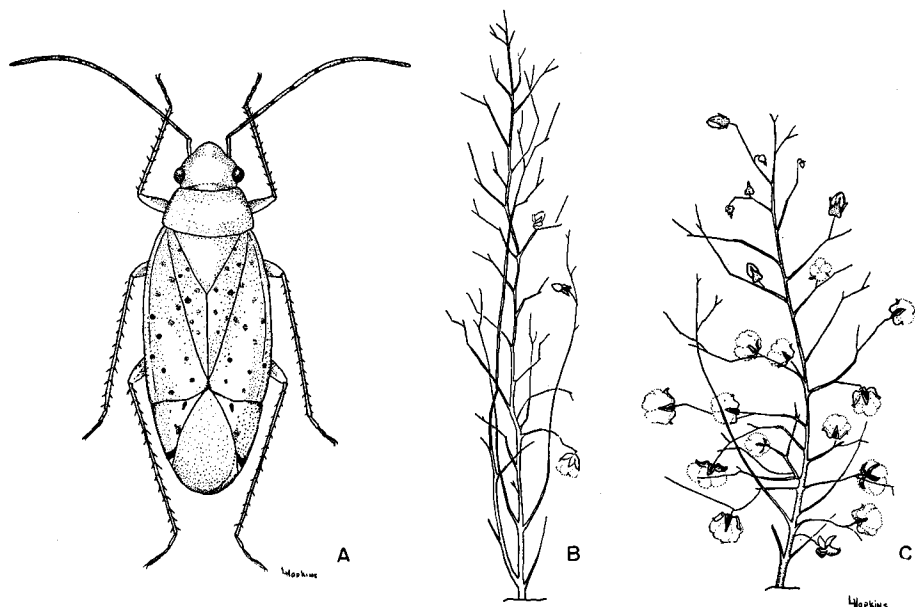


Figure 17.—Leafhopper adult.

eggs and grow to maturity on cotton, it is not considered to be a preferred host plant.



**Figure 18.—Cotton fleahopper. A) Adult; B) Damaged mature cotton plant. Note whip-like stems and suppression of bolls; C) Normal mature cotton plant.**

### **COTTON FLEAHOPPER** *Psallus seriatus* (Reut.)

The cotton fleahopper occasionally becomes destructive in localized areas in Arizona. The cumulative effect of this pest in combination with other cotton pests can cause considerable crop damage.

The adults are about one-eighth inch long, a third as broad and look like small lygus bugs. They are light green with fine black speckling over the body. The older nymphs resemble adults, but lack wings. Newly-hatched nymphs are very small, white and elongated, with slender legs.

Eggs are inserted into the plant tissues. Upon hatching, the young bugs move to the growing tips to feed. The older nymphs and adults usually feed in the terminals but also attack squares and small bolls. During the summer fleahoppers mature

in approximately three weeks.

The cotton fleahopper is particularly attracted to weed hosts but migrates during the summer to more succulent cotton plants. When cotton plants become mature and tough, the fleahopper returns to weed hosts until the following summer. Cotton plants injured by fleahoppers are often subnormal in appearance, with long, whip-like main stems and a suppression of the fruiting branches. The number of vegetative branches may be increased. Leaves and stems may be scarred or deformed.

Control measures are indicated when approximately 20 fleahoppers are found per 100 sweeps of a standard net. Samples should be taken in several locations in the field. At each location 100 sweeps should be

made in a single row, contacting one plant terminal per sweep.

In 1955, black fleahoppers, tentatively identified as *Spanogonicus albofasciatus* (Reut.) and *Rhinacloa forticornis* Reut., were generally distributed in the state and were suspected of causing serious injury at

Eloy in July. The details of their biologies and an analysis of their effect on cotton have not yet been evaluated. Preliminary investigations in 1956 indicated that they may prefer to feed upon the leaves and the bracts rather than the fruiting parts of the plant.

## LYGUS BUGS

Lygus are the most harmful of the true bugs on cotton. Three species are important pests in Arizona. *Lygus hesperus* Knight constitutes about 95% of the total population, with *Lygus elisus* Van Duzee and *Lygus lineolaris* (P. de B.) making up the remainder.

The adults are oval, approximately one-fourth inch long and about one-half as broad. They range from straw-green to rather dark brown, with a conspicuous lighter diamond between the "shoulders." All have relatively long antennae and legs. The posterior halves of the wings are bent downward. *Hesperus* is green, often infused with red or brown just behind the middle. *Elisus* is always pale green. *Lineolaris*, the darkest species, is variegated brown throughout. Sometimes it is marked with small red spots on the wings at the middle of the outer edges. These insects are swift of foot and can quickly take to flight.

In Arizona lygus bugs breed continuously throughout the year on alfalfa and other hosts. They are found in cotton from the time the squares begin to appear. Their eggs are laid in the plant tissues and, after hatching, the nymphs molt five times before maturity. During July and August it takes approximately three to four weeks for a generation to develop.

In order to feed, these insects insert their long, needle-like mouth

parts into the squares, flowers and young bolls. Feeding punctures cause warty growths on the flower petals and brown spots on the pistils and stamens. Similar warts occur within bolls. Extensive feeding causes "flared" squares and flowers with the eventual dropping of these forms as well as injured small bolls. Injured bolls that fail to drop may later open abnormally. The lint is inferior and clings to the warty carpels, making picking more difficult. Seeds that are not totally destroyed contain less oil and germinate poorly.

Serious infestations show a number of characteristic signs: (1) increased flaring of the squares, (2) abnormal dropping of the squares and small bolls, (3) warty, deformed flowers, (4) circular, shiny spots of excrement on the squares, stems and flowers, (5) adult and immature lygus bugs on or around the fruiting structures during the cooler hours of the day.

Lygus bugs are extremely fond of alfalfa and develop large populations in that crop. When the hay is cut, these bugs move over into adjacent fields. Once in cotton, a population may become established and reproduce.

The common practice in Arizona has been to control lygus bugs when 10 to 12 are found per 100 standard net sweeps. When numerous nymphs are found it indicates that the insects are well established and reproducing. Such fields should be watched closely.

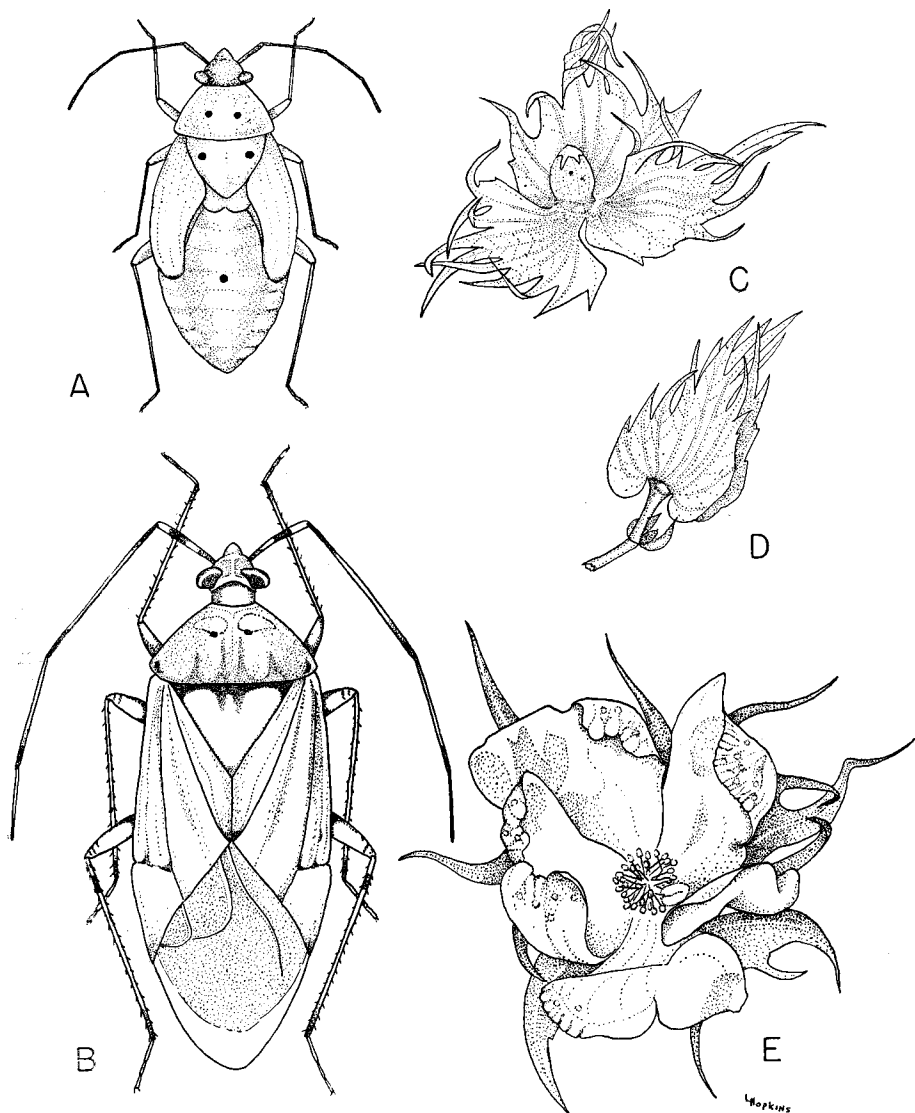


Figure 19.—*Lygus*. A) Nymph; B) Adult; C) Square, punctured and flared; D) Normal square; E) Damaged blossom showing typical warty and deformed petals.

## STINK BUGS

Stink bugs are shield-shaped, relatively flattened insects, about two-thirds as broad as long. The nymphs are oval, wingless, often variable in color, and may not closely resemble the adults. Most give off a heavy,

offensive odor, especially when disturbed.

Five kinds of stink bugs are commonly found in Arizona cotton fields: Say's stink bug, *Chlorochroa sayi* Stal; the brown stink bug, *Euschistus*

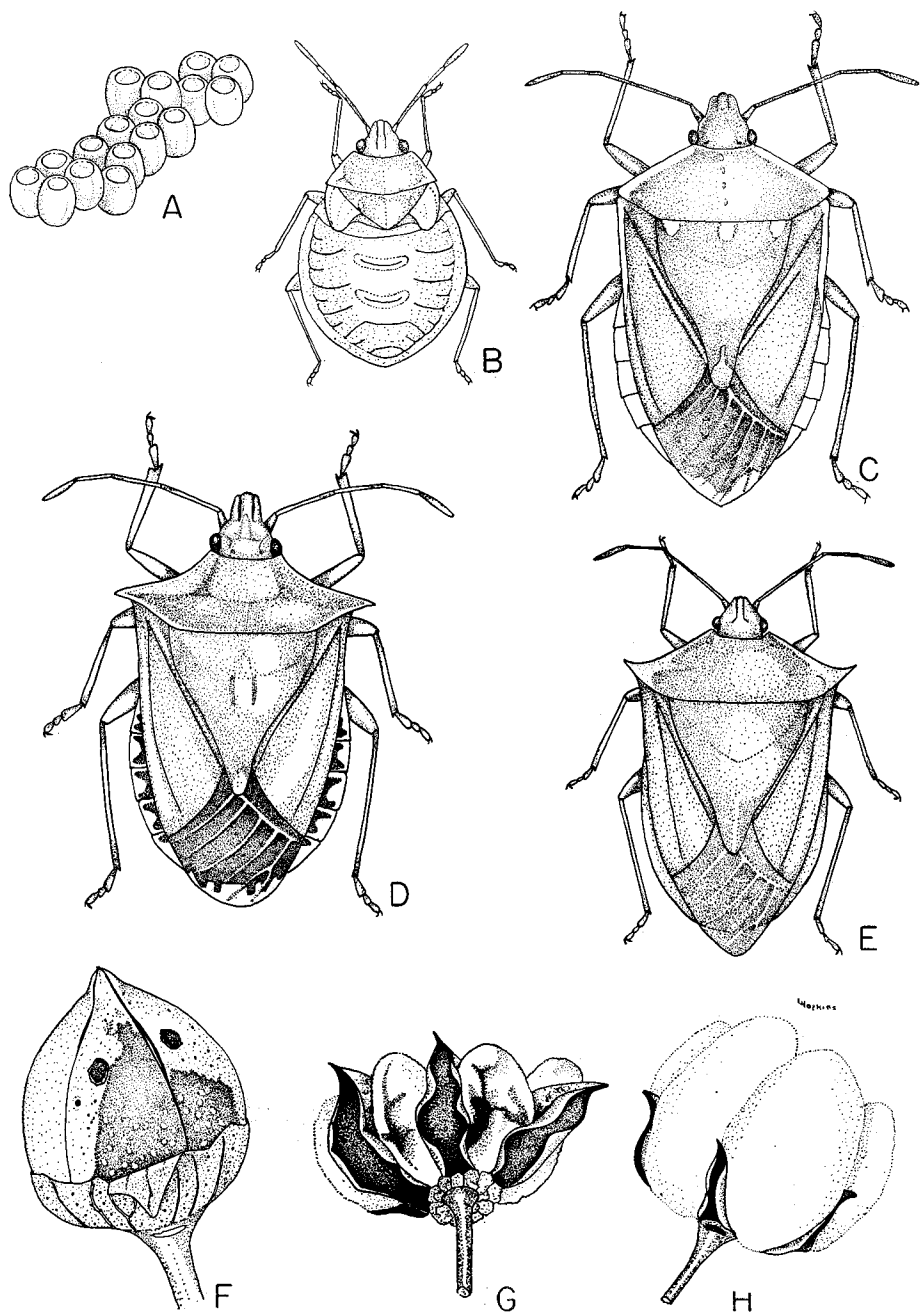


Figure 20.—Stink bugs. A) Say's stink bug egg cluster; B) Say's stink bug nymph; C) Say's stink bug adult; D) The brown stink bug; E) The red-shouldered plant bug; F) A maturing boll infected with boll rot introduced by feeding stink bugs; G) An abnormal open boll with hardened dry locks caused by stink bug feeding during boll development; H) A normal open boll.

*impictiventris* Stal; the red-shouldered plant bug, *Thyanta custator* (F.); the small green stink bug, *Thyanta brevis* Van D.; and the conchuela, *Chlorochroa ligata* (Say). The following characteristics will facilitate field recognition of these species:

1. Large stink bugs (one-half inch or longer)

a. *Say's stink bug* in Arizona is usually dark green with three prominent light spots in the triangular area between the wings. During the summer, however, light green forms are seen, and olive to reddish-brown forms occur in the fall. This is the most generally harmful of our species. Occasionally it can develop tremendous localized populations which are exceedingly destructive.

b. *The brown stink bug* is light brown above and yellow to yellow-green on the underside. Its "shoulders" are sharply pointed laterally. This stink bug is commonly found in cotton throughout the state, and has caused particularly serious damage in Yuma County.

c. *The conchuela* is slightly larger than either *Say's stink bug* or the brown stink bug. It is dark brown with a narrow border of red around the body except for the head. The triangular area between the wings is usually tipped with red. This species is occasionally found in southeastern Arizona, but seldom causes serious damage. In New Mexico and Texas the conchuela is more abundant and harmful.

2. Small stink bugs (seven-sixteenths inch or shorter)

a. *The red-shouldered plant bug* is variable in color, ranging from light green to tan. Often there is a red to pink band across the back at the "shoulders." This band may be absent or only suggested by a pinkish tint. The red-shouldered plant bug is the most generally harmful of the smaller stink bugs. It is distributed throughout the state, but is most abundant in the Salt River Valley.

b. *The small green stink bug* resembles the green form of the red-shouldered plant bug but is slightly smaller. It does not vary in color. Although it is generally less abundant than the red-shouldered plant bug, large local populations have been observed.

Specific life histories for all species are not known; however, they follow a similar general pattern. Females lay clusters of small, barrel-shaped eggs on the stems and leaves of host plants. The young bugs molt approximately five times before maturing. When conditions are favorable, this takes two to four weeks. The life span during summer is about two months, but overwintering adults may survive for six months or more. Stink bugs are particularly attracted to wild grasses, grains, alfalfa and various weeds. Fortunately, cotton is attacked only when more preferred host plants are absent or in an unattractive condition. These bugs are seldom found in cotton fields before the first bolls are set, and usually do not reproduce on cotton plants.

Stink bugs are particularly injurious because of their habit of attacking many bolls in all stages of growth. They feed by inserting their long beaks into the bolls and extracting juices from developing tissues and young seeds. Small injured bolls fall from the plant but larger bolls remain. Rough, warty, cellular growths form at the puncture sites on the inner surfaces of the carpels. In addition, seeds are shriveled and fibers are stained. Feeding injuries may eventually cause hardened, dry locks which cannot be harvested. Small reddish-brown spots on the carpels are external evidence of stink bug feeding. Boll rot fungi are often introduced by the feeding bugs.

Certain cultural practices will help to reduce the numbers of invading bugs. It is advisable to destroy the preferred hosts of stink bugs, as well as grain stubble, in the early winter and spring before the cotton bolls begin to develop. Cotton fields subject to stink bug invasions from nearby alfalfa should be watched carefully.

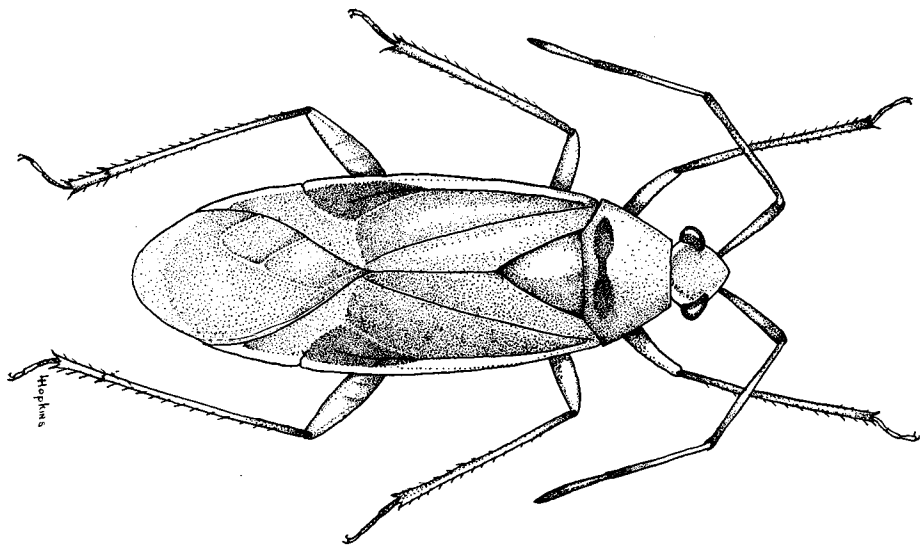


Figure 21.—Superb plant bug.

### MISCELLANEOUS PLANT BUGS OCCASIONALLY FOUND ON COTTON

The superb plant bug *Adelphocoris superbus* (Uhler) is a common pest of cotton and alfalfa in the southeastern counties of Arizona. Although infestations are not usually of major importance, serious combined injury may result when lygus bugs are also present.

The adults are about three-eighths inch long and are dark brown to black with orange to red outer wing margins. There are two black markings in the reddish triangular area behind the head. Superficially they resemble lygus bugs. The nymphs are usually green marked with red.

Like lygus bugs, these insects puncture the squares, flowers and bolls. Because they are slightly larger, each feeding puncture may be more severe and larger bolls may be attacked. Little is known of their life history. Eggs are laid in the stems of the host plants. The winter may be

passed in the adult stage or in the egg. There are probably three or more generations a year in Arizona. This pest is most often found in association with lygus bugs and is incorporated into the same sweep count evaluations when control measures are being considered.

Several closely related species of bordered plant bugs, *Euryopthalmus*, have been recorded from Arizona. The adults are mostly oval and approximately one-half inch long. They are black with a narrow orange margin around most of the body. Often there are fine orange specks over the back. The nymphs are oval to circular, brilliant metallic blue, often with a conspicuous red spot anteriorly on the abdomen. These bugs have been known to feed upon squares and bolls, but have always been of minor importance.

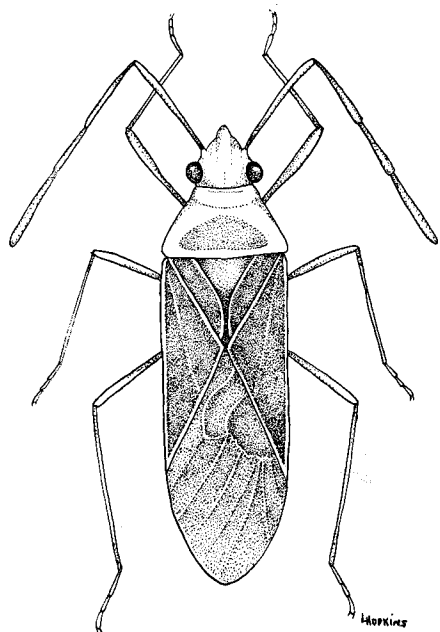


Figure 22.—A cotton stainer.

The leaf-footed plant bug, *Leptoglossus zonatus* (Dallas) and its relatives are large, usually brown, with conspicuous leaf-like enlargements on the hind legs. *Zonatus*, the commonest species, has two yellow spots in the triangular area behind the head, and an irregular yellow band across the middle of the back. It is a general feeder, and although rarely found on cotton, it will sometimes attack squares and bolls.

The spotted milkweed bug, *Oncopectus fasciatus* (Dallas) is about one-half inch long. It is bright orange or red with three black areas on the back and black spots on the under-

side. The common milkweed bug, *Lygaeus reclinatus* Say is very similar to the spotted milkweed bug. The head, the triangle at the shoulders, the legs and the spots on the abdomen are velvety gray-black. The abdomen and spots on the back are bright red. The black wings have white margins and two characteristic white spots near the middle. These bugs are common in the Southwest. Their primary host is milkweed, but they are found on a wide range of plants. They are presumed to rarely feed upon the squares and bolls, although injury has never been noticeable.

*Creontiades femoralis* Van Duzee and *Dysdercus albidiventris* Stal are other plant bugs similar to lygus bugs. Since the introduction of modern organic insecticides after World War II these bugs have rarely been found on commercial cotton crops in Arizona.

*Creontiades femoralis*, locally known as the western plant bug, is about one-fourth inch long and slightly more than one-sixteenth inch broad. It is reddish brown with long antennae and legs. Before World War II, it frequently caused deformed plants and reduced yields.

*Dysdercus albidiventris* is about three-eighths inch long, and black with red markings on the head. The leathery portion of the forewings is yellowish with two large black spots near the middle. Before organic insecticides were used extensively this insect and closely related species caused damage similar to that of the superb plant bug. These insects are commonly called Arizona cotton stainers.

## COLASPIS BEETLES

Colaspis beetles, mainly *Colaspis flavida* Say, attack a wide variety of plants, and occasionally become abun-

dant on cotton, particularly in southeastern Arizona. They are mid-season pests and rarely cause significant injury except in weedy fields.



These beetles are three-eighths to one-fourth inch long and about half as broad. They are buff in color and have conspicuous, rather threadlike antennae. A series of narrow, punctuate grooves and alternating ridges traverses the length of the wing covers, causing them to appear longitudinally striped.

Colaspis beetles feed upon the bracts, flowers and leaves of cotton plants, showing a preference for the bracts. Individual beetles riddle or "shot hole" these structures, while large populations cause more obvious ragging. Short, black, threadlike droppings of excrement are often associated with colaspis beetle damage.

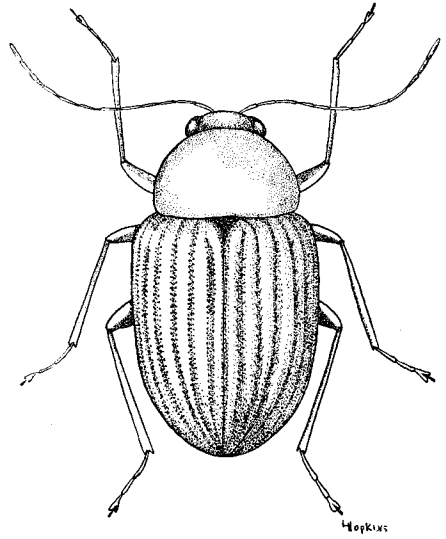


Figure 23.—A colaspis beetle.

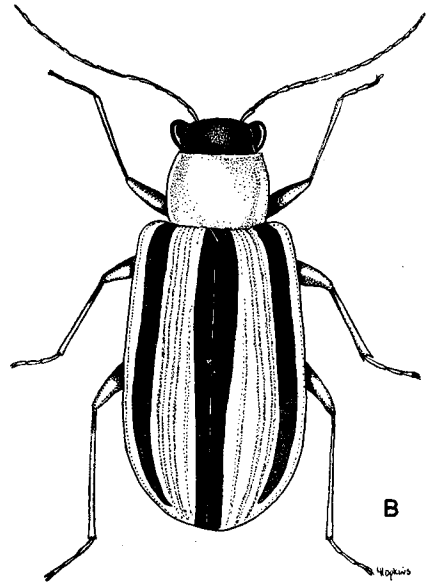
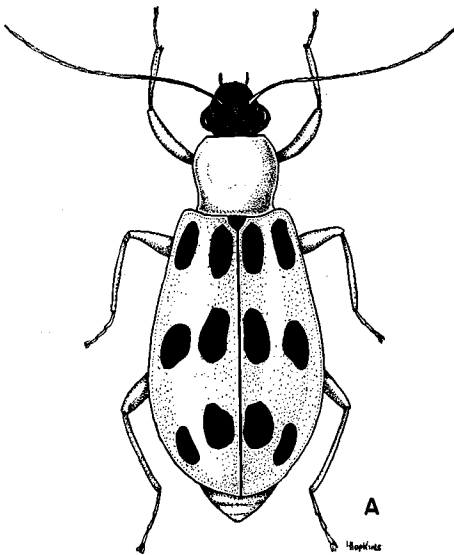


Figure 24.—Cucumber beetles. A) A spotted cucumber beetle; B) A striped cucumber beetle.

## CUCUMBER BEETLES

*Diabrotica* spp.

Spotted cucumber beetles are approximately one-fourth inch long and half as broad. They have pale yellow or black bodies and bright green wing covers with about a dozen prominent black spots. The larvae feed in the soil on the roots of various plants. The adults feed on foliage and either riddle or rag the leaves.

Striped cucumber beetles are sim-

ilar in general appearance but have yellow to cream wing covers with four longitudinal black stripes. The area behind their black heads is red to orange in color. Striped cucumber beetles are occasionally seen in cotton flowers.

Cucumber beetles are minor cotton pests but may rarely cause localized damage in Arizona cotton fields.

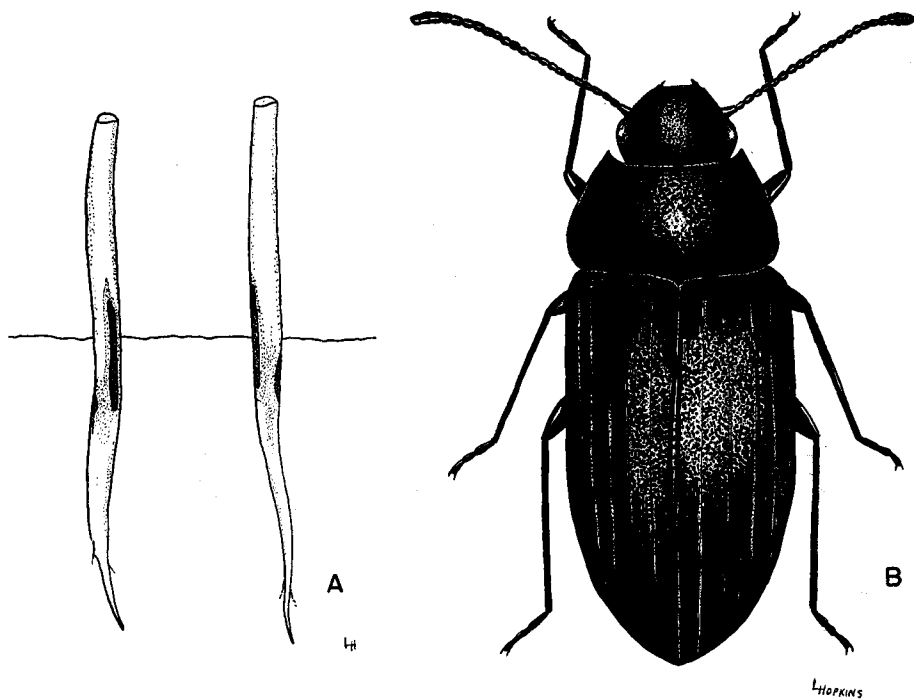


Figure 25.—A typical darkling beetle. A) Seedling stalks, with cotyledons removed, showing darkling beetle injury at ground level.

## DARKLING BEETLES

*Blapstinus* sp. and  
*Ulus crassus* (Lec.)

Darkling beetles are frequently destructive to seedlings early in the spring. They invade cotton fields from nearby pastures, alfalfa and fal-

low land, and often cause sufficient damage to warrant control measures. These dull brown to nearly black beetles range from one-fourth to one-

third inch in length, and are approximately a third as broad.

Although darkling beetles can feed upon a variety of organic matter, they are particularly attracted to succulent cotton seedlings. Characteristically, the seedling stalks are nibbled at ground level and may be girdled. As a result, the stalks may shrivel, causing the seedlings to fall over and die.

This injury differs from cutworm

damage because the stalks remain attached to the roots. Cutworms, on the other hand, usually completely sever the stalks, and may partially or totally devour small seedlings. Darkling beetle injury is most often restricted in area but extensive damage sometimes occurs. The larvae are commonly called false wireworms. Little is known of their habits in Arizona.

## JUNE BEETLES

The desert June beetle, *Dichromina dimidiata* (Burm.) is a relatively common general feeder in the southwestern states. It is about one-half inch long and half as broad, with a reddish-brown to black body and light buff wing covers. The grub, or larva, feeds on the roots of various wild host plants. The adult is most active in the evening and at night, but is occasionally seen earlier in the day feeding in cotton flowers. The desert June beetle has never been numerous enough in cotton to cause significant damage.

The Texas June beetle, *Cotinus tex-*

*ana* Casey, is about one inch long and measures approximately five-eighths inch across the "shoulders" where it is most broad. It is a robust, metallic green species, usually with an irregular buff margin on the wing covers. The grub, or larva, is similar in habit to the desert June beetle. The Texas June beetle is very destructive to ripening fruit of all kinds throughout southern Arizona, and is occasionally found within the cups of cotton blossoms. However, this beetle has never been sufficiently abundant in cotton flowers to cause alarm.

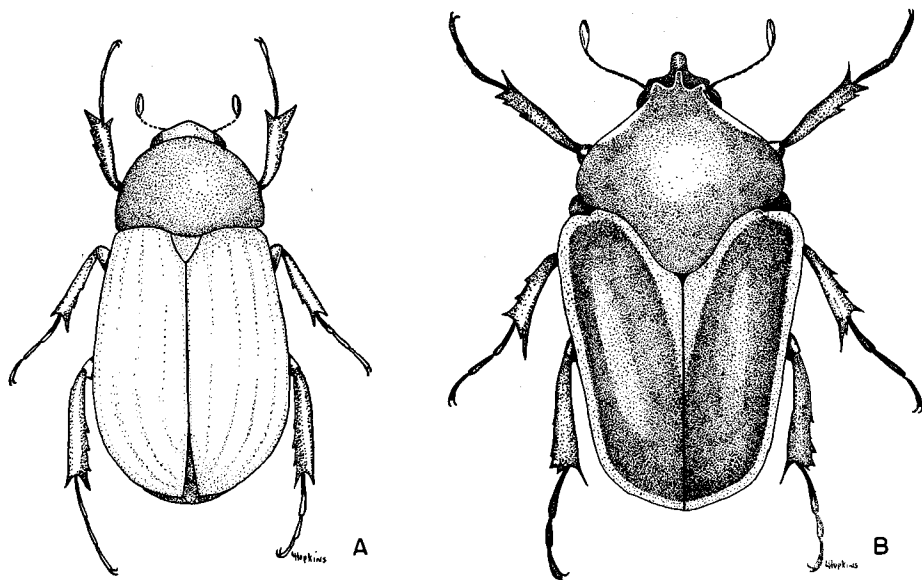


Figure 26.—June beetles. A) The desert June beetle; B) The Texas June beetle.

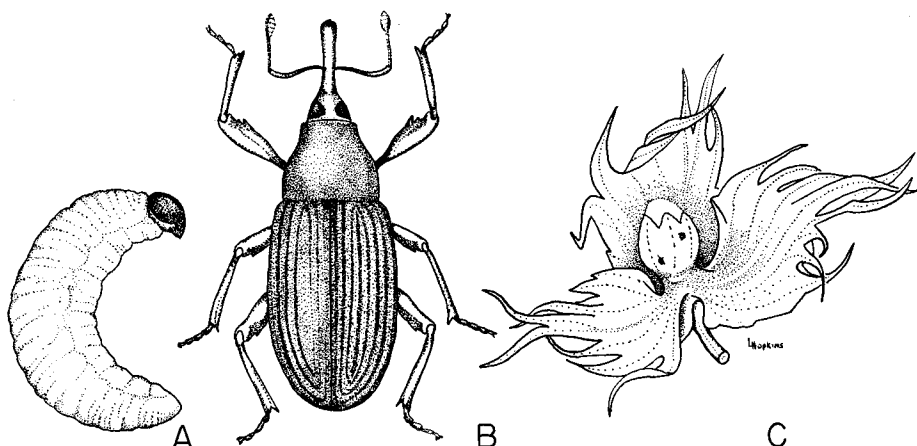


Figure 27.—Cotton boll weevil. A) Mature larva; B) Adult; C) Square with dark spots at oviposition sites.

## COTTON BOLL WEEVIL

*Anthonomus grandis* Boh.

The cotton boll weevil is the primary pest of cotton in southeastern United States and in parts of its original home, Mexico. Thus far in the United States it has not become established west of Texas.

The adult weevil is a rust-brown beetle about one-fourth inch long and half as broad, and is usually sparsely covered with silver gray hairs. Like most weevils, it has a prominent snout. The soft, wrinkled larva is white with a darker head and is slightly less than three-eighths inch long when full grown.

The boll weevil makes its appearance early in the year; the first individuals emerge as early as February. Unlike the thurberia weevil, it prefers to attack squares rather than bolls. Because of its earlier emer-

gence, there are many more generations a year. As a result, the boll weevil is more injurious. When cold weather approaches, most of the adult weevils disperse to hibernate until the following spring. However, like thurberia weevils, many remain in the field throughout the winter.

Many entomologists believe that uncultivated, arid deserts have prevented a natural spread of the cotton boll weevil into New Mexico, Arizona and California. Nevertheless, with increased private and commercial traffic throughout the cotton belt, the threat of a cotton boll weevil introduction into the Southwest becomes ever greater. Consequently, Arizona cotton growers should be on the alert against this pest.

## THURBERIA WEEVIL

*Anthonomus grandis thurberiae* Pierce

The thurberia weevil, a race of the cotton boll weevil, is restricted to southeastern Arizona and Mexico at

higher elevations. Before commercial cotton was grown it survived on wild cotton in the mountain canyons

throughout its range. The thurberia weevil still shows a preference for its wild cotton host, but rarely attacks cultivated varieties grown in the foothill areas of southern Arizona.

Superficially, the thurberia weevil appears to be identical to the cotton boll weevil of southeastern United States. The exact relationship of these weevils in the scheme of insect classification is obscure. The golden body hairs of the thurberia weevil are said to distinguish it from the boll weevil, which has silver-gray hairs. Their biologies, however, are more obviously different.

Overwintering adults usually do not emerge until July or August of the following year. Then they mate and deposit their eggs. Unlike the cotton boll weevil, the thurberia weevil prefers to lay its eggs in the bolls. The female drills a small hole in the boll and places an egg in it. After

laying she seals the hole with a mixture of excrement and a cement-like secretion. The presence of eggs and larvae in the bolls causes cell proliferations, or warty growths, on the insides of the carpels. The larvae feed on the proliferating cells, the developing lint and the young seeds.

Pupation occurs within oval cells constructed in the lint. After pupation, the adult weevils gnaw out of the bolls. Due to the late emergence of overwintering adults and because of the cooler climate at high elevations, thurberia weevils have only one or two generations each year. Occasionally, a partial third generation may occur.

Overwintering thurberia weevils are reduced when thurberia plants near cotton fields are eliminated and stalks and field trash are destroyed after picking.

## WIREWORMS

Although wireworms are seldom pests of Arizona cotton, they occasionally kill or retard seedlings in light, sandy soils. These pests are actually beetle larvae (family *Elateridae*), and are called wireworms because of their rather shiny, tough body covering and slender, cylindrical shape. Their heads are rust brown in color and their bodies are cream to tawny-white. Adults of the common species are dull rust-brown, flattened, bullet-shaped beetles which range from one-fourth to one-half inch in length. When turned on their backs, these beetles make jerking motions accompanied by a clicking sound when attempting to right themselves. It is

because of this that they are commonly called click beetles. Unlike their larvae, the click beetles are not pests of cotton.

Wireworms inhabit moist sandy soil where they feed upon the roots of numerous plants. Although they are not specifically attracted to cotton plants, infestations may become serious where soil conditions are right and young plants are available. Many species require a year or more to mature but, because generations overlap, a new brood is started each year.

Where infestations are serious, a good rotation program and fallowing aid in the control of wireworms.

## NON-INJURIOUS BEETLES COMMON ON COTTON IN ARIZONA

The fruit bud beetle, *Conotelus mexicanus* Murray, is occasionally abundant in Arizona cotton fields

where it congregates in the flowers. These slender, black beetles are approximately three-sixteenths inch long,

and have short wing covers which expose much of their cone-shaped abdomens. Fruit bud beetles feed upon pollen in the flowers but do not harm the cotton plants.

Notoxus beetles are very often numerous in cotton fields. Two species, *Notoxus calcaratus* Horn and *N. nuperus* Horn are most frequently encountered. Both are about three-sixteenths inch long and one-third as broad, and are light rusty brown with darker bands across the wing covers. The part of the body behind the "neck" projects forward in a horn-like process above the head, which seems to hang loosely beneath. Notoxus beetles have never been known to cause injury to the cotton plants. They feed upon secretions of the nectar glands at the bases of the bracts and on the undersides of the leaves.

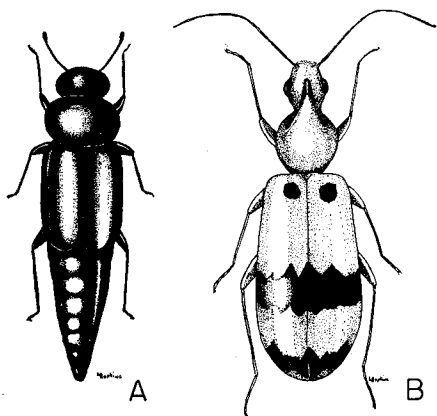


Figure 28.—Non-injurious beetles found on cotton plants. A) The fruit bud beetle; B) A notoxxus beetle.

## LEAF MINER FLY

*Liriomyza* sp.

Leaf miner flies attack a wide variety of crops and, in this state, have been particularly abundant on melons and alfalfa. Although this insect has been steadily increasing in Arizona, it has not yet become a serious cotton pest.

The immature leaf miner is a cream to yellowish colored maggot approximately one-eighth inch long. The adult is a minute black fly marked with yellow on its under side, on its face and on the small triangle between the wings. The female lays her eggs on the leaves of the host plant. After hatching, the maggot eats its way beneath the surface of the leaf. Continued feeding results in a twisting tunnel which increases in size with the growth of the maggot. Full grown maggots normally pupate in the mines. A generation requires an average of three weeks to develop under favorable conditions.

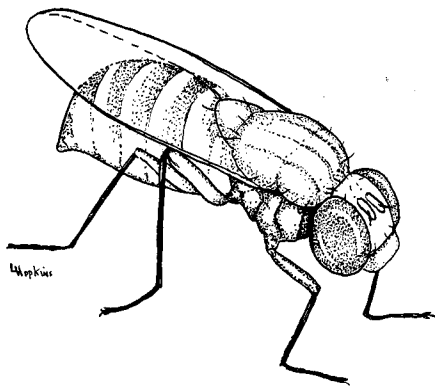


Figure 29.—Leaf miner fly adult.

A high percentage of parasitism and warm summer temperatures normally hold leaf miner populations in check.

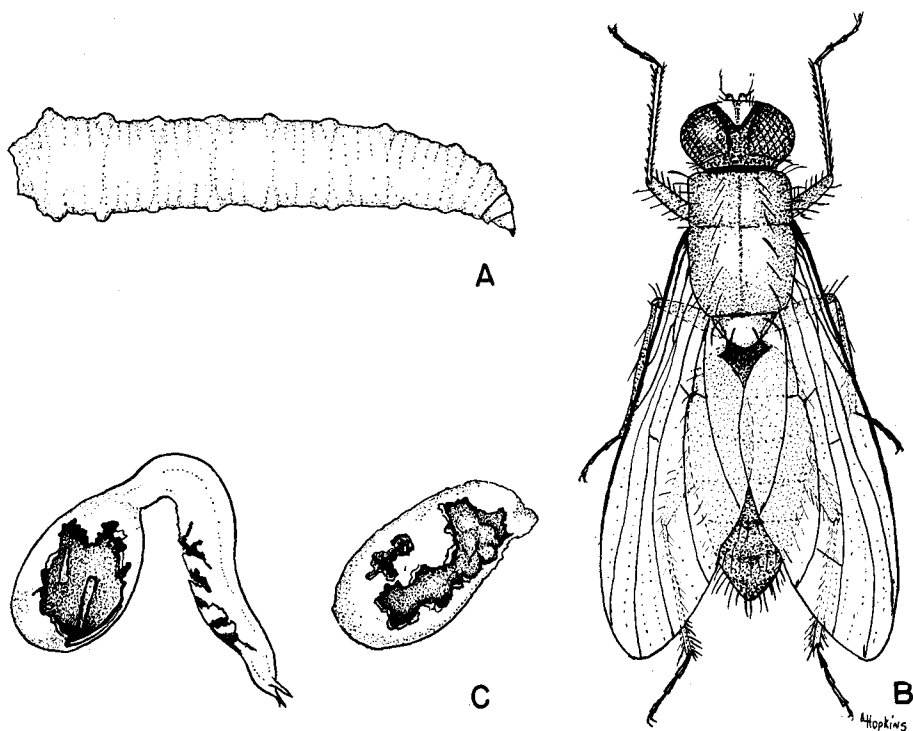


Figure 30.—Seed-corn maggot. A) Mature larva; B) Adult; C) Injured germinating seed.

### SEED-CORN MAGGOT *Hylemya cilicrura* (Rondani)

The seed-corn maggot is a pest of many crops and is occasionally injurious to cotton.

The adults are small gray flies less than one-fourth inch long. The white legless larvae, or maggots, attain a length of one-fourth inch before pupating. They inhabit the soil, usually where there is abundant organic matter. The maggots attack planted

seed and very young seedlings, thereby reducing germination and sometimes killing young plants.

In Arizona, serious seed-corn maggot infestations occasionally occur. Plant injury is relatively rare when the soil is warm enough to cause rapid germination and quick seedling growth.

### ANTS

In Arizona ants are usually most injurious in cotton grown on newly cleared land or in fields that follow alfalfa and grains.

The red harvest ant, *Pogonomyrmex* sp., is rarely a pest to seedling cotton. It is about one-fourth inch long, conspicuous and active. The nests are identified by a bare mound of earth. This ant habitually clears

away all plant growth within several feet of the nest mound. Several colonies in a field can cause considerable seedling loss.

The dark brown leaf-cutting ant, *Acromyrmex versicolor* (Perg.), has been reported to cut off stems and foliage of seedlings, usually along a single row, to supply its less conspicuous nests. It is seldom troublesome.

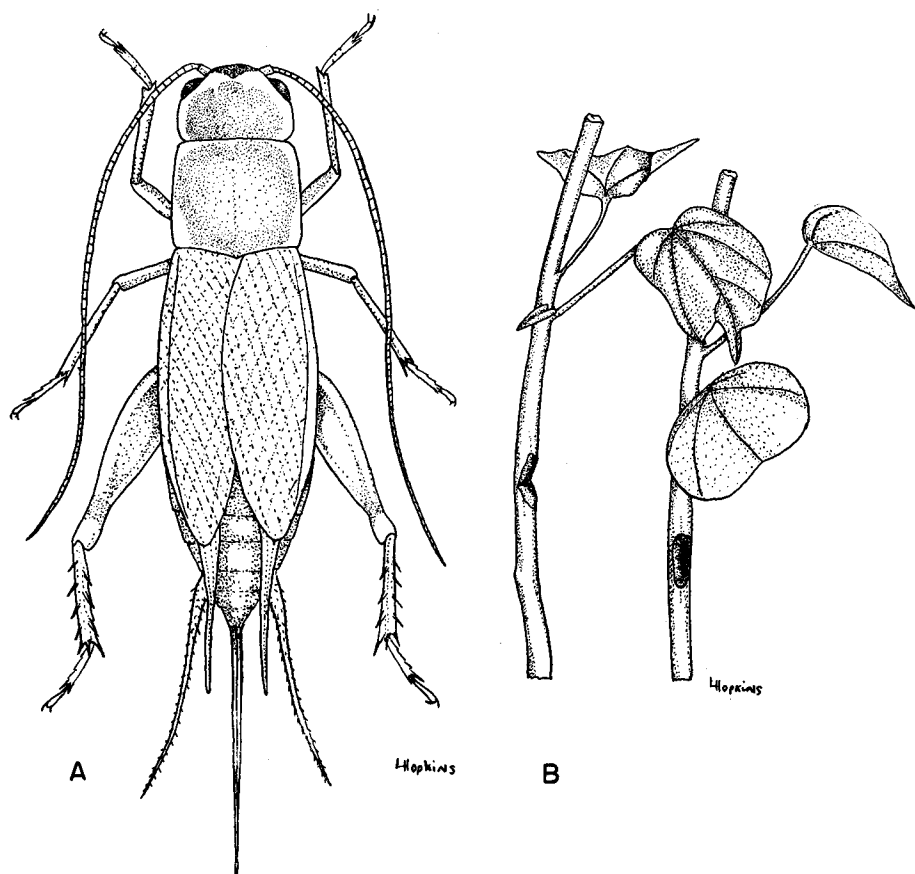


Figure 31.—Common field cricket. A) Adult; B) Stems of young cotton plants gouged by field crickets.

## COMMON FIELD CRICKET

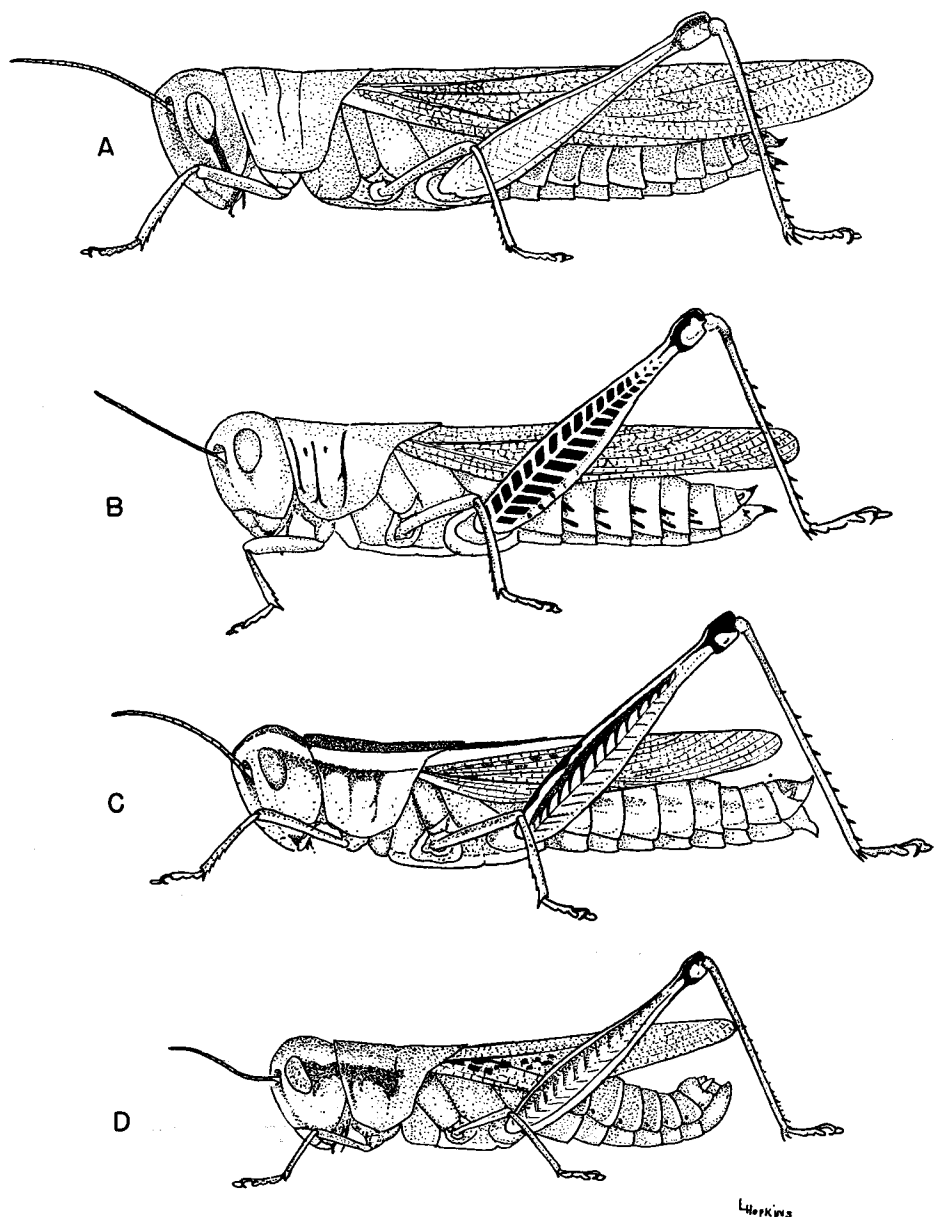
*Acheta assimilis* F.

The field cricket is very common throughout the United States. Occasionally, when conditions are favorable for large outbreaks, crickets may become particularly injurious to cotton plants.

In Arizona, crickets are usually early season pests. They hide during the day in weedy ditches, grassy areas and cracks in the ground, and come

out to feed at night. They frequently gouge the stems of young cotton plants but, like grasshoppers, they will feed on all parts of the plant and, when sufficiently numerous, can strip the plants to the ground. Cricket infestations on cotton have been reported from Yuma County more frequently than from other areas of the state.





**Figure 32.—Grasshoppers. A) A bird locust; B) The differential grasshopper; C) The two-striped grasshopper; D) The migratory grasshopper.**

## GRASSHOPPERS

Many species of grasshoppers are potentially pests of cotton in Arizona. When weeds and grasses become undesirable food sources or when alfalfa fields are cut, grasshoppers move onto the nearest attractive growth. Under these conditions, grasshoppers can rapidly defoliate the marginal rows of a cotton field.

Some of the commonest species encountered on cotton in Arizona are:

1. The differential grasshopper  
*Melanoplus differentialis* (Thos.)
2. The migratory grasshopper  
*Melanoplus mexicanus* (Saus.)
3. The red-legged grasshopper  
*Melanoplus femur-rubrum* (De G.)
4. The two-striped grasshopper  
*Melanoplus bivittatus* (Say)
5. The bird locusts  
*Schistocerca* spp.
6. The lubber grasshopper  
*Brachystola magna* (Gir.)

The differential grasshopper, the migratory grasshopper and the bird locusts make up the major portion of the grasshoppers that attack cultivated crops in southern Arizona. In areas where grasshoppers lay eggs in open ground, road and ditch banks and other open areas should be disked during the winter.

## SPIDER MITES

Spider mites are close relatives of insects and may seriously injure cotton by sucking plant juices. They are difficult to see and identify without magnification. Females lay eggs which are often attached to webbing on the under sides of the leaves. Newly laid eggs look like tiny translucent dew drops, but most become orange in color before hatching.

Young mites have only six legs but otherwise resemble the eight-legged adults. Most species require less than a week to mature during the summer, and in cool climates overwinter as eggs or non-feeding females. In warmer areas they reproduce at a slower rate during the winter on wild host plants.

The five spider mites recorded from cotton in Arizona are, in order of importance:

1. The two-spotted spider mite  
*Tetranychus telarius* (L.)
2. The atlantic spider mite  
*Tetranychus atlanticus* McGreg.
3. The desert spider mite  
*Tetranychus desertorum* Banks

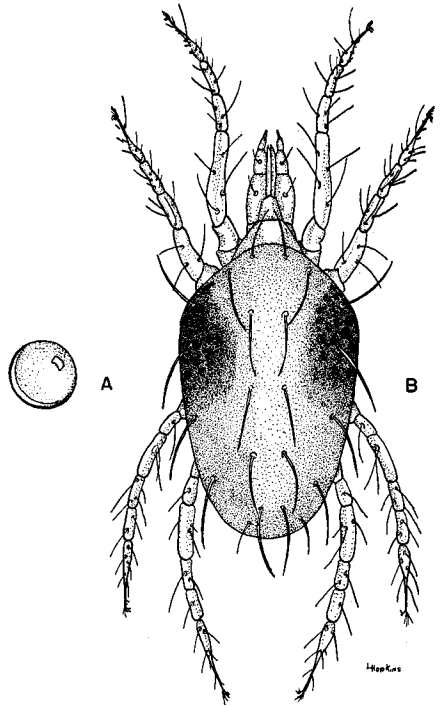


Figure 33.—Two-spotted spider mite. A) Egg; B) Adult.

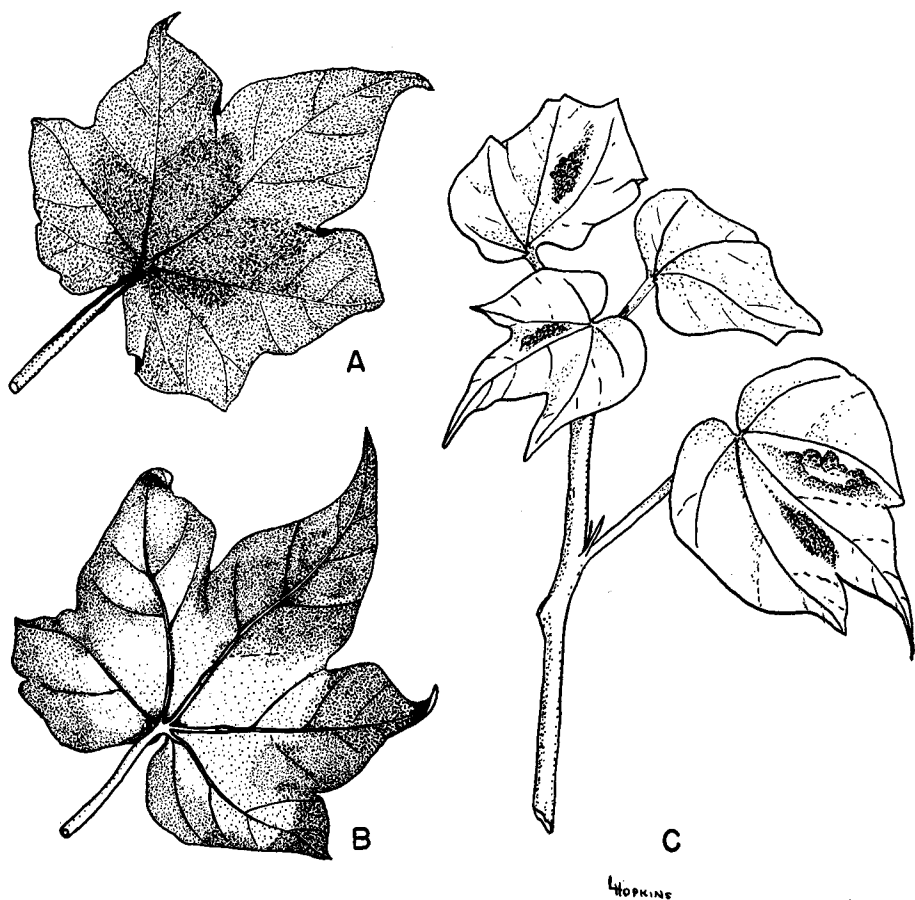


Figure 34.—Spider mite damage. A) Leaf injury by the two-spotted spider mite, surface view; B) Leaf injury by the two-spotted spider mite, under side; C) Leaf injury by the atlantic spider mite, surface view. Note the restricted red “islands”.

4. The tumid spider mite  
*Tetranychus tumidus* Banks
5. The brown wheat mite  
*Petrobia latens* (Müller)

The **two-spotted spider mite** is the most serious mite pest of Arizona cotton. Typically, it is greenish or straw-colored with a large dark spot on each side **near the middle** of the body. A red (carmine) form is often found in this region. This mite closely resembles the atlantic spider mite; however, the characteristic damage caused by its colonies distinguishes it in the field.

Two-spotted spider mite colonies spread between the major veins of the cotton leaves and cause a general yellowing of the infested areas. A red coloration on the upper surfaces of the leaves may develop slowly. This redding is not usually as restricted nor as vivid as that caused by the atlantic spider mite. Webbing spun by adults on the under sides of the leaves is usually brown, but may occasionally be whitish. The lower leaves of the plant are not necessarily the first to be attacked. Feeding injuries cause eventual but rarely

rapid shedding of leaves. On cotton, two-spotted spider mites are often intimately associated with atlantic spider mites, and species identification by field damage may be difficult.

The **atlantic spider mite** is a pest primarily in the western states, where it is a major problem in California and is frequently harmful in western Arizona. This mite is typically straw-colored to greenish with a dark spot on each side at "**shoulder**" level. Pure colonies of the atlantic spider mite are usually localized and do not spread rapidly along the leaf veins. Their feeding quickly produces red islands on the upper surfaces of the infested leaves. This red blotching is particularly evident on young plants early in the season. Webbing on the under sides of the leaves is brown. The bottom leaves of the plant are attacked first and severe infestations will cause rapid defoliation.

The **desert spider mite** is recorded from most of the cotton-growing areas of the state. Although it is a serious pest in Texas, it has caused only occasional limited damage in Arizona. The red (carmine) adults resemble the carmine form of the two-spotted spider mite and the tumid spider mite, but are slightly larger and easier to

see. The colonies are generally distributed over the leaves and throughout the plant. The upper leaf surfaces take on a mottled yellow appearance. Webbing on the under sides of the leaves is characteristically white.

The **tumid spider mite** was first recorded at Safford in September of 1950, but, as yet, has not become a serious pest in Arizona. In the field the tumid spider mite cannot be distinguished from the desert spider mite and the carmine form of the two-spotted spider mite.

The **brown wheat mite** only rarely infests Arizona cotton. Grasses and grain crops are its preferred hosts. When preferred hosts become dry and are harvested, the mites move to the nearest suitable plants, which may include cotton. Infestations are sporadic and disappear with hot, dry weather.

Brown wheat mites are metallic brown or greenish, with yellow legs. The fore legs of the females are noticeably elongated. Unlike the other species mentioned here, these mites are not web spinners. Infestations are recognized by a yellowing and speckling of the leaves.

### **BENEFICIAL INSECTS ASSOCIATED WITH COTTON IN ARIZONA**

Fortunately, not all insects are enemies of mankind. Insects provide a source for numerous useful products, some are important pollinators of major crops and others feed upon their own destructive relatives.

Many predatory and parasitic insects are directly helpful to Arizona cotton growers. These beneficial insects can frequently hold or reduce populations of harmful insects to levels that do not require chemical control. An efficient economical control program should incorporate the advantages of beneficial insects and of

insecticides. These two control factors are compatible and complementary **when good judgment and proper methods are used.** Indiscriminate use of highly poisonous insecticides quickly nullifies the cost-free benefit of parasites and predators.

It is important that the grower familiarize himself with the insects that are working for him. He should be able to distinguish them from harmful insects and should know when he is receiving this cost-free control. For these reasons the major beneficial insects found in Arizona's cotton are presented here.

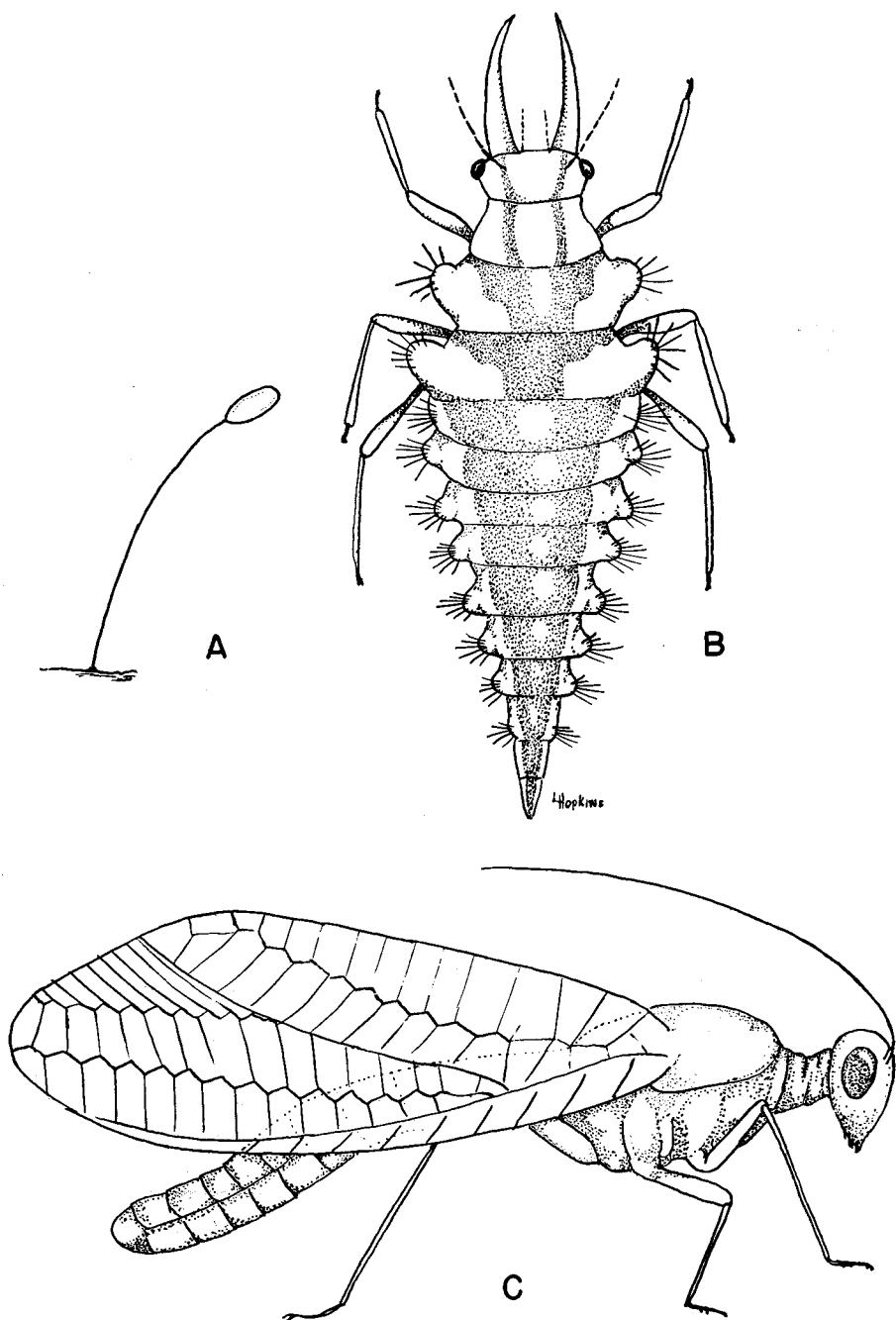


Figure 35.—A green lacewing. A) Egg; B) Mature larva; C) Adult.

## LACEWINGS

Green lacewing larvae, *Chrysopa* spp., are called aphid lions because they ferociously attack aphids, mites and other soft-bodied insects. Mature aphid lions are three-eighths to one-half inch long, flat, elongated and tapered at both ends. They somewhat resemble miniature alligators and are cream to yellow, mottled with red or brown.

Their large, conspicuous sickle-shaped jaws are used to puncture their prey. The adults are beautiful, delicate, slender, pale green insects usually one-half to three-fourths inch in length. They are named for their handsome net-veined wings

which are held in a roof-like position over the body. Adults are not known to be predaceous. Eggs of the green lacewings are usually laid singly upon leaves and other plant parts. Each egg is suspended about one-half an inch above the leaf or stem surface by a fine silken stalk.

The brown lacewings, *Hemerobius* spp. and *Symphorobius* spp., are very similar to the green lacewing in habit and appearance. The larvae may be amber or slate color with darker markings. The adults, as the name implies, are dusky brown in color and resemble small, brown, clear-winged moths.

## ASSASSIN BUGS

The most common assassin bugs found in Arizona cotton are the spined soldier bugs. The commonest species is *Sinea confusa* Caud. *S. complexa* Caud. is less abundant. These insects are about one-half inch long, brown to buff, noticeably spiny and have rather long, slender legs. Like the praying mantis, their fore legs are held in the posture of prayer and are used to capture and hold other insects. They walk about with a slow, clumsy gait and are rather awkward fliers. Spined soldier bugs have been observed to feed on caterpillars and other insect larvae.

*Atrachelus cinereus wygodzinskyi* Elkins is very similar to the spined soldier bugs but is slightly smaller and darker. It has occasionally been observed in cotton and alfalfa in Arizona.

The leafhopper assassin group is second in abundance to the spined soldier bugs. In Arizona cotton fields *Zelus socius* Uhler and *Zelus renardii*

Kolen. are most often seen. They are about one-half inch long and one-eighth inch broad, light brown above with the basal half of the wings and the top of the abdomen wine red; beneath they are green. These bugs are more linear and generally less spiny than the spined soldier bugs. Their legs are long and slender with the fore pair held in the characteristic prayer-like attitude. There is a sticky substance covering the fore legs which aids in capturing prey. Quite often small bits of debris adhere to this sticky material. Immature leafhopper assassins are small, awkward, delicate green insects. The assassin bugs of this group are well known predators of leafhoppers but also attack other harmful cotton insects.

Assassin bugs, as a whole, are effective predators. Although certain species show a preference for particular kinds of prey, in general they are not narrowly restricted to specific insect hosts.

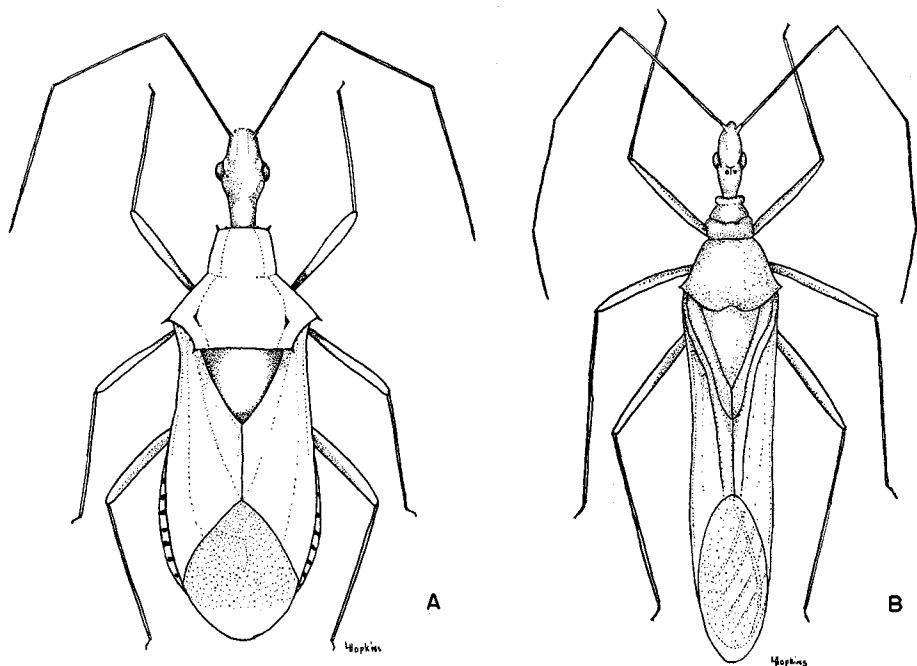


Figure 36.—Assassin bugs. A) A spined soldier bug; B) A leafhopper assassin.

## DAMSEL BUGS

Damsel bugs, or nabids, look and act much like their close relatives, the assassin bugs. The two species in Arizona cotton are difficult to distinguish from one another. Both are pale gray to tan in color, approximately three-eighths inch long and one-third as broad. They are less spiny and slightly more robust than the assassin bugs. Their fore legs are also used for capturing prey and are held in the characteristic attitude of prayer.

*Nabis alternatus* Parshley is the most common species from Tucson east, but also occurs in other areas of southern Arizona. It is grayish tan, usually with oblique dark bands

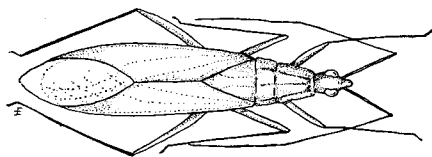


Figure 37.—A damsel bug.

across the fore legs. Three distinct dark lines are found on the area between the head and the wing base. In addition, this area almost always has a fine, variegated dark pattern.

*Nabis ferus* (Linn.) is the most common species at Yuma and in the Salt River Valley. It is tan and usually does not have the darker markings of *N. alternatus*. These two species

have similar habits but each is dominant in a different area. They are reported to be important predators of aphids, leafhoppers, treehoppers, lygus bugs and small caterpillars.

## DAMSELFLIES

Damselflies are smaller, more fragile and less agile fliers than their relatives the dragonflies. They are abundant near standing water, canals or quiet streams, in which their aquatic

immature stages develop. Both the young and the adults are predacious. Adult damselflies often enter cotton fields in the morning and evening to prey upon small insects.

## BIG-EYED BUGS

*Geocoris* spp.

These small insects are sometimes extremely abundant in cotton fields and on numerous occasions have been mistaken for lygus bugs by some growers. They are, however, valuable predators and do not injure cotton plants.

Adult big-eyed bugs are about one-eighth inch long and approximately one-half as broad, tan to dark brown or black, and have dark, protruding eyes. The clear portion of the wings forms a silver triangle posteriorly over the back. They are very agile and move rapidly over the plants. Immature big-eyed bugs are brownish green to gray or black and resemble the adults in shape and habit.

In Arizona, the most common species is *Geocoris punctipes sonoraensis* Van D. It is slightly larger and lighter in color than most of the others. *Geocoris atricolor* Montd., *G. carinatus* McAtee and *G. pallens* Stal are all found on cotton in Arizona but it is difficult to distinguish one from another in the field. The big-eyed bugs have been reported to be efficient predators of lygus bugs (especially the young), fleahoppers, leafhoppers and spider mites.

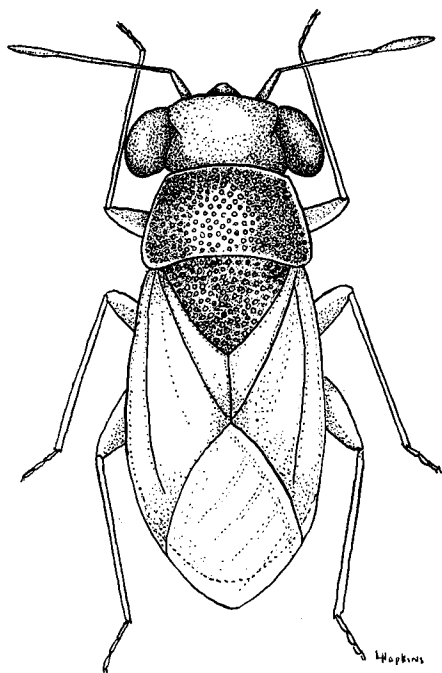


Figure 38.—A big-eyed bug.



## MINUTE PIRATE BUGS

The minute pirate bugs, *Orius* spp. and *Anthocoris* spp., on cotton closely resemble one another. The adults are approximately one-sixteenth inch in length, somewhat oval and flat. They are black with three silvery white spots formed by the transparent parts of the wings folded on the back. The immature bugs are amber in color, wingless, more linear and rather round. Both adult and young pirate bugs have been reported to be excellent predators of thrips, spider mites and their eggs, small larvae of the bollworm and other moths and their eggs, young lygus bugs and aphids.

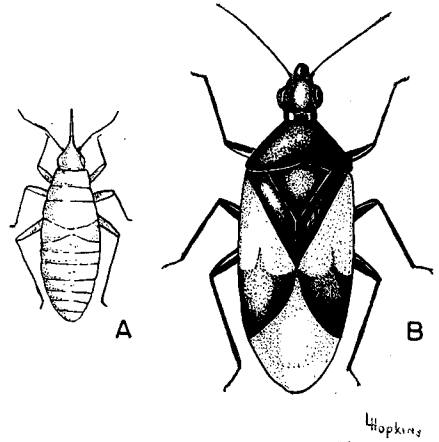


Figure 39.—Minute pirate bug. A) Nymph; B) Adult.

## LADY BEETLES

In Arizona there are many species of lady beetles which are predatory on aphids, mealybugs, scales and mites. However, there are only a few that regularly feed upon cotton insects.

Females deposit their eggs on the cotton plants, usually near a food source for the young. The eggs are yellow and cigar-shaped and are most often laid in groups. Lady beetle larvae are very different in appearance from the adults, and resemble small, hairy, wrinkled dragons. Most are black, marked with orange and white, but some have a white, waxy covering. Pupae are attached to the plant and may easily be mistaken for a piece of dirt or a bird dropping. Both the dragon-like larvae and the adults are active predators of aphids and mites, and other soft-bodied cotton pests.

The convergent lady beetle, *Hippodamia convergens* Guer., is the most common species in cotton throughout the state. It is ovate and approximately one-fourth inch long. The disk behind the head is black with

pale margins and two oblique pale lines on each side; the wing covers are orange, usually with 12 small, oval black spots. The orange cigar-shaped eggs are laid standing on end in clusters. The dragon-like larvae are black marked with orange. This species feeds extensively on aphids.

The ash-gray lady beetle, *Olla abdominalis* (Say) is a less common species. The pale orange to buff adult is almost circular in outline and is slightly less than one-fourth inch long. The disk behind the head is spotted with black. The wing covers have six spots across the base near the disk, and four to six larger spots across the middle and one spot at the tip on either side. This beetle has another color form which is black with a red spot on either side of the wing covers near the middle. The larvae resemble those of the convergent lady beetle. This species is also chiefly a cotton aphid predator.

A third species, the spotted lady beetle, *Coleomegilla maculata* (De G.) is frequently abundant in the Salt River Valley. It has the ellip-

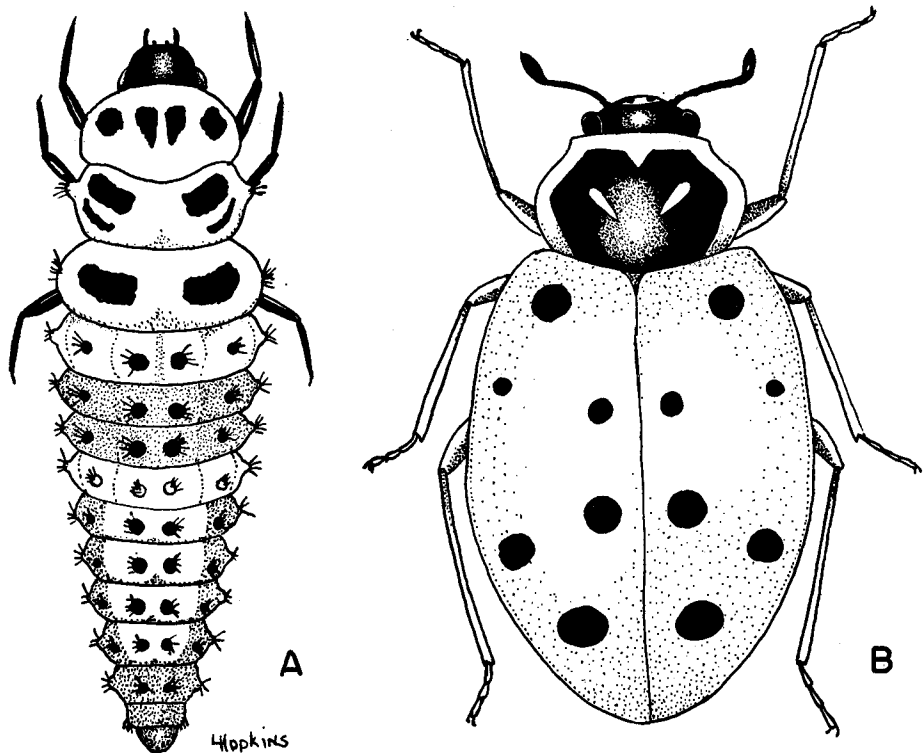


Figure 40.—Convergent lady beetle. A) Mature larva; B) Adult.

tical outline of the convergent beetle but is less than one-fourth inch long. In the Salt River Valley this beetle is pink above and black beneath. The disk behind the head carries two large black spots and the wing covers are variously marked with black spots. This beetle also feeds primarily upon aphids.

In addition to these, there are other species which are less frequently seen in cotton fields. Included in this

more obscure group are *Cycloneda sanguinea* (L.) and *Hippodamia parenthesis* (Say). *C. sanguinea* is a bright orange species. *H. parenthesis* is a spotted orange with parenthesis-like markings posteriorly on the outer margin of each wing cover. Small (one-sixteenth to one-eighth inch), usually drab species belonging to the genera *Scymnus* and *Hyperaspis* also deserve mention here. Some are efficient spider mite predators.

**SIX-SPOTTED THRIPS**  
*Scolothrips sexmaculatus* (Perg.)

Like other members of its group, the six-spotted thrips is hardly visible without magnification. It is approximately one - twenty - fifth inch long, straw-colored and has three dark

spots on each of the fore wings. This insect will attack other thrips and the young of many small insects. Much of its prey consists of spider mites that attack cotton.

**STRIPED COLLOPS**  
*Collops vittatus* (Say)

The striped collops beetle is one of the most common predators that inhabit Arizona's cotton fields. It is about one-fourth inch long and one-half as broad, basically orange with a longitudinal, indented, metallic blue stripe on each wing cover. There is sometimes a conspicuous blue spot on the orange disk behind the head.

These beetles are general predators and have been observed to attack various caterpillars, lygus bugs, fleahoppers and leafhoppers. Little is known about the larvae. They live in the soil and are also believed to be predaceous.

The striking abundance and wide distribution of the striped collops make it one of our more important beneficial cotton insects. Other variously marked orange and blue relatives of the striped collops are also found in cotton fields but are far less numerous.

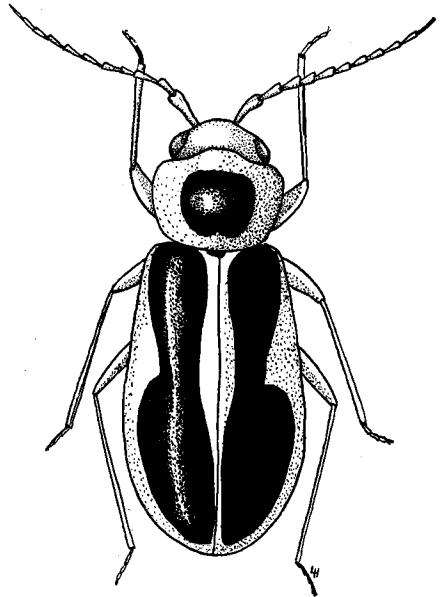


Figure 41.—Striped Collops beetle.

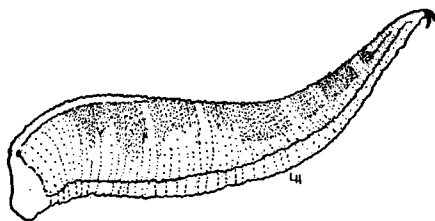
**SYRPHID FLIES**

Many syrphid fly larvae, or maggots, are abundant and active aphid predators. They range from one-fourth to one-half inch in length, are legless, soft-bodied and taper towards the head. Small, dark mouth hooks and the absence of a head capsule distinguish syrphid maggots from harmful caterpillars.

The species most frequently seen in cotton are greenish in color. The adults are similar in structure to houseflies and range from one-fourth to one-half inch in length. Their abdomens are usually flattened beneath and brightly striped above with combinations of yellow, white and black. They are often called "hover flies"

because of their ability to remain stationary in the air while rapidly beating their wings. Syrphid flies are remarkably fast fliers and may dart about with great agility.

Female syrphid flies are attracted to aphid colonies where they deposit their eggs. The young maggots then hatch in the midst of an abundance of food. The maggots are active feeders and consume many aphids by puncturing them with the mouth hooks and then sucking out the body contents. Adult syrphids are not predaceous but are known to feed on nectar, honeydew and sweet plant secretions.



**Figure 42.—A typical aphid feeding syrphid fly maggot.**

## **PARASITIC FLIES AND WASPS**

Insect parasitism is probably the primary force which actively keeps populations of injurious insects below the economic level. Many flies and wasps are parasitic on the eggs, young and adults of insects harmful to cotton. They range from minute wasps which destroy bollworm eggs to large flies whose maggots internally devour large caterpillars.

Because most parasites are small and because many do not congregate about cotton plants they are seldom seen by growers. For this reason a more detailed treatment of these highly important groups is omitted.

Other insect groups (beetles, bees, etc.) contain species that are also parasitic on insects. However, in general these have little economic importance.

## **INSECT POLLINATORS**

It has been generally established that the visitation of cotton by insect pollinators can produce an earlier crop. This has been particularly true with the long staple varieties. Various domestic and wild bees, wasps, flies, beetles and other insects regularly visit cotton blossoms. They also render their services to many other crops. It is highly im-

portant to protect and maintain effective populations of our natural pollinators and domestic honeybees. The application of cotton insecticides without consideration for insect pollinators can seriously reduce yields of other crops such as alfalfa seed and cantaloups, which require insect pollination for maximum production.

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HAROLD E. MYERS  
Dean  
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## **Agricultural Industry – A Versatile Giant!**

Does it pay to get a college education in preparing for a career in agricultural industry? The answer is contained in a recent issue of the Kiplinger News Letter.

Kiplinger reported that the average high school graduate earns \$165,000 in a lifetime — and that the average college graduate earns \$268,000 in a lifetime. The difference: \$103,000. It does pay, apparently, to get a college education in preparing for a career in agricultural industry.

And when he completes his studies at any one of the nation's 51 great Land Grant institutions, the agricultural graduate faces an industry which can justly be called "a versatile giant." For it is gigantic — and wonderfully versatile. It consists of 12 major areas.

- Machinery, equipment and supplies
- Food processing
- Grain and seed processing
- Meat and poultry packing
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- Feed manufacturing
- Dairy processing
- Fats and oils
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- Lumber and forest products
- Pesticides and herbicides