



COTTON SCOUTING

H A N D B O O K

ANR-409

Alabama Cooperative Extension System, Alabama A&M and Auburn Universities

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Cotton Scouting Handbook

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Introduction To Cotton Insect Scouting

Ronald H. Smith, *Extension Entomologist*

The Alabama Cotton Integrated Pest Management (IPM) Program is an intensified educational program conducted by the Alabama Cooperative Extension System. This program was initiated in 1972 and encompasses many phases of management and production. Some of these components were ongoing prior to 1972. The prominent practices that make up insect management on cotton are scouting, the use of cultural practices, the use of economic thresholds, and the proper use of insecticides and beneficial insects.

In the near future, new programs and technology will incorporate additional components and advances to insect management. Two technological advances are the boll weevil eradication program and the introduction of the genetically altered "Bt" Bollgard varieties of cotton that are tolerant to bollworms and tobacco budworms. Other new selective chemistries are nearing development. Before the turn of the century, a tremendous evolution in cotton insect management will likely occur. Growers will need to stay informed of new technologies that will impact scouting practices and what new insects will emerge as economically important.

The primary objectives of this program are to help Alabama cotton growers use all available methods of insect suppression and use insecticides more economically and efficiently, thereby increasing net profits.

Alabama is one of the leading cotton producing states in the percentage of acres scouted annually. More than 85 percent of the acreage in the state will be scouted weekly by a scout, trained grower, or private consultant. The Alabama scouting program was initiated in Pickens county in 1959 and has since expanded to all major cotton producing counties of Alabama.

References

- "Cotton Pest Management Recommendations," Extension publication ANR-415.
- "Cotton Insect Infestation Report," Alabama Cotton Pest Management Program ANR-F11.
- "Cotton Aphids," Extension publication ANR-845.
- "Soybean Loopers: Late Season Foliage Feeders On Cotton," Extension publication ANR-483.
- "European Corn Borers," Extension publication ANR-900.
- "Stink Bugs: New Economic Pests Of Cotton," Extension publication ANR-882.
- "Managing Bandedwinged Whiteflies On Cotton," Extension publication ANR-901.
- "Fall Armyworms: Consistent Cotton Pests," Extension publication ANR-892.
- "Alabama Plan For The Management Of Beet Armyworms," Extension publication ANR-842.

Cotton: Morphology, Physiology, Fruiting, And Development

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The cotton plant has an amazing ability to withstand adverse weather conditions (cold, excessive rain, drought, etc.) and many practices imposed by growers. Not only does the plant survive, but it produces a decent yield of cotton under these conditions.

The genetics of cotton controls its basic behavior. Thus, when a cotton seed is planted in conditions favorable for germination, growth, and development in Alabama, we know how it will behave under average conditions. We can expect the following schedule of development: 1) From seed to emergence of a young plant averages 7 to 10 days in favorable conditions; in unfavorable conditions, 3 to 4 weeks. At this point, the plant has two cotyledonary leaves; 2) From emergence to first true leaf requires 8 or 9 days; 3) From emergence to the appearance of first square averages 35 to 40 days; 4) From square to open blossom, 20 to 25 days; 5) From open blossom to full-size boll, 25 days; 6) From full size-boll to open boll, 30 days; 7) From blossom to open boll, 45 to 65 days.

Germination Of Seed

Many things influence the ability of cotton seed to germinate, but the best seed are those that have fully developed embryos, have remained reasonably dry in the field and, after ginning, have been stored in a relatively cool, dry place until planted. In general, the drier the seed and the cooler the storage temperature, the better the chance that the seed will retain viability and vigor. Drying below 10 percent moisture is essential to safe storage on the farm, even for a short period.

The reserve food supply of the cotton seed is stored in its two cotyledons. The oxygen, moisture, and temperature requirements for cotton seed are higher than for many other crop plants. Cotton seed is very rich in oil and protein. These reserve foods require large amounts of oxygen for conversion to the simple foods needed in plant growth, much more than that needed for the conversion of starch in seed such as corn and wheat. This high oxygen requirement for germinating cotton seed explains the need for maintaining good soil aeration, especially during germination.

Optimum germination of cotton seed occurs at a soil temperature of 93°F. The minimum soil temperature for both germination and early seedling growth averages 60°F and the maximum about 102°F.

Under conditions favorable for germination, the sprout pushes through the pointed end of the seed in 2 to 3 days. The primary root develops from the radical of the sprout and grows downward into the soil. The cotyledons are carried well above the soil by the elongating hypocotyl and unfold about 5 days after planting if adequate soil moisture and temperature exist.

The Root System

The primary root of the cotton plant grows without branching for several days and may have reached a depth of 9 inches by the time the top emerges from the soil. Branch roots begin to develop about the time the seedling straightens up and the cotyledons begin to expand. The depth that the primary root penetrates depends on the depth and character of soil layers, and on soil moisture and aeration.

The location of most of the root system depends on the character of the soil and the amount of moisture available. If the plant grows in a soil that contains little moisture in the upper layers but adequate moisture further down, the main root system usually develops a considerable depth, up to 6 feet or more. But when early growth is in fairly wet soil overlaying a compacted layer, the greater part of the functional root system is usually shallow.

Leaves

The arrangement of leaves on a stem is known as "phyllotaxy." Cotton leaves are arranged in a spiral with each leaf being $\frac{3}{8}$ of a turn above the last. A stem may have the leaves arranged in a right- or left-handed spiral and occasionally you will see one that reverses direction. The first true leaf of the central stem is usually not lobed. As the plant matures, the leaves formed at higher positions are more and more deeply lobed until the climax leaf shape is reached at about the sixth to tenth position.

Nodes

The point on the stem from which the leaf originates is called a node. The points where the two seed leaves or cotyledons are attached are opposite and are the first node. This node is counted as "0" when plant mapping. The point at which the true leaf occurs becomes the first node and successively on up the main stem.

Branches

There are two kinds of branches on cotton—vegetative branches and fruiting branches. Vegetative branches have a development pattern almost identical to that of the main stem. Each of them develops continuously from an apical bud, and they often grow nearly upright. At the lower nodes, the branch is always vegetative. Usually, the vegetative branches occur in a definite zone near the base of the plant, and the fruiting branches occur further up the stem.

The first fruiting branch is normally produced at the sixth to ninth node on the main stem. This can be delayed by a number of environmental factors such as: 1) exceptionally thick stands (plant populations approaching 100,000 per acre and above); 2) excessive nitrogen; 3) excessive rainfall resulting in waterlogged soils at critical times; 4) late planting; and 5) insects (plant bugs, bollworms, etc.). Fruiting branches tend to grow in a more lateral position and have a somewhat zigzag appearance in contrast to the straightness of the main stem and vegetative branches. Once fruiting has begun, fruiting branches are produced at each higher position or node.

Fruiting

As the fruiting branch grows from the main stem or from the vegetative branch, it is terminated by a floral bud (square) and a leaf. Any further growth of the fruiting branch occurs through the development of an axillary bud at the base of the leaf that accompanies the flower. Termination of one growing point by a square and leaf, and the development of another growing point from the bud at the leaf axil to form the next fruit form and leaf, continues throughout the season and produces the zigzag appearance mentioned previously.

The first square can usually be recognized in about 35 to 40 days after seedlings emerge. Twenty to 25 days are required for it to develop into an open flower. Thus, cotton planted in mid to late April will usually produce the first flower sometime in late June. A flower is produced at the first node of the next higher fruiting branch at intervals of

about 3 days. Flowers appear on successive positions of the same fruiting branch at intervals of about 6 days. The number of squares produced is directly related to the number of fruiting branches and their fruiting positions. Peak blooming usually occurs about a month after first bloom, levels off for 2 to 3 weeks, and then declines rapidly.

Shortly after the flower opens, the anthers split open and discharge pollen which adheres to the sticky surface of the stigma. Pollination usually occurs without the aid of insects because of the closeness of the stigma and anthers. Very little pollen is disseminated by air movement. The flower is white when it opens, then closes and turns pink after 24 hours.

The Boll

The ovary (boll) develops rapidly after fertilization and reaches full size after about 21 days. An additional 20 to 50 days elapse before the boll is mature and ready to open, depending primarily on temperature. Bolls from flowers opening during July mature much more rapidly than bolls from flowers opening during late August.

The size of the boll varies with variety, soil fertility, soil moisture, and cultural practices. Usually, 50 to 90 bolls are required to make a pound of seed cotton. When bolls mature, the carpel walls dry and split along the lines where the carpels meet. In favorable conditions, the bolls open rapidly, and the locks of cotton dry and fluff within a period of 3 to 4 days. The number of locks corresponds to the number of carpels and varies from three to five. The number of seeds per lock is about nine.

Development Of Seed And Lint

The fertilized ovule (developing seed) enlarges rapidly, reaching its maximum volume about 3 weeks after blooming. About 2 weeks prior to the opening of the boll, the seed is completely filled by the embryo, which has already become differentiated into sprout and seedling leaves. However, maximum weight is attained only a few days before the boll opens. Most of the oil and protein accumulates in the embryo during the second half of the boll maturation period.

Each cotton fiber originates from an extension of a single cell on the outer layer of the seed coat. These cells begin to elongate about the time the flower opens. They continue to elongate as thin-walled tubular structures until maximum length is reached, usually about 18 to 20 days after blooming. Fiber length is shortened considerably by a shortage of water if it occurs during the period of

fiber elongation. After the fibers reach their maximum length, the fiber walls are thickened by the deposit of consecutive layers of cellulose on their inner surfaces in a spiral fashion.

Secondary thickening continues until just before the boll opens. Secondary-wall structure never completely fills the cell, as some space is always left in the center. The degree of thickening and the angle of the spirals affect fiber maturity and strength. They are dependent upon variety as well as environmental conditions which affect growth and opening of bolls. Droughty conditions during the wall thickening process usually increase fiber strength slightly.

Until the boll opens, the cotton fiber is a living, cylindrical cell. Moisture is lost from the fibers when the boll opens, causing the fibers to collapse and die. As the fibers collapse, they assume a flattened, ribbon-like form with few to many twists which help cause the locks of seed cotton to fluff.

Shedding Of Fruit

The cotton plant has tremendous fruiting potential. It produces many more flowers than it can possibly mature. Only about 40 percent of the fruiting forms produced under ideal conditions eventually mature. This great reserve of fruiting forms effectively serves to minimize loss in yield as a result of conditions temporarily unfavorable for fruiting or from light infestations of insects.

Shedding may occur as a result of insect injury or as a result of conditions attributed to the physiology of the plant. This is called natural shedding. Almost all fruiting forms that shed naturally are either very young bolls or very small squares. Young bolls are more readily shed than small squares. Most squares over one-third grown normally do not shed unless injured. Shedding does not occur in the flower stage and only seldom in bolls more than 10 days old.

Factors which adversely affect growth such as drought, flooding, prolonged cloudy weather, unbalanced fertilizer, and root pruning by deep cultivation are known to accelerate shedding temporarily. When conditions become more favorable for growth, the plants compensate by retaining a higher percentage of their later blooms.

Cut-Out

Usually, vegetative growth and flowering gradually decrease and practically cease after the plants have become heavily loaded with bolls later in the summer. The rather abrupt reduction in growth and flowering is referred to as cut-out. Apparently, the developing bolls have first claim to the plant's food supply produced by photosynthesis and the nutrients absorbed by the root system. Growth is slowed and finally stopped as the plant matures the bolls that are already set. With the approach of cut-out, shedding becomes very high.

In addition to the young bolls, many of the very small squares are shed, especially if cut-out is abrupt. Many of the leaves on the lower portion of the plant drop during this stage. The cessation of vegetative growth and the loss of leaves on the lower portion of the plant stimulate the rapid opening of bolls and reduce losses from boll rot. Thus, the occurrence of cut-out is desirable unless it occurs so early that yield is reduced.

The degree and time of cut-out are influenced by variety as well as environmental conditions such as insect control, weather, and soil fertility. High rates of nitrogen, particularly in combination with high rainfall during late summer and early fall, are very conducive to continued vegetative growth.

* This section was originally prepared by Louie J. Chapman, Former Head of Extension Agronomy.

Cotton Insect Pests

Barry L. Freeman, *Extension Entomologist*

The proper recognition of the many different insects found in cotton fields is essential to the efficient management and, frequently, the profitability of the crop. Although more beneficial insect species than pest species occur in cotton, pest populations can reach tremendous levels and do exten-

sive crop damage. To maintain pest populations below damaging levels, by efficient management of natural enemies, chemical suppression, or other means, requires a thorough understanding of their life cycles and relationships to host crops and to other organisms.

Boll Weevil

(Anthonomus grandis)

DESCRIPTION: Adult boll weevils are hard-bodied insects about 1/4 inch long. They have chewing mouthparts at the end of a slender, curved proboscis or snout, which is approximately half the length of the body. Newly emerged adults are reddish-brown to gray, and they darken with age. The elytra (wing covers) are longitudinally striated and are clothed with short, silver-gray hairs. Spurs are present on the inside of the front femurs (Figure 1).

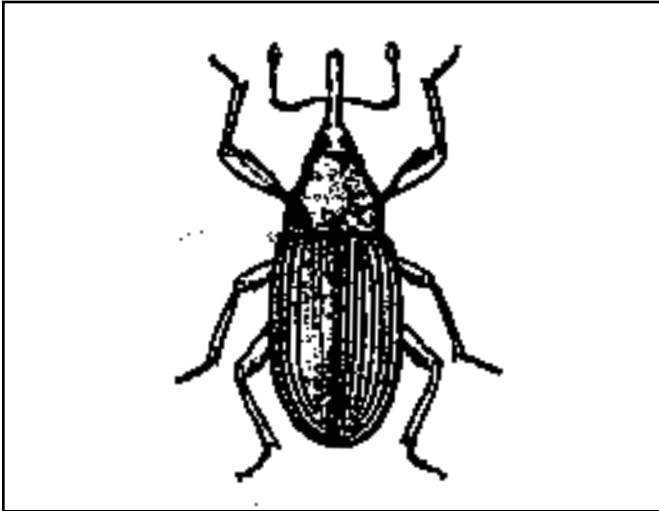


Figure 1. Boll weevil adult.

The larvae are off-white, legless, wrinkled grubs with brown heads. They attain a maximum length of 3/8 inch.

The pupae are white and somewhat resemble the larvae in shape, but have their appendages folded loosely against the body.

The boll weevil immigrated to the United States from Mexico in 1892 and to Alabama in the early 1900s. Because the boll weevil did not have the natural enemies that many native pests do, control of the weevil has been heavily dependent on chemical insecticides. The majority of chemicals used to combat the weevil have resulted in the destruction of parasites and predators of other pests, often resulting in a status change of these pests from secondary to primary pest. In fact, after the elimination of their natural enemies, some of these pests have superseded the boll weevil in destructiveness and in difficulty of control.

A massive program to eradicate the boll weevil from the United States is underway. For the most part, this program has eliminated the boll weevil from Alabama and eastward. At the present time, boll weevils remain west of Alabama and the future of eradication efforts in those areas is in some

doubt. As a result, reinfestations of boll weevils in Alabama cotton is a possibility.

The boll weevil overwinters as an adult in a variety of well-drained, protected places surrounding cotton fields. The majority of surviving weevils come out of hibernation and enter cotton fields in May and early June if moisture is adequate. Cotton is the only plant on which the boll weevil can reproduce.

Before squares form, feeding is limited to tender terminal growth and leaf petioles. These damaged plant parts often wither, turn dark and droop, creating *black flag* damage.

As the first squares become one-third grown, female weevils chew a small hole (usually in the bottom half of the square) deposit an egg, and seal the hole. Some overwintered weevils will not seal the ovipositional punctures; however, later in the season most of the punctures will be sealed with a gelatinous material, creating a distinctive tit-like appearance on the square. Eggs hatch in 3 to 5 days and the larvae begin feeding. As the larvae continue to feed and develop, the squares flare, turn yellow, and fall to the ground.

The larvae feed a total of 7 to 12 days and then pupate within the square. Pupation lasts for 3 to 5 days and then the new adult weevils emerge. Before a new weevil can lay eggs, 3 to 7 days are spent feeding, locating a mate, and mating. Later in the season, eggs may be deposited in young bolls, which may or may not fall from the plant. A complete life cycle requires about 3 weeks.

Cotton Bollworm

(Helicoverpa zea)

Tobacco Budworm

(Heliothis virescens)

DESCRIPTION: The bollworm moth (this species is also known as the corn earworm) is buff colored and 3/4 to 1 inch long. A dark spot is present near the center of each forewing and a dark band traverses the wings behind this spot; however, this band often becomes worn with age. There is also a dark transverse band near the posterior margin of the hind wings (Figure 2).

The adult budworm is slightly smaller than the bollworm moth and is cream colored with distinctive greenish bands across the forewings (Figure 3).

The larvae (worms) of both species are very similar and attain a maximum length of 1 1/2 inches. Color varies from green to yellow to pink. Both possess three pairs of thoracic (true) legs, four pairs of abdominal prolegs, and one pair of anal prolegs.

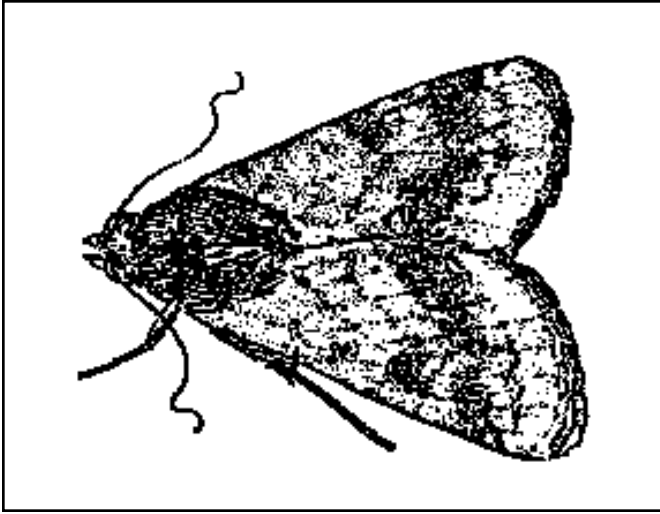


Figure 2. Bollworm moth.

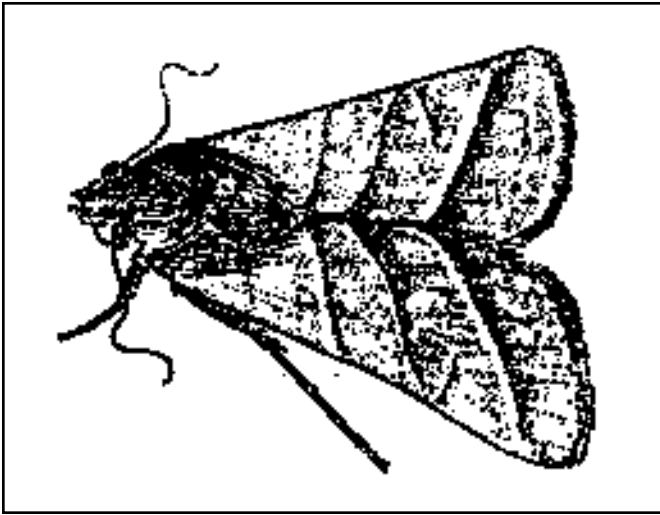


Figure 3. Tobacco budworm moth.

The eggs of both species are spherical and about the size of a pinhead. Close inspection reveals ridges running from top to bottom. Eggs are normally deposited singly and first appear pearly-white, but they darken with age.

These two insects damage cotton similarly and can be found in the same fields. Generally speaking, the June generation is mostly tobacco budworms, the July generation is a mixture, and in late season, the budworm is usually dominant.

Each female moth may lay 1,000 or more eggs. The eggs are often deposited on the tops of leaves in the terminal of the plant, but they may also be found on square or boll bracts, stems, and dried blooms. The egg stage lasts for 2½ to 4 days.

The eggs hatch into small larvae which feed on terminal growth, squares, blooms, bolls, and occasionally, leaves. As the larva matures and each

square or boll is consumed, it moves on to another, damaging several fruiting forms during its 14- to 21-day life.

Generally, each larva will work its way down the plant, attacking larger fruit. The full-grown larva finally drops to the ground and pupates in the soil. The adult emerges 10 to 14 days later. The average length of the life cycle is 30 to 40 days. The overwintering stage is the pupa.

Tarnished Plant Bug

(Lygus lineolaris)

DESCRIPTION: Adults are predominately straw to dark brown and mottled with red, yellow, and black. They are about ¼ inch long. The wingless nymphs are green, similar in appearance to the adults, and attain a maximum length of ¼ inch. The older nymphs possess wing pads and distinctive black spots (Figure 4).

The tarnished plant bug overwinters as an adult and completes one or two spring generations on a variety of wild hosts, including fleabanes, wild carrot, dock, mustard, and many legumes. A few plant bugs may develop on cotton during May; however, the main migration to cotton is in June. Cotton is not a preferred host of the tarnished plant bug and the adults constantly search for a better host.

As plant bugs enter cotton, they begin feeding and laying eggs. The egg stage is rather long, 7 to 14 days. During this time, the population is predominately adult. As the eggs begin hatching, usually the latter half of June, populations contain many nymphs. There are five nymphal stages requiring 2 to 3 weeks for development. Plant bug populations decline naturally during July.

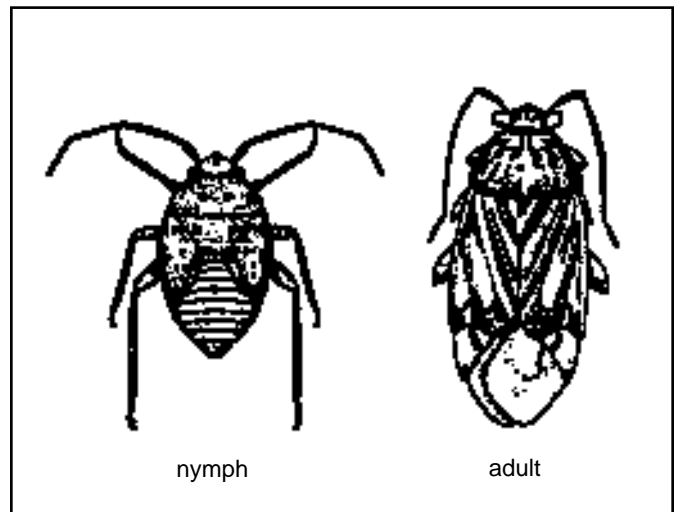


Figure 4. Tarnished plant bug.

Both adult and nymphal plant bugs have piercing-sucking mouthparts to suck plant juices from tender tissue. They may damage all fruiting forms of cotton, but the most damage is to pinhead squares. Adults and larger nymphs do significantly more damage than do the smaller nymphs.

After a pinhead square has been damaged, it turns brown and soon falls from the plant. No outward appearance of damage is present on squares fed upon by plant bugs. Plant bug feeding in the terminal of the plant can alter the physiology of the plant, resulting in what is often referred to as *crazy cotton*. Often associated with this condition are split lesions on the stems and leaf petioles, aborted terminals, fruitless lateral branches seeking dominance, and swollen nodes and leaf petioles. In general, a tall, spindly, and relatively fruitless plant develops.

Damage to large squares is inconspicuous, but as the blooms open, the damage becomes evident. The anthers are darkened and warty spots can be seen on the petals. Heavy feeding by plant bugs on large squares can cause abortion, but most often the result is poor pollination and deformed bolls.

Direct boll feeding by tarnished plant bugs does occur. Boll injury appears as small, dark sunken spots on the outside of the boll. Severe feeding on young bolls may cause the bolls to shed, but more often, localized lint and seed damage is the result.

Unlike many of the other cotton insect pests, the number of tarnished plant bugs do not necessarily represent how much damage will be incurred. Therefore, the pinhead square retention of a field must be monitored along with the numbers of plant bugs before a logical control decision can be made. Years with cool, rainy conditions during June are most often the worst plant bug years.

There are several other plant bugs which may attack cotton. The most common of these are the clouded plant bug, *Neurocolpus nubilus*, and the cotton fleahopper, *Pseudatomoscelis seriatus*. Damage to cotton by these insects is similar to that of the tarnished plant bug.

Spider Mites

(*Tetranychus urticae*)

DESCRIPTION: Spider mites are very small, wingless arthropods closely related to insects. Color is variable, including yellow, red, and straw-colored forms. There are several life stages, including six-legged larvae and eight-legged nymphs and adults. The two-spotted spider mite is so named because of two dark areas on the sides of the abdomen

which are actually the gut contents visible through the exoskeleton.

Although several species of spider mites damage cotton in Alabama, the two-spotted spider mite is the most common. It is more frequent in northern Alabama than the rest of the state.

Mites damage cotton by sucking plant juices from the bottom surface of leaves. Damage varies from a light mottling of leaves, to severe mottling and discoloration, to defoliation.

Mite infestations arise locally near field margins in weed clumps, around power poles, etc. They prosper in warm, dry weather. Since mites do not fly and crawling is inefficient, widespread mite infestations can be a result of mechanical dispersal by farm machinery, people moving through fields, and windy weather.

The spider mite life cycle is short, about 15 days, and high populations can be reached quickly. However, mites are very susceptible to predation and certain diseases, which is one reason some insecticides cause a mite outbreak.

Thrips

(*Frankliniella* spp.)

DESCRIPTION: Adult thrips are small ($1/20$ to $1/16$ inch), slender insects and are yellow to black. Their developed wings are long, slender, and fringed with hairs.

The larvae of thrips are similar to the adults but are smaller and have no wings. Wing pads are developed in the later instars.

Unlike some other cotton insect pests which are sporadic, the tobacco thrips, *F. fusca*, the flower thrips, *F. tritici*, the western flower thrips, *F. occidentalis*, and others tend to be a chronic problem. In early spring as soon as cotton emerges, thrips migrate from a multitude of wild hosts to cotton. Thrips use their rasping mouthparts to rupture plant cells and imbibe the released contents.

Heavy thrips feeding results in ragged, split leaves which are often cupped upward. When fed upon by thrips, the cotyledons often appear silvery on the bottom surface. Heavy thrips damage delays maturity and lowers yields. As temperatures warm and cotton begins to grow vigorously, thrips are still present but are generally no longer considered harmful.

Thrips deposit eggs in tender plant tissue, and a generation is complete in about two weeks. There are multiple generations each year in Alabama.

The western flower thrips is a native of the western United States. It appeared in the southeast around 1980 and is now common throughout Alabama. In addition to being a pest of seedling

cotton, the western flower thrips is also a pest of in-season cotton. During the dry weather of the spring or summer, huge migrations of western flower thrips often occur. This insect is not as easily controlled as other species of thrips.

Cotton Aphids (*Aphis gossypii*)

DESCRIPTION: Adult aphids (plant lice) may be winged or wingless. They are small (about $\frac{1}{14}$ inch), pear-shaped, soft-bodied insects with sucking mouthparts. Color varies from yellow to green to nearly black.

The nymphs are similar in appearance to the adults; both have two tube-like structures (cornicles) on the top of the abdomen (Figure 5).

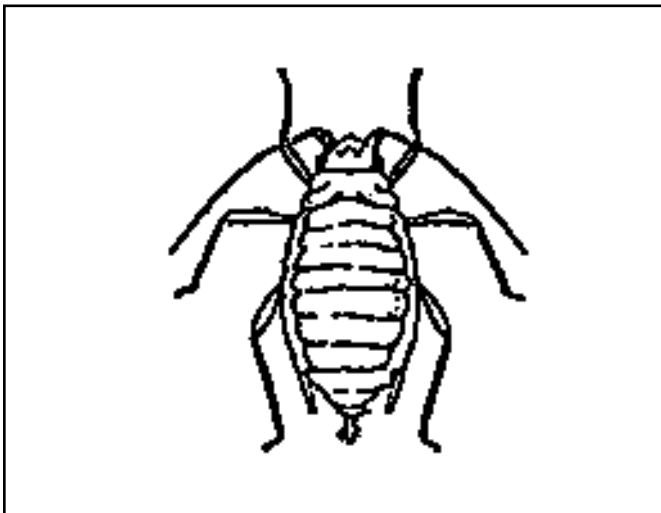


Figure 5. Aphid.

Winged aphids enter cotton in spring or early summer and give birth to live young. Aphids damage cotton by sucking plant juices, which lowers plant vigor and causes the damaged leaves to crinkle and cup downwards. During the feeding process, a sugary secretion called honeydew is produced on which sooty mold grows. If this occurs after the bolls open, the lint is stained, and the quality of the cotton may be significantly reduced.

Aphids have a tremendous reproductive potential, and if unchecked, they can attain huge populations in a short time. They are, however, extremely vulnerable to predation and parasitism. Aphids may, on occasion, cause severe damage to seedling cotton. This normally occurs in cool weather which permits aphid reproduction but retards the reproduction and subsequent increase in natural enemies.

During the 1970s, the cotton aphid was a rare mid and late season pest of cotton. Due to changes in the class of insecticides used to control other

cotton pests, the cotton aphid now has established itself as a consistent pest of mid and late season cotton in most of Alabama. Cotton aphids are tolerant to most insecticides. Control is usually realized from the effects of a fungal pathogen, *Neozygites fresenii*. When this disease becomes present, virtually the entire aphid population succumbs in a matter of days. This usually occurs in July.

Cutworms (*Several species*)

DESCRIPTION: Moths have mottled brown to gray front wings with a wingspan of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches. The hind wings are often more uniform and have a lighter color than the front wings.

Cutworm larvae appear soft, fat, and greasy and attain a maximum length of about $1\frac{1}{4}$ inches. When disturbed, the larvae curl up and remain motionless.

Some of the more common cutworms in Alabama are: the granulate, *Feltia subterranea*; the variegated, *Peridroma saucia*; the black, *Agrotis ipsilon*; and the climbing cutworms. Cutworms spend the day in the soil, coming out at night to feed. Damage to cotton is primarily confined to the seedling stage. Small larvae often feed on leaves producing an irregular hole. Medium and large larvae often cut off young plants just above ground level.

Cutworm damage is normally dispersed enough to attract little attention; however, at times they may be concentrated enough to threaten the stand. This usually occurs in low areas, on new ground, and in places with heavy weed competition. Cutworm populations have been more common in cotton produced with minimum tillage practices.

Cabbage And Soybean Looper

(*Trichoplusia ni* & *Pseudoplusia includens*)

DESCRIPTION: The adults, are mottled gray to black moths with a wingspan of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches. The hind wings are a lighter color than the forewings.

The larvae are predominantly green with pale white stripes down the back and sides. Maximum length is $1\frac{1}{2}$ inches. There are three pairs of thoracic legs, two pairs of abdominal prolegs, and one anal pair of prolegs. The soybean loopers usually can be distinguished by black thoracic legs.

The eggs of loopers are similar to those of bollworms but are somewhat flattened and are placed on the bottom side of leaves.

Looper eggs are deposited by night, and the larvae feed on cotton leaves for 2 weeks or longer

before pupating. Pupation occurs within a web on the underside of leaves. Cabbage loopers seldom require chemical control due to the incidence of natural control agents. One of the common natural controls is a viral disease which can be evidenced by the black, slimy remains of the larvae hanging from leaves. Soybean loopers can be a serious pest and may entirely defoliate cotton.

Fall Armyworm

(Spodoptera frugiperda)

DESCRIPTION: The moths have dark gray forewings with some mottling. The hind wings are a much lighter color and are bordered by a dark band. The wingspan is about 1¼ inches.

Fall armyworm larvae reach a maximum of 1½ inches. In cotton, the larvae are usually grayish with lighter stripes running the length of the body. There is normally a light-colored inverted Y on the front of the head. On many specimens, especially when small, a dark spot can be found on the sides of the first abdominal segment.

The cervical shield (top of the neck area) is dark with three lighter colored longitudinal stripes which are continuous with, but more conspicuous than, those on the body. The most consistent identifying characteristic is the four circular sclerotized plates atop the eighth abdominal segment. These plates are arranged in a small square and are plainly larger than the spiracles found on the sides of this segment.

Eggs are whitish and deposited in groups of up to 150. The egg masses, which may be two or three eggs deep, are concealed with a layer of scales from the moth. Although the eggs may be placed anywhere on the plant, they are usually found on the bottom of fully expanded leaves.

The fall armyworm overwinters south of the freeze line and begins its northward migration as the weather warms. Cotton in Alabama is always infested by some fall armyworms. The size of these populations is dependent, evidently, on weather conditions, especially during the development of early generations on alternate grass hosts. Problems with fall armyworms are fairly consistent in extreme southern Alabama.

As the egg masses hatch (2 to 10 days), the young larvae disperse and will feed on leaves, blooms, squares, and bolls. Larval development requires 12 or more days. When full grown, the larvae burrow beneath the soil surface and pupate. In about 2 weeks, the adults (moths) emerge to begin a new generation.

Unlike bollworms and budworms, fall armyworm larvae may begin their feeding on large

squares and bolls, are often found in higher numbers in drought-stressed portions of the field, tend to occur further down the plant, and, on the average, spend more time feeding on an individual fruiting form. When young fall armyworm larvae attack large fruit, their first damage is often an etching on the inner surface of bracts, resulting in a characteristic window pane damage. Fall armyworm survival is often quite poor.

Beet Armyworm

(Spodoptera exigua)

DESCRIPTION: The beet armyworm moth is about ¾ inch long. The forewings are grayish or brownish and have a pale spot near the center. The hind wings are white and have a fringed border.

The eggs are deposited in masses, usually on the bottom of leaves, and appear fuzzy, somewhat like the egg masses of the fall armyworm.

The larvae vary from pale to dark olive green, have a dark stripe down the back, pale stripes down the sides, and reach a maximum length of 1¼ inch. A characteristic black spot is located above the second pair of thoracic (true) legs. This spot is often obscured by a dark lateral line. Do not confuse the beet armyworm with other armyworms which often possess an evident spot on the side of the first abdominal segment.

The newly hatched larvae feed en masse, skeletonizing leaves near the oviposition site. As they mature they disperse, eating the foliage as they go. Infestations often begin on open grown plants; for example on the ends of rows, in skippy stands, etc. Although mainly a defoliator, the beet armyworm will damage squares and small bolls and even bore into the stalk. This insect is capable of reaching high populations by late season and may defoliate a considerable amount of cotton.

Whiteflies

(Trialeurodes abutilonea)

DESCRIPTION: Adult whiteflies are small (1/16 inch) and resemble tiny moths. The bandedwinged whitefly is dusty-white with several dark bands across the wings.

With the exception of the first instar, the immature stages are sessile, found attached to the bottom of leaves, and somewhat resemble scale insects.

Whiteflies have piercing-sucking mouthparts that damage cotton by extracting plant juices. Further damage is caused by the excretion of honeydew and, subsequently, the growth of sooty mold on leaves and open bolls. Whitefly populations generally peak in late season, when a generation requires 2 to 3 weeks for development.

The silverleaf whitefly, *Bemisia tabaci*, is a serious pest of cotton in the southwestern portions of the cotton belt. It has been found in southern Alabama and may occur alone or with the banded-winged whitefly. The life history of the silverleaf whitefly is similar to that of the banded-winged whitefly. The adults lack dark bands on the wings.

Stink Bugs (*Nezara viridula*)

Stink bugs, primarily the southern green stink bug, may occur as a mid to late season pest in any area of the state (Figure 6). In the past, stink bugs have been controlled mostly by insecticide applications for other pests. As these applications are reduced it is likely that stink bugs will become a more common pest. Both adult and nymphal stink bugs pierce young soft bolls and feed on the developing seeds within. Their damage is best observed by slicing the bolls to reveal the necrotic tissue caused by their feeding. Stink bug eggs are laid in masses on plant foliage. The eggs are metallic colored before hatching and are shaped like tiny barrels with spiny rims. Stink bugs can be observed visually and some idea of abundance can be gained through sweep net or drop cloth samples. Their presence can sometimes be detected by smell.

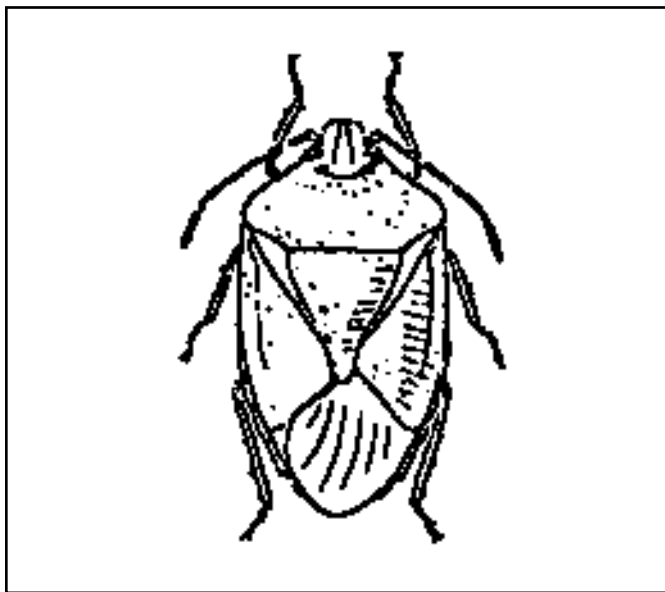


Figure 6. Stink bug.

Other Insects In Cotton

The **yellow-striped armyworm**, *Prodenia ornithogalli*, may be found on cotton throughout the state, but is more common in northern Alabama. The larvae are velvety black with yellow longitudinal stripes. They are mainly leaf feeders but will occasionally damage squares and young bolls.

The **cotton leafworm**, *Alabama agrillacea*, is a voracious leaf feeder and may be found in large numbers late in the season. Cotton leafworm larvae are slender and reach a length of 1½ inches. Color varies from yellowish green to near black. There are white stripes running down the back and sides and two rows of black spots down the back. This insect does not overwinter in the United States and must migrate from the tropics each year.

The **European Corn Borer**, *Ostrinia nubilalis*, and the **Common Stalk Borer**, *Papaipema nebris*, bore into cotton plant stalks, causing the tops to wither, die, and eventually break over. Young European corn borer larvae often are found inside leaf petioles before moving to larger stems. This insect also may be found attacking squares and bolls.

There are other insects which are found in cotton but seldom cause economic damage. They include leaf rollers, wooly bears, grasshoppers, flea beetles, grape colaspis beetles, cucumber beetles, leafhoppers, cotton square borers, white-fringed beetles, leaf miners, seed corn maggots, salt marsh caterpillars, southern armyworms, and others (Figure 7).

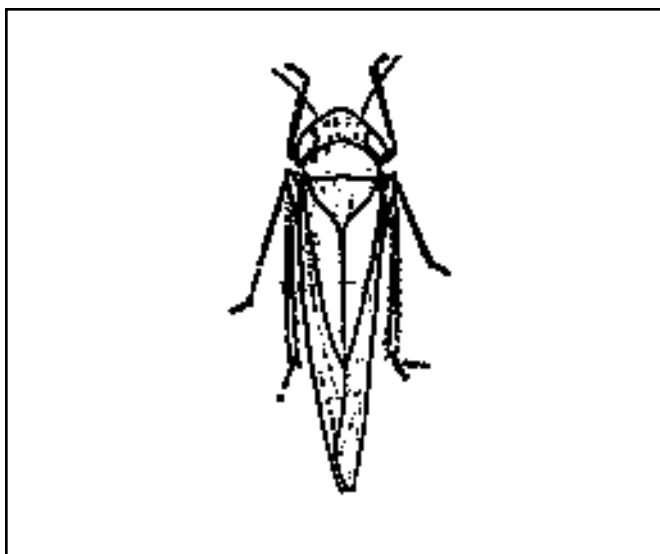


Figure 7. Leafhopper.

Beneficial Insects In A Cotton Insect Pest Management Program

Barry L. Freeman, *Extension Entomologist*

Beneficial insects play an important role in moderating the damage caused by pest insects. Sometimes their effect can be most dramatic and almost complete, but more often their benefit is more subtle. Beneficial insects are important because most of our damaging pests were imported into this country without their complement of native natural enemies. With the boll weevil no longer a cotton pest and with advances in insect control via transgenic cotton, the importance of beneficial insects will be greatly increased.

Generally, beneficial insects do not occur commonly unless there is a source of food. As a result, there is usually a lapse of time between the appearance of a pest insect population and the activity of beneficial insects. This is called lag time and many factors can influence its duration.

Another general but important point is that the effect of beneficial insects is usually greater when more than one species is involved.

Many species of beneficial insects can be important in cotton pest management programs. At least 600 different species of beneficial insects have been identified in the cotton insect community. Some of these species are very common and others are only observed on occasion. Some species are only involved with one pest species while others are involved with many pest species.

Beneficial insects can be separated into two broad groups; predators and parasitoids. Predators attack and feed on other animals (prey). The prey species are usually smaller and weaker than the predators. Many prey are consumed during the life of the predator. Parasitoids feed in or on another living animal (host) for a relatively long time. They consume a substantial amount of tissue and eventually kill the host. Each parasitoid normally develops on and kills only one host.

Predators

Hemiptera

Orius insidiosus, often called the minute pirate bug or flower bug, is a predator of eggs and the first instar larvae of the bollworm, budworm, thrips, and other small insects (Figure 8). Big-eyed bugs, *Geocoris* spp., are common predators of eggs and small larvae of the bollworm, budworm, other Lepidoptera, mirids, thrips, and aphids (Figure 9). Damsel bugs of the genus *Nabis* are efficient predators of a wide range of prey, including mirids,

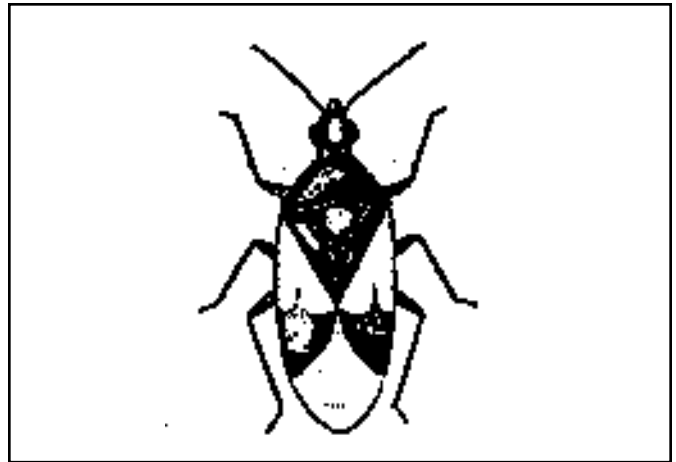


Figure 8. Minute pirate bug.

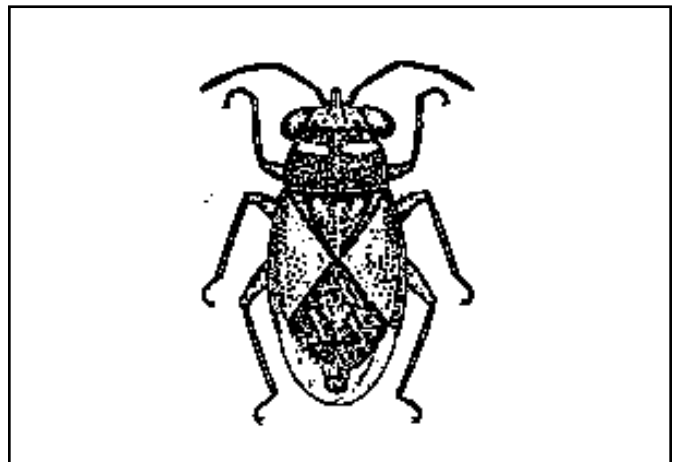


Figure 9. Big-eyed bug.

leafhoppers, aphids, and eggs and larvae of Lepidoptera (Figure 10). They attack bollworms as large as the second instar. Assassin bugs, particularly the genus *Zelus*, feed freely on eggs and larvae of the bollworm, tobacco bollworm, armyworms, and loopers (Figure 11). These insects are usually more common in the southern portion of the state but are less abundant than the predators previously discussed.

Neuroptera

Larvae of green lacewings, *Chrysopa* spp., are important predators of aphids and also attack the eggs and small larvae of bollworms and other Lepidoptera. Brown lacewings can also be common in some situations.

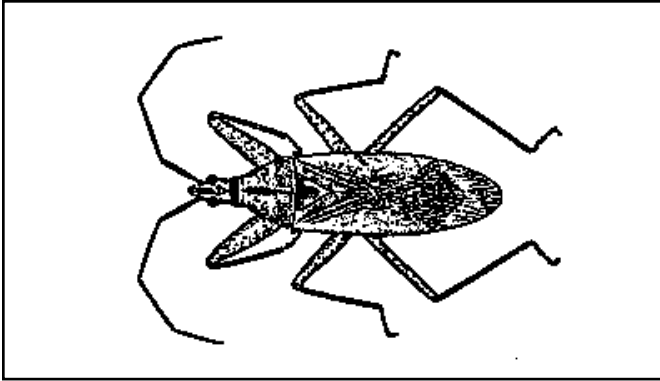


Figure 10. Damsel bug (nabid)

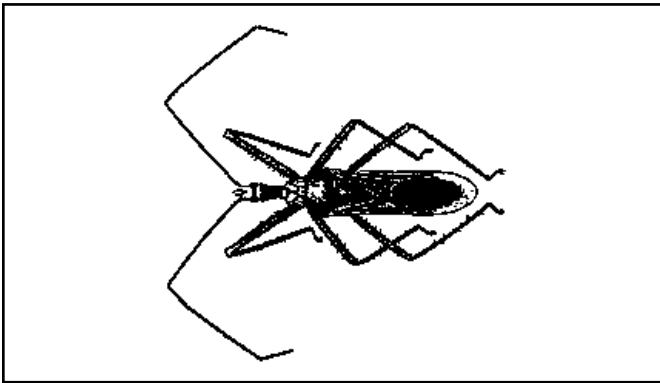


Figure 11. Assassin bug.

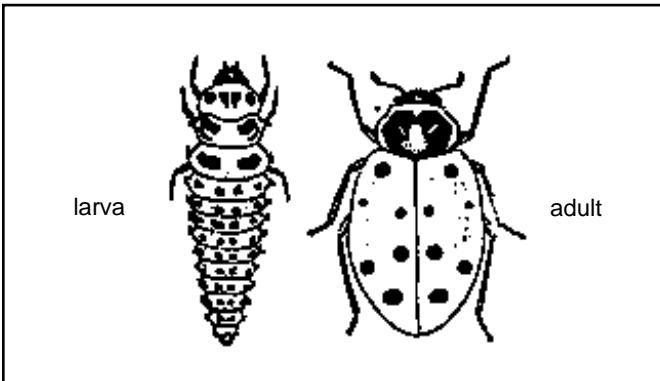


Figure 12. Lady beetle.

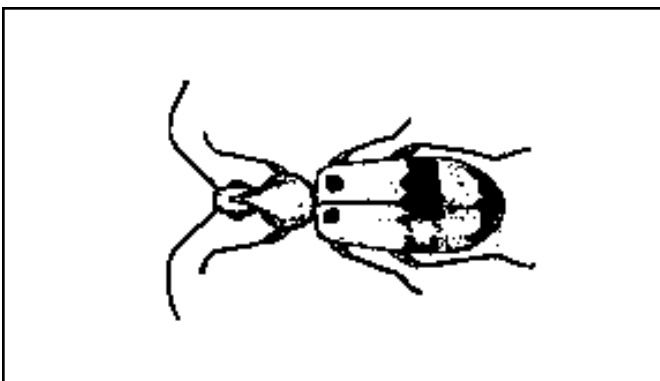


Figure 13. Notoxus beetle.

Coleoptera

Ground beetles of the family Carabidae have considerable potential as predators in the cotton field, but knowledge is lacking on the habits and factors affecting the abundance of the many species. Lady beetles (Coccinellidae) are common predators in cotton fields and are especially abundant in fields infested by aphids (Figure 12). Hooded beetles, *Notoxus* sp., are often abundant in cotton. They reportedly feed on the eggs and small larvae of the bollworm and other lepidopterous species (Figure 13).

Diptera

Many families contain species predaceous as adults or larvae. Best known as predators in the cotton fields are the larvae of syrphid flies that prey primarily on aphids.

Hymenoptera

Ants (Formicidae) include many predaceous species. Paper wasps, *Polistes* spp., and many solitary wasps provide their young with lepidopterous larvae. Fire ants are tremendous predators and, if present, are often the dominant beneficial species.

Spiders

All spiders are predaceous and many species are common in cotton fields. Orb weavers capture many moths in their webs. Wolf and lynx spiders capture moths and other insects. Larvae and adults of the bollworm and boll weevil adults are among the prey of jumping spiders.

Parasites

Hymenoptera

Numerous hymenopterous parasite species of several families are of great value in the biological control of cotton pests. These parasites vary tremendously in size, behavior, ecology, and host preference.

Almost every pest has several parasitic wasp species associated with it. *Cotesia* sp., a parasite of the beet armyworm has become rather well-known as has *Trichogramma* sp., a parasite of various lepidopteran eggs.

Diptera

Tachinid flies commonly parasitize many types of caterpillars, especially those which are exposed during feeding.

Cotton Insect Survey Techniques

Barry L. Freeman, *Extension Entomologist*

The main goal of cotton scouting is to estimate the pest populations or pest damage in a particular field. Counts should represent an average of what is in the entire field, not what was found in the wet areas, dry areas, field edges, etc. It is absolutely essential that all areas of the field are inspected because most pests are not randomly distributed in a field.

Scouting is not a precise science. Different scouts invariably get different counts from the same field; however, with a little interest, training, and effort, counts will seldom vary enough to influence the farmer's final decision.

Scouting for most major pests involves counting the number of pests (or damaged fruit) per so many plants or plant parts for conversion to a percentage. In your trek through the field, you will be making counts for several different insects at the same time. Therefore, it is imperative that notes of the individual field counts be taken. These can be tallied and recorded back at your vehicle.

Pencil is usually preferable to ink for field notes because it does not run when wet. A hand counter can be an asset for certain types of counts.

Several methods may be used to cover a field, depending on field size, shape, and access. Time will not permit you to inspect the entire field, so it is important to change your route from week to week.

Quickly learn the location of fields and establish an approximate schedule so that the farmer will have an idea of when and where to find you. After field inspections are completed, transfer field notes to the final inspection report and give them to the farmer. Your scouting data is useless until it reaches the farmer.

At all times, keep an open channel of communication with your employing farmers. And, above all, be honest!

Boll Weevil

The boll weevil has been eliminated from almost all of Alabama and few scouts are monitoring this pest. The following section is being retained in case there are isolated outbreaks or significant immigration.

After the weevils begin laying eggs (about when the oldest squares are one-third grown), scouting consists of determining the percentage of weevil damaged squares. To do this, pull a few squares from the plants as you walk and store them

in a nail apron until you have finished scouting the field. Your sample size should be at least as large as the following:

Fields of 1 to 20 acres:	50 squares
Fields of 20 to 100 acres:	100 squares
Fields of over 100 acres:	100 squares + 25 squares per additional 50 acres.

Pull only healthy-looking squares that are one-third grown or larger and try to sample evenly from the top, middle, and bottom portions of the plant. Vary the size of squares pulled, making sure not to sample only large squares.

Never include squares from the ground, flared squares, or bolls in your sample. Once you have finished inspecting a field, examine the squares for weevil damage; both egg-laying punctures and feeding punctures are considered damage. Record the weevil damage as a percentage. The percentage is obtained by dividing the number of damaged squares by the total number of squares collected and then multiplying by 100.

Bollworms And Budworms

Since the eggs and worms (larvae) of these two insects are very similar, they are normally lumped together in scouting. These insects should be monitored throughout the season.

To determine the number of eggs and worms in the terminals, closely examine the top 6 inches of the main terminal. After a little experience, the eggs will be fairly evident; however, the small worms are normally concealed in rolled-up leaves or small squares of the terminal.

In fields where beneficial insects are active, many terminals will exhibit worm damage, but the worm may have already been consumed by a predator. It is a scout's job to determine if the insect is still there. This is sometimes a difficult and tedious task, but one of the most critical aspects of scouting.

Terminal samples should represent all areas of the field. Most scouts find it easier to inspect five or ten terminals in several locations than to sample single terminals here and there. Do not, however, take your samples from a single row.

Later in the season and in drought conditions, many of the eggs and small worms may occur below the main terminal. To detect this activity, whole plant examinations or an expanded terminal inspection will be necessary. These examinations

are much more time consuming than routine terminal inspections. If they become necessary, the number of counts will have to be lowered to keep you on schedule. Some observations of entire plants should be made throughout the season to ensure detection of possible insect problems which otherwise may not be noticed.

In addition to scouting for bollworm eggs and small larvae, a damaged square count is also made. To do this, inspect the squares which were pulled for the boll weevil sample and record the worm damaged squares as a percentage. The number of live worms found in this sample is not recorded but can indicate such things as poor performance of previous insecticide applications, moth activity down the plant, or poor scouting the previous week. This is also a good way to pick up fall armyworm activity.

In the comments section, record the species and number of moths, age of eggs, and size and location of worms, etc.

Much of the cotton planted in Alabama in the near future will likely be resistant or tolerant to bollworms and budworms. Exactly how these varieties should be scouted is not defined at this time, but in all probability only a cursory examination will be made for budworms and bollworms. It should be noted, however, that these varieties will not prevent egg deposition and that newly hatched caterpillars will have to feed a short time before they are killed.

Spider Mites

Spider mites are scouted by general observation. Look for damage first, and then turn the leaves over and examine them for mites. The degree of infestation is recorded as follows:

- None: None observed
- Light: Spider mites found on an occasional plant
- Medium: Spider mites found on many plants; the leaves lightly mottled yellow, red, or brown
- Heavy: Spider mites numerous on most plants; leaves appearing reddish-brown.

If a mite infestation is confined to the edges or a part of a field, as is often the case, this should be noted in the comments section.

Cotton Aphids

General observations for aphids and their damage are used to monitor populations. Record the degree of infestation as follows:

- None: None observed
- Light: Aphids found on an occasional plant
- Medium: Aphids found on many plants; some leaves curling along edges
- Heavy: Aphids numerous on most plants; honey dew evident; crinkling of leaves present; chlorotic terminals common.

Seedling Thrips

Usually, cotton has surpassed the stage of being susceptible to thrips injury by the time most scouts begin examining fields. In general, thrips are scouted for by random observations of the insects and their damage while walking the field. Adult thrips can be counted on a row-foot basis by shaking plants over a sheet of paper or into a box.

Normally, it is sufficient to record thrips damage as follows:

- None: No thrips or damage found
- Light: Only occasional thrips found; newest unfolding leaves without brown edges and crinkling; no silvering of the bottom of leaves
- Medium: Thrips found readily; most of the newest leaves showing browning of edges and crinkling; many of the leaf bottoms silvery
- Heavy: Thrips numerous; terminal of plant showing injury; silvering of leaves very noticeable; plant's general appearance ragged, deformed and stunted.

Western Flower Thrips

Monitor western flower thrips by observing insects and their damage from early bloom through cut-out. Numbers of thrips per bloom can be estimated by visually bisecting the bloom, counting the thrips on one side, and multiplying by 4. Four is used due to the numbers of thrips hidden among overlapping petals and between petals and bracts. Infestations should be recorded as follows:

- None: No thrips or damage observed
- Light: Less than 20 thrips per bloom; callous tissue on leaf ribs and smutted nectaries found on an occasional plant; first-day blooms healthy.
- Medium: 20-80 thrips per bloom; callous tissue and smutted nectaries common; some first-day blooms appearing wilted and off-color.
- Heavy: 80 or more thrips per bloom; callous tissue on leaf ribs and smutted nectaries obvious and present on most plants; numerous first-day blooms appearing wilted and off-color.

Whiteflies

To determine whitefly infestations, observe the whiteflies and their damage as you scout the field. Record the degree of infestation as follows:

- None: None observed
- Light: Whiteflies found in the terminal of an occasional plant
- Medium: Whiteflies observed in terminals of many plants; some honeydew found on lower leaves
- Heavy: Whiteflies numerous in the terminals of most plants; honeydew clearly evident.

Plant Bugs

Plant bugs should be monitored at least weekly from the time the first plants begin squaring until mid to late July or when the farmer begins a scheduled control program. A good method for sampling plant bugs is to vigorously shake plants over a drop cloth; then simply count the number of plant bugs and record on a row-foot basis. Most drop cloths are 3 feet long; therefore, if one row is shaken, the sample is 3 feet; if both rows are shaken, the sample is 6 feet. Both the adults and nymphs are counted. The adults will fly, so count them quickly. For the most accurate counts, some adults will have to be noted as you shake the plants. The small nymphs are difficult to see. Make a thorough examination so as not to overlook these.

If cotton fleahoppers, clouded plant bugs, or other plant bugs are noticed, record them in the comment section.

Although not as reliable, a sweep net can be used for plant bug sampling. The numbers found should be recorded as numbers of plant bugs per so many sweeps.

In addition to sampling plant bugs themselves, a pinhead square retention count should be made. Inspect one pinhead square in the terminal of plants, note if it is good or bad, and record the percentage of healthy pinhead squares.

Probably the easiest way to make this sample is to inspect one square in each of ten terminals in several locations. Only sample one square per ter-

terminal. A leaf 1 to 2 inches in diameter will be associated with the size square you should be sampling. Picking this leaf out and then inspecting the square associated with it, before actually looking into the terminal, will prevent sample bias.

The pinhead square on the first differentiated limb beneath the plant terminal is often favored by plant bugs. This square should comprise a large portion of your sample. The leaf associated with this square will be furled.

Since adult plant bugs are difficult to accurately sample by any method, emphasis should be placed on pinhead square retention. If adult plant bugs are commonly observed but not reflected in drop cloth samples, this should be noted.

Beneficial Insects

Most of the beneficial insects you will be concerned with are predators of the bollworm. Some of the more important ones are big-eyed bugs, nabids, minute pirate bugs, damsel bugs, lacewings, and lady beetles. Spiders, although not insects, are also important predators.

During other scouting activities, especially the plant bug samples, you will see beneficials. This will give you a good feel for their abundance. In addition to the beneficials themselves, you should also note their effects; that is, a high proportion of one-day-old bollworm eggs or numerous terminals showing damage from small worms but with no worms present. Also, a variety of beneficials in a field is indicative of a healthy population.

Light, medium, or heavy (L,M,H) is generally sufficient for denoting beneficial populations. After the start of hard insecticide treatments, beneficial insect populations decline and are of less interest.

Others

There are other insects which at times may be bothersome but can only be recorded in the comment section of the infestation report. Some of these include fall armyworms, beet armyworms, loopers, and stink bugs. If these occur, make a note and try to give the farmer an idea of abundance and amount of damage.

Pesticide Safety For Scouts

Wheeler Foshee, *Extension Pesticide Education Specialist*

Cotton scouts have an excellent safety record with pesticides. Nevertheless, pesticides can present certain hazards. Individuals scouting fields for pests and pest problems need to be aware of the chemicals being used by farmers, the general toxicity of the chemicals, and the effects pesticides can have on people. Safety is a topic that cannot be overemphasized. Safety is a frame of mind or an attitude you develop and practice for your well-being and for that of the public. A lack of knowledge about pesticides is the basic reason in most adult pesticide-related injuries.

There are three routes of entry to the human body by a chemical. These are dermal, respiratory, and ingestion. Dermal exposure, during formulation and application in the field, has been reported as the more critical type of exposure to humans. The following factors affect dermal exposure and skin penetration: 1) Physical and chemical properties of the pesticide; 2) Health and condition of the skin; 3) Temperature; 4) Humidity; 5) Presence of other chemicals (solvents, surfactants, etc.); 6) Concentration of the pesticide; and 7) Type of formulation.

Collectively, the factors affecting absorption will influence dermal toxicity. Of the factors listed above, only the health and condition of the skin are independent of these factors. Concentration, physical and chemical properties of the pesticide, and the presence of other chemicals are established by the manufacturer or farmer. Temperature and humidity are the environmental conditions existing at the time of application, often established for favorable and effective pest control. Persons with cuts, abrasions, scratches, scuffs, or any other skin damage should exercise caution by minimizing exposure of such areas to pesticides.

Skin absorption increases as you perspire. Skin pores open in response to increased body temperature. This allows for faster and increased chemical absorption. To prevent skin absorption, wear a long-sleeved shirt of tightly woven material to protect your arms. Try not to enter the field immediately behind application equipment.

Fields that have been treated with foliar insecticides classified as highly toxic should not be entered, and plant foliage should not be handled for at least 24 hours to protect you by minimizing dermal exposure. Worker Protection Standards (WPS) requires that scouts use the appropriate Personal Protective Equipment (PPE) if entering a field before the Restricted Entry Interval (REI) has expired (see pesticide label). To minimize dermal exposure:

- 1) Use clean clothing daily;
- 2) Bathe or shower daily;
- 3) Avoid wearing canvas shoes when plant foliage is wet from dew;
- 4) Avoid entering any field that has recently been treated;
- 5) Avoid wiping face or forehead with shirt sleeves;
- 6) Avoid rubbing eyes with contaminated hands; and
- 7) Wear long-sleeved shirts and full-length trousers.

Exposure by oral ingestion is usually caused by not practicing proper personal hygiene. Accidental ingestion has occurred when applicators were loading spray equipment. Scouts can minimize oral exposure by following these procedures: 1) Never eat or drink while handling pesticide-treated plant parts; 2) Always wash hands and face with soap and water before eating; 3) Do not wipe mouth with hands; and 4) Do not chew on treated plant parts.

Respiratory exposure is not a threat to scouts if other precautions are followed. Some of the highly toxic organophosphates may volatilize or cause a vapor-like action within the field shortly after being applied. For this reason and because of dermal contact possibility, many products have a 24 or 48 hour reentry time. (Check label for restricted entry interval (REI)).

A scout should be familiar with the general chemicals used by each farmer and know what reentry interval is safe to follow. The current pesticide label will carry particular warnings on reentry of fields after treatment and other special precautions.

A scout should know the symptoms of pesticide poisoning so that medical attention can be sought if needed. Symptoms of blurred vision, abdominal cramps, tightness of chest, nausea, diarrhea, headache, and confusion are associated with organophosphate poisoning. Medical attention should be obtained promptly if symptoms exist. All pesticide labels have suggested antidotes for accidental poisoning treatment. Poison Control Centers have current antidote treatment information and can be reached 24 hours a day by any physician.

The Poison Control Center at Children's Hospital in Birmingham can be reached by calling toll-free, 1-800-292-6678, from anywhere in Alabama.

Some scouts may develop a rash or skin condition because of an unusual sensitivity. If, as a scout, this condition should occur, try an oil skin lotion before entering fields. Commercial preparations are available to prevent skin absorption and to act as a protectant.

* This section was originally prepared by G. Talmadge Balch, former *Extension Pesticide Education Specialist*.

Herbicide Injury To Cotton

Michael Patterson, *Extension Weed Scientist*
and
C. Dale Monks, *Extension Crop Physiologist*

As a cotton scout, you must be able to identify various insects found in cotton and recognize the damage or benefit resulting from their presence. However, you should be able to recognize other agents that injure cotton or cause it to be abnormal in appearance. One such group of agents is herbicides.

Virtually all the cotton in Alabama receives at least one herbicide application. Most of the acreage you scout will have had several applications, and possibly as many as four different herbicides used during the season. You will very likely encounter some injury to plants or plants that are abnormal in appearance as a result of the use of pesticides.

The majority of the cases of injury result from misuse and/or carelessness in the application herbicides to cotton or to other crops nearby.

1) Phenoxy injury. One of the most common types of injury encountered during the time you will be in the field is caused by phenoxy or related compounds such as 2,4-D, 2,4-DB, and Banvel. Cotton is extremely sensitive to this group of herbicides, and injury usually results from spray drift and/or volatilization from treated areas such as pastures, corn, peanuts, fencerows, forests, and roadsides. Injury can also result from contaminated equipment used to treat cotton. The injury symptoms are quite readily recognized. They are characterized by an abnormal elongation of the leaf veins with a decrease in area between veins. This results in a finger-like or okra leaf appearance accompanied by a twisting of the stems or new growth. The severity of the symptoms depends on the dosage received and the growth stage of cotton.

2) Methanearsonates. The herbicides MSMA and DSMA are sold under various trade names. When used properly as directed sprays, little or no injury occurs. However, some growers use MSMA or DSMA over the top of cotton, and injury invariably occurs. The extent of injury depends on the rate used, the age of the cotton when sprayed, and weather conditions before and after treatment. The injury can appear as a burning of the leaves, reddening of the stems, shortening of the internodes, and dwarfing of leaves on new growth. In some cases, leaves of new growth may have a mottled chlorotic appearance. In severe cases, bolls will be shaped somewhat like hickory nuts, being long and pointed in the apex.

3) Substituted ureas. Cotton herbicides such as fluometuron (Cotoran, etc.) and diuron (Karmex, etc.) belong to this group. Injury symptoms are characterized by chlorotic leaves. Chlorosis may be veinal (as with diuron) or interveinal (as with fluometuron). Usually only older leaves are affected. Minor symptoms usually occur on a few plants in most fields even when materials are used properly, but this does not affect the yield of cotton. Excessive rates, improper calibration, or poor agitation can cause more severe injury. It should be pointed out that factors other than herbicides—such as diseases, nematodes, plant nutrient deficiencies, and air pollution—can cause chlorosis of the leaves. Therefore, chlorotic leaves are by no means a positive diagnosis of herbicide injury.

4) Triazines. Prometryn (Caparol, etc.) and cyanazine (Bladex, etc.) are the only herbicides of this group currently used in cotton. However, other members of the group such as atrazine or simazine, commonly used on corn, sometimes get misapplied to cotton. These materials also cause leaf chlorosis (usually interveinal) very similar to that caused by some of the substituted ureas.

5) Dinitroanilines. This is the most widely used group of herbicides in cotton with probably 80 percent of the acreage in cotton being treated with either trifluralin (Treflan, etc.) or Prowl. Injury from these materials results from excessive rates or improper incorporation into the soil. Injury is observed as stunted plants resulting from damage to the root systems which can delay fruiting and maturity.

6) Imidazolinones. Herbicides in this group, including Scepter, Pursuit, and Cadre, are toxic to cotton both from foliar and soil activity. These herbicides inhibit the formation of a critical amino acid (ALS) in susceptible plants causing stunting and yellowing in the plant terminal. Most cotton injury from these herbicides is due to carryover from an application to a previous crop.

7) Sulfonylureas. Herbicides in this group include Classic, Accent, Ally, and Oust. They are also toxic to cotton and work very similar to the imidazolinones. Cotton injury can occur from carryover of sulfonylurea herbicides to cotton, but a more likely source would be contaminated spray equipment as the sulfonylurea herbicides are very active in low dosages. Injury symptoms are very similar to those caused by the imidazolinones.

8) Miscellaneous. Norflurazon (Zorial) and clo-mazone (Command) are registered for soil application to cotton, but can sometimes cause bleaching of foliage and purpling of the stems on seedling cotton. Bromoxynil (Buctril) and glyphosate (Roundup) used with genetically modified cotton varieties can severely injure or kill regular cotton if mistakenly applied to non-modified varieties. Bromoxynil causes a rapid burning and desiccation of plant tissue while glyphosate injury is exhibited as a yellowing and stunting similar to the imidazolines and sulfonyleureas.

Summary

None of these herbicide symptoms should be confused with insect damage. Avoid telling growers that their cotton has herbicide damage. If you should encounter a significant amount of any of the conditions mentioned above, bring the condition to the grower's attention and suggest consulting the county Extension office for assistance in diagnosing the problem.



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