ALABAMA COOPERATIVE Extension SYSTEM

ANR-1191

Tomato Insect Management Guide for Alabama

Management of insect pests in tomatoes is a constantly changing process because of the introduction of new control technologies and new pests that may threaten production. The key to successful pest management is to develop a regular scouting program to obtain information on pest and beneficial insect populations that may be used to determine if insecticide applications are needed. In general, new generation insecticides act against a narrow range of pest species and are more costly than older, broad-spectrum materials. Thus, it is critical to properly identify the pests to be controlled and to determine if their presence or potential for damage warrants insecticide treatment. The only way to obtain this information is through routine scouting of fields. The purpose of this guide is to serve as a reference for insect pest identification and for general management guidelines. Please refer to the latest version of Extension publication ANR-500, *Alabama Pesticide Handbook*, for current, complete insecticide recommendations and insecticide use restrictions and guidelines.

Figure 1. Tomato fruitworm eggs

General Recommendations for Scouting Tomato Fields

Fields should be monitored for pests at least once, preferably twice, per week. Each tomato field or planting should be sampled separately, because conditions may be different in each field. Bring a 10X hand lens to help identify small insects and insect eggs and a data sheet to record the date and pest density. Keeping records will help identify periods of peak pest activity during the season and can be used to predict when peak activity will occur in future years. Sample the field in a pattern that covers the entire field (i.e., follow an X, V, or zigzag pattern). It is best to check plants along the field edges separately. Then walk at least 10 rows or 25 paces into the field to begin the X, V, or zigzag pattern. While walking the pattern, select 10 random sites, and sample 5 adjacent plants per site for 50 plants sampled per field. If an X or V pattern is used, select five sites along each "arm" of the pattern. Scouting for insect pests, damage, and disease problems can be done at the same time. The 50-plant sample can be done in less than an hour.

Figure 2. Tomato fruitworm larvae boring into fruit

Figure 3. Armyworm egg mass on tomato leaflet

Key Caterpillar Pests of Tomato

Tomato Fruitworm and Beet Armyworm

Depending on the year, environmental conditions, and proximity of adjacent host crops, infestations of these insects on tomatoes may range from very light to extremely severe. The tomato fruitworm *(Helicoverpa zea)*, also known as the corn earworm and bollworm, and the beet armyworm *(Spodoptera exigua)* both overwinter in Alabama; so early season infestations of these species may occur.

However, later season tomato plantings are often damaged more severely because fruitworm and armyworm populations generally increase as the season progresses. It is common that the most severe fruitworm damage in tomatoes occurs after dry-down or harvest of adjacent corn, and that heavy beet armyworm damage in tomatoes occurs after population buildup on cotton.

Because fruitworm and armyworm are considered occasional pests in Alabama tomato fields, prophylactic or calendar-based insecticide sprays are not recommended. A calendar-based spray program is not cost-effective, will destroy natural insect enemies (i.e., parasites and predators) of fruitworm and armyworm, and will pose a hazard to public health and the environment. A more effective strategy for managing the fruitworm and armyworm is to monitor fields regularly for signs of insects or damage and to apply an insecticide only when necessary. Field trials in Alabama tomatoes have demonstrated that use of the insect monitoring program will result in an average savings of $44 to $65 per acre in insecticide costs alone when compared with a program where insecticides are applied on a weekly basis. In addition to applying insecticides only when needed, the fruitworm/armyworm scouting program enables growers to apply sprays at the optimal time, when the worms are young and most susceptible to insecticides. The following discussion will provide the specific information needed to implement the tomato fruitworm and armyworm management program.

How to Identify Tomato Fruitworm and Damage

The adult fruitworm moth is tan or buff-colored, with dark spots on the outer edge of the forewings. Moths are 1 inch long, with a wing span of 1.5 inches. They are active at night, and the females are attracted to tomato plants in the flower and fruiting stages for egg laying. Eggs are laid singly on foliage near the flowers or developing fruit, usually on the outer portions of the plant (Figure 1). Fruitworm eggs are about the size of a pinhead, hemispherical in shape, and slightly flattened at the top, with 12 or more distinct ridges radiating from the top. They are white when laid but develop a reddish brown ring after about 24 hours. The eggs turn black if parasitized by the tiny Trichogramma wasps, which are usually prevalent in fields not sprayed regularly with insecticides. Young larvae have several rows of black bumps along their backs and two bristles or whisker-like hairs that grow from each bump. Older larvae vary in color from light green to reddish-brown and often have stripes running lengthwise down the body. The older larvae also have distinct hairs covering large portions of their skin. This characteristic can be used to distinguish fruitworm larvae from armyworm larvae that have no body hairs.

Newly hatched larvae usually enter tomato fruit at the stem end when the fruit is small and green (Figure 2). They bore deeply into the fruit and during development they may emerge from one fruit and enter another. Their feeding results in a watery, internal cavity filled with feces; damaged fruit will ripen prematurely and be susceptible to secondary invasion by fungi and bacteria.

How to Identify Beet Armyworm and Damage

The beet armyworm moth is slightly smaller than the fruitworm moth and darker, with a mottled, grayish brown color. Like the fruitworm, armyworm moths are active at night, but eggs are deposited in masses covered by white, fluffy scales from the female (Figure 3). Beet armyworm egg masses are deposited randomly throughout the tomato plant, often on the underside of leaves. It is common to see many small armyworm larvae feeding on the underside of tomato leaves before they disperse throughout the plant. Beet armyworm larvae are smooth, without hairs, and vary in color from dull green to black (Figure 4). Older larvae have a broad, light-colored stripe along the side of the body. Beet armyworm larvae usually have a dark spot on the side of the body in the front just above the middle pair of true legs.

Beet armyworm is primarily a foliage feeder, but they will also attack fruit, usually creating single or closely grouped round or irregularly shaped holes (Figure 5). Feeding damage is usually superficial, and larvae only occasionally develop inside the fruit. Unfortunately, decay organisms enter the feeding-damaged areas and can rot the fruit.

Sampling for Tomato Fruitworm and Armyworm

Because beet armyworm is a foliage feeder, infestations may begin early—before the flower and fruit stage. Therefore, it is prudent to check young plants regularly for beet armyworm egg masses or small larvae. The presence of beet armyworm larvae can also be detected by shaking foliage over a shake cloth. The critical period for

tomato fruitworm and fruitworm egg sampling begins at flower or, at the latest, when there are a significant number of green fruit at least 1 inch in diameter. Fruitworms are usually not a concern before flowering unless high numbers are present.

Sample for fruitworm eggs and armyworm egg masses by selecting the first fully expanded leaf and all new foliage above this leaf on 5 consecutive plants in each of the 10 random locations per field. The first fully expanded leaf will be located at the top of the plant where new growth begins. For sampling purposes, a "leaf" is defined as all the foliage along a branch stem (branching from a main stem). Therefore a leaf may include as many as 8 to10 leaflets along the stem; each leaflet, upper and lower surface, should be checked for eggs. Although fruitworm eggs are small, they stand out and are easily detected with a little practice. Don't count black, parasitized fruitworm eggs in the sample. Beet armyworm egg masses are covered by fuzzy white scales and are easy to spot. It is a good idea to check or shake some of the lower foliage for beet armyworm egg masses and larvae after the first fully expanded leaf is sampled.

Fruit sampling serves as an extra precaution and a backup to the foliage sampling for worms and worm eggs. Pick 100 fruit samples at least 1 inch in diameter at random throughout the field. Check to see if any fruit have worm-feeding damage. Slice open damaged fruit to determine if damage is due to fruitworm (feeding deep inside fruit, feces often present) or armyworm (feeding usually confined to the surface). It is important to know which worm species is present to select the most effective insecticide needed.

When to Treat for Tomato Fruitworm and Armyworm

For producers with a low or 0 threshold for worm-damaged fruit, an insecticide application is recommended if 1 fruitworm egg or 1 beet armyworm egg mass is found on any of the 50 plants sampled per field. Growers that can tolerate a low percentage of damaged fruit may use a fruitworm egg threshold of 3 to 5 eggs per 50 plants. Damage thresholds have not been developed for damaged fruit samples in fresh-market tomatoes, but California processing tomato growers use a threshold of 3 percent worm-damaged fruit from 100 fruit samples randomly chosen in the field.

Other Armyworm Species

Several other armyworm species may occasionally infest Alabama tomato fields and cause damage. These include plain armyworms *(Pseudaletia unipuncta),* yellowstriped armyworms *(Spodoptera ornithogalli),* and southern armyworms *(Spodoptera eridania).* Plain armyworms are variously marked in brown, black, grey, or green, with head sutures forming an inverted "Y". Yellowstriped armyworms have dark heads and dark lateral marks bisected by a thin, white line on each segment behind the true legs. Southern armyworms are dark caterpillars, with two yellowish lateral lines interrupted by a large dark spot on the first abdominal segment. The larger, mature larvae have two rows of dark triangles on the upper surface. Damage is similar to that done by the beet armyworm, which feeds primarily on foliage but will attack fruit when encountered. Sampling and control guidelines are the same as those described for the beet armyworm.

Cabbage Looper

Cabbage loopers *(Trichoplusia ni)* are green caterpillars with white stripes running lengthwise down the body (Figure 6). Loopers have only three pairs of fleshy prolegs in the rear. The young larvae are often found on the underside of leaves where they feed on tender leaf tissue, leaving most veins intact. Because loopers feed only on foliage, damage is usually not severe enough to warrant treatment. After fruit sets and scouting indicates severe foliage feeding such that fruit become prone to sunburn, insecticide application may be warranted.

Tomato Pinworm

Newly hatched larvae of tomato pinworm *(Keiferia lycopersicella)* are yellow-grey and less than 1 mm long. Mature larvae are darker and covered with dark purple spots (Figure 7). Early stage larvae feed on leaves and create blotch-type mines (Figure 8). This damage appears similar to leaf-miner damage. In some cases, larvae may tie the leaf together with silk and feed in the protected area inside. Later stage larvae that bore into the fruit, usually at the calyx or stem end, cause the most serious damage (Figure 9). Pinworm larvae make dry burrows in the core and do not penetrate very far into the fruit. When infested fruit is picked, caterpillars may be difficult to detect, unless they have been feeding long enough to create small piles of brown granular frass at the edge of the calyx. Because the pinworm has many generations per season, it becomes a more serious pest as the season advances. The greatest damage occurs where tomatoes are grown from early in the season to late in the fall or

Figure 4. Beet armyworm larvae

Figure 5. Beet armyworm feeding damage on tomato fruit

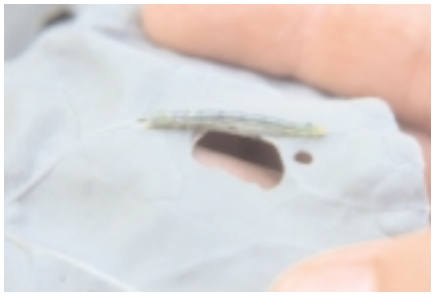

Figure 6. A cabbage looper

Figure 7. A mature tomato pinworm larvae

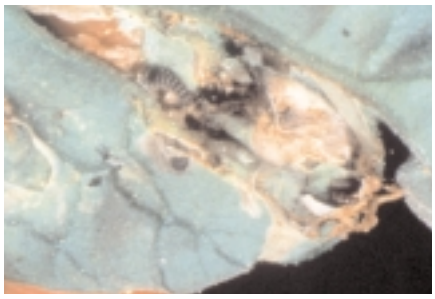

Figure 8. Tomato pinworm leaf damage

Figure 9. Tomato pinworm damage to fruit

Figure 10. Tomato hornworm

Figure 11. Potato aphids on a tomato leaf

Figure 12. Thrips in a tomato blossom

Figure 13. Bronzing symptoms of tomato spotted wilt on tomato leaf

Figure 14. Symptoms of tomato spotted wilt on fruit

Figure 15. An adult sweetpotato whitefly

Figure 16. A whitefly nymph

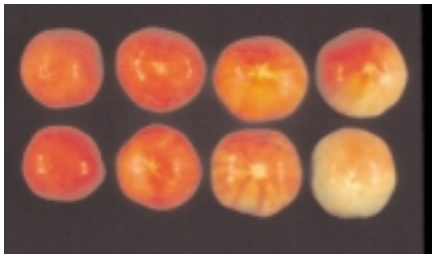

Figure 17. Irregular ripening symptom caused by sweetpotato

Figure 18. An adult stinkbug

Figure 19. Stinkbug eggs

Figure 22. A blister beetle

where late plantings are adjacent to early planted-infested fields. Pinworm is more severe in south Alabama.

Pinworms can be controlled with mating disruption techniques or insecticides. Mating disruption pheromones have been used successfully in areas where pinworms have developed resistance to insecticides. Mating disruption is most successful where fields are isolated or whole areas are treated. Pheromone traps should be used to detect the presence of adult moths. As soon as moths begin to appear in pheromone traps, apply mating disruption pheromone products. If nearby infested tomato fields are terminated or abandoned, adults can immigrate into late-planted fields in large numbers. If monitoring detects a significant movement, consider border treatments. To reduce future populations of pinworm, destroy crop residues after harvest by burning or plowing-under. If pinworm is a serious pest in the area, avoid growing more than one crop per year. Check transplants carefully for pinworm infestation before setting them in the field.

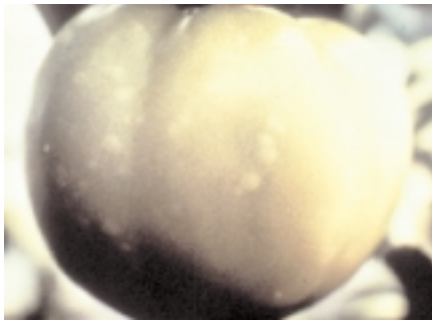

Figure 20. Stinkbug damage on fruit

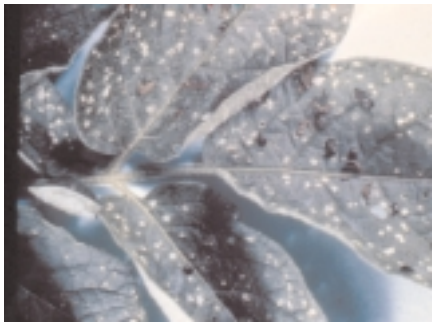

Figure 23. Flea beetle adults and signs of feeding damage

Figure 25. Larvae of Colorado potato beetle

Hornworms

Hornworm *(Manduca spp.)* larvae usually have green bodies with seven diagonal white stripes on the side, or eight V-shaped markings, depending on the species (Figure 10). The name comes from the large horn on the posterior end of the body. Hornworms can grow longer than 4½ inches in length. They strip the leaves and may cause feeding scars on fruit. Hornworms are often controlled naturally by parasites. Parasitized hornworms may be identified by the presence of many white cocoons attached to the upper body surface. The preferred management approach is to wait until fruit begins to mature before applying insecticides. Insecticides may be applied sooner if extensive foliar feeding is observed. Insecticides are not highly effective against late stage larvae.

For more information regarding caterpillar pests, see Extension publication ANR-1121, "Identifying Caterpillars in Field, Forage, and Horticultural Crops."

Figure 21. Typical symptom of leaf miner damage

Figure 24. An adult Colorado potato beetle

Insect Vectors of Virus Disease: Aphids, Thrips, Whiteflies

Aphids

Aphids are small, soft-bodied insects that vary in color from pale yellow to red to green to black, depending on the species, the host plant, and time of season

(Figure 11). Direct-feeding damage by aphids is rarely severe enough to kill plants. They pierce plant tissue with needlelike mouthparts, which may result in blossom shed or curling or stunting of new growth. They also produce a sticky material called honeydew that supports growth of a black sooty mold fungus. However, aphid transmission and the spread of plant viruses cause greatest economic damage. Aphid-vectored viruses and resultant virus disease epidemics have severely limited tomato production in north Alabama in recent years. Several different aphid species probably are involved in the spread of viruses to tomato fields, including the cotton aphid *(Aphis gossypii),* green peach aphid *(Myzus persicae),* and the potato aphid *(Macrosiphum euphorbiae).* The green peach aphid and the potato aphid are known to develop on tomato and are known to be efficient vectors of tomato viruses. The cotton aphid is also an efficient virus vector but does not develop on tomato. Cotton aphid populations commonly build up on cotton, then move to weeds and vegetable crops where they may acquire and transmit virus.

While insecticides recommended for aphid control are effective at killing aphids, there is no way to prevent the spread of nonpersistent (stylet-borne) viruses in tomatoes with insecticides. This is because of the short time needed to transmit the virus by aphid feeding. An aphid landing on an insecticide-treated plant will transmit the virus before succumbing to the insecticide. However, insecticides applied for aphids may delay the spread of the virus or reduce the magnitude of the disease. Application of imidacloprid (Admire) at planting has been shown to reduce or delay the incidence of virus in tomatoes. Many tomato growers in Florida use reflective (aluminum-colored) mulch to delay the spread of aphid or whitefly-transmitted virus diseases. The reflective mulch reflects UV light, which the insects perceive as light coming from the sky. This masks the attractive color of the plants.

The most effective way to reduce aphid and aphid-vectored virus problems is to reduce the number of aphids migrating into the field. One way to do this is to implement regular weed control practices to eliminate weeds that may serve as alternate hosts for aphids in, or adjacent to, tomato fields. Predominant winter hosts for the green peach aphid are plants in the Prunus genus, including rose, peach, and plum. Pruning in peach orchards destroys many green peach aphid eggs. Orchards or fruit tree areas adjacent to tomato fields should be kept free of weed hosts, and untended peach trees should be treated with insecticides or removed. Fruit trees adjacent to tomatoes may be treated with insecticides or dormant oils in the spring before tomatoes are planted.

Ultra-fine oils (Saf-T-Side, JMS Stylet Oil, etc) have shown some effectiveness for management of aphids and virus. Oils act in two ways. The highly refined oils dissolve or degrade the cuticle of soft-bodied insects like aphids, causing direct mortality. It has also been shown that oils sprayed on plants may intercept the stylet-borne virus particles from the aphid before penetration into the plant, thereby delaying infection. In general, oils are not as effective as insecticides for aphid control because they are not as toxic. Therefore, oil sprays may have to be applied more frequently. Also, for maximum effectiveness, oils should be sprayed in a volume of at least 50, preferably 100, gallons per acre (gpa) and using at least 200 psi (preferably 400 psi) pressure. Oils are used frequently in California, where green peach aphids are highly insecticide resistant, for management of aphid-vectored viruses in cucurbit crops.

Thrips

Several species of thrips may infest tomatoes, including western *(Frankliniella occindentalis)* and eastern *(Frankliniella tritici)* flower thrips, melon thrips *(Thrips palmi),* and tobacco thrips *(Frankliniella fusca).* These are tiny (1/16 inch), slender insects that may vary in color from yellow to dark brown or black (Figure 12). They prefer to feed in flowers but also occur in flower and leaf buds and, occasionally, on leaves. Thrips damage tomatoes in several ways. Feeding in blossoms may cause blossom drop, or fruit may not develop properly and become deformed. Feeding on foliage may cause a bronzing or silvering of foliage. Eggs inserted in fruit causes dimpling, and the infested area may appear white. Thrips are also vectors of tomato spotted wilt virus (TSWV), a potentially devastating disease of tomato. Infected plants have dark lesions on the foliage (Figure 13) and fruit show characteristic halo markings (Figure 14). Refer to Extension publication ANR-836, "Virus Diseases of Tomato," for more information on this disease.

Research has demonstrated that even low numbers of thrips may be enough to infest fields with TSWV. However, high populations are more likely to result in a greater incidence of virus in the field. To determine thrips presence, sample one flower per plant during the routine scouting procedure. Thrips may be visible inside the flower using a hand

lens, or the flower may be shaken over a piece of paper to dislodge the thrips for observation. If the area has a history of TSWV, insecticide application is recommended if any thrips are found. If TSWV has not been a problem in the past, the recommended thrips treatment threshold is five thrips per flower. Application of imidacloprid (Admire) at planting may help to delay the onset of TSWV symptoms in the field. Recent research in Georgia has indicated that insecticides applied during the first 4 weeks after transplanting provide the greatest protection against yield reduction from TSWV. As indicated for aphid control, reflective (aluminum-colored) mulch may also help to reduce thrips infestations and spread of TSWV.

Whiteflies

The adults are tiny, white or yellowish winged insects that rise in clouds above the plant when they are disturbed (Figure 15). All growth stages are usually located on the underside of leaves. The immatures, or nymphs, are scalelike in appearance, immobile, and lack legs (Figure 16). Adults and nymphs produce honeydew, which is a food source for sooty mold fungus. Large populations of whiteflies debilitate plants directly through sap removal and indirectly through shading effects of sooty mold. The sweetpotato whitefly *(Bemisia tabaci),* sometimes called the silverleaf whitefly *(Bemisia argentifolii),* may also cause a physiological disorder called irregular ripening, where fruit fails to color evenly during the ripening process (Figure 17). This species of whitefly also transmits a plant virus, tomato mottle geminivirus (TMoV). TMoV has only been reported in Florida, but south Alabama growers should be on the lookout for this disease.

In Florida, successful management has depended on the integration of cultural, biological, and chemical control. Growers are encouraged to maintain at least one crop-free period of 2 months or more during which fields are kept free of crop residues to reduce the source of virus and whiteflies. If successive plantings are required during the season, they should be separated the maximum distance possible by nonsusceptible crops. Application of imidacloprid (Admire) at planting has helped to reduce whitefly populations and the incidence of TMoV. The use of stylet oils (see aphid management section) has also demonstrated some effectiveness for management of whitefly and associated virus diseases.

Other Insects Affecting Tomato

Stinkbugs

These insects in the "true bug" group are distinctly shield-shaped and are either green or brown (Figure 18). Immatures, or nymphs, look like adults but are small and lack wings. Eggs are keg-shaped and are laid in clusters on foliage (Figure 19). On green fruit, damage appears as dark pinpricks surrounded by a light discolored area (Figure 20). Stinkbugs *(Nezara viridula)* are highly mobile but may be sampled by beating or shaking vines and checking the soil under the beat sheet for stinkbugs.

Treatment thresholds vary by location. In Florida, the threshold is one bug per six plants once plants set flowers. The published California threshold is ⅓ to ½ stinkbug per beating sheet or tray. Application of imidacloprid (Admire) at planting is reported to reduce stinkbug damage on tomato.

Leaf Miners

Leaf miner *(Liriomyza sativae)* adults are small flies, with a black head and yellow between the eyes, a black thorax, and a tubelike ovipositor at the end of the abdomen. Eggs are inserted into leaf tissue, and the yellow larva feeds between the upper and lower leaf surface. This results in the characteristic serpentine mine containing a string of black fecal matter (Figure 21). Mature larvae drop to the ground (or plastic mulch), where they molt into dark brown pupae. Generally, leaf miners are not a serious pest of tomatoes. Leaf mining reduces photosynthetic areas but usually not enough to reduce tomato yields. Occasionally, severe infestations reduce foliage to the point where fruit become sunburned.

Leaf miners suffer parasitism by a variety of parasitic wasps that normally keep populations in check. For this reason, application of highly toxic insecticides, like methomyl, that destroy natural enemies should be avoided. If control is necessary, use of narrow-range, or less toxic, insecticides is preferred.

Beetles (Blister Beetles, Flea Beetles, Colorado Potato Beetle)

Beetles are foliage feeders and normally do not damage fruit unless populations are very high. Blister beetles are slender elongated beetles up to three-fourths of an inch long with prominent heads (Figure 22). Their body color varies but is usually black, or black with yellow margins or stripes. They produce stringy, black excrement, and their feeding results in ragged holes on the leaves. Flea beetles *(Epitris spp.)* are tiny dark beetles with enlarged hind legs that enable them to jump away instantly when disturbed. They

are more of a problem in the spring, when they move into tomatoes from adjacent weedy areas. They produce tiny round holes in foliage (Figure 23). Colorado potato beetles *(Leptinotarsa decemlineata)* feed on solanaceous plants but prefer potato and eggplant to tomato. The adults have dark bodies with five longitudinal yellow stripes on each wing cover (Figure 24). Larvae are reddish with dark spots. Both adults and larvae feed on foliage (Figure 25).

Regular monitoring of plants will easily detect the presence of beetles and their potential for damage. Remember that low levels of defoliation will not have any impact on yield, particularly when plants are mature. Therefore, insecticides are recommended only if feeding damage is moderate to severe. However, beetle populations on plants (particularly Colorado potato beetle) may build rapidly. Therefore, if beetles are detected but no insecticide is applied, it is recommended that another sample be taken within 2 days to determine if beetle numbers are increasing.

Edward Sikora, *Extension Plant Pathologist,* Associate Professor, Entomology and Plant Pathology, Auburn University. Originally prepared by **Geoff Zehnder,** former *Extension Entomologist.*

Issued in furtherance of Cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, and other related acts, in cooperation with the U.S. Department of Agriculture. The Alabama Cooperative Extension System (Alabama A&M University and Auburn University) offers educational programs, materials, and equal opportunity employment to all people without regard to race, color, national origin, religion, sex, age, veteran status, or disability.

UPS, 15M30, **New Nov 2000,** ANR-1191

ALABAMA COOPERATIVE Extension SYSTEM

ANR-1191