

# *Control of* INSECTS *and* FOLIAGE DISEASES *of* TOMATOES *in Alabama*

W. G. EDEN, *Entomologist*

R. L. SELF, *Plant Pathologist*

U. L. DIENER, *Assistant Plant Pathologist*

TOMATOES ARE WIDELY GROWN in the commercial horticultural areas of Alabama and in most home gardens. Diseases and insects are frequently the limiting factors in the production of tomatoes in Alabama.

Research on the control of insects and foliage diseases of tomatoes has been conducted in Alabama for the past several years. Experiments have been conducted at the Chilton Area Horticulture Substation at Clanton, the North Alabama Horticulture Substation at Cullman, the Southeast Alabama Horticulture Field at Ashford, and the Gulf Coast Substation at Fairhope. The recommendations given in this leaflet are based on the results of these experiments.

## INSECTS of TOMATOES

The most important insects on tomatoes in Alabama are the tomato fruitworm, *Heliothis armigera* (Hbn.); the tomato hornworm, *Protoparce quinque-maculata* (Haw.); the tomato pinworm, *Keiferia lycopersicella* (Busck); and the potato aphid, *Macrosiphum solanifolii* (Ashm.).

Tomato fruitworms are nearly 2 inches long when full-grown and are not characterized by any definite color

pattern. The worms vary greatly in color from a light green or pink to brown or nearly black with lighter underparts. They are marked with alternating light and dark stripes running lengthwise of the body. There is usually a double dark line lengthwise of the body in the middle of the back. When the larvae hatch, they feed sparingly on the leaves and crawl about until they find their way to the fruits; here they cut holes and burrow into the fruits, usually at the stem end. A worm may feed on a single tomato until fully grown, or it may move from one tomato to another, injuring several before it completes its growth. The mature or adult stage of the tomato fruitworm is a grayish brown moth with a wing expanse of about 1½ inches. The moth lays its eggs singly on the leaves of the plant and the eggs hatch in 2 to 10 days. Each moth is capable of laying 500 to 3,000 eggs during its lifetime.

The tomato hornworm is a large green caterpillar, up to 4 inches long, with diagonal white stripes on the sides and a slender horn at the tip of the body. After hatching from the egg, the hornworms feed ravenously for 3 to 4 weeks, devouring fruit and foliage. They cling to the stems and literally strip the foliage from the plants. The

**AGRICULTURAL EXPERIMENT STATION**  
*of the* **ALABAMA POLYTECHNIC INSTITUTE**

E. V. Smith, *Director*

Auburn, Alabama

adult of the hornworm is a large, swift-flying hawk moth, gray or brown in color with white and dark mottlings, and about 4 or 5 inches from wing tip to wing tip. The moth lays its eggs singly on the underside of the leaves, and the eggs hatch in about a week.

The full-grown tomato pinworm is about one-fourth inch long with a slender ash-gray body mottled with dark purple spots. After hatching from the eggs, the pinworm larvae mine the leaves, feeding only on the inner parts. The mines are of the serpentine type at first but are later widened to form a blotch. When about half grown, the larvae leave the mines to form leaf folds that act as shelters from which they continue to feed on the inner parts of the leaf. Many leaves may be destroyed, but the more important injury from the pinworm is to the fruit. Larvae that have mined the calyx lobes and many of those from the nearest leaves enter the fruit instead of folding the leaves. The larvae usually enter the fruit beneath the calyx lobe but may enter at other places as well. The entrance holes, which resemble pinholes, have resulted in the common name of pinworm being attached to the insect. Pinworms bore into the fruit as far as three-fourths of an inch. The injury caused by each pinworm is not great, but its appearance is objectionable and may cause the fruit to decay. The adult form of the tomato pinworm is a small gray moth, which is about one-fourth inch long when the wings are folded. The moth lays its eggs indiscriminately on the plants, and the eggs hatch in 4 to 10 days, depending upon the temperature. The complete life cycle from egg to adult usually requires 4 to 6 weeks.

The potato aphid is a clear green or glistening pink plant louse, which is nearly one-eighth inch long when fully grown. The aphids suck the juices from the leaves and tender portions of the plant. The most noticeable injury is the devitalizing of the blossom clusters so that the blossoms fall and no

tomatoes are set. The aphid also causes serious injury by infecting tomato plants with virus diseases. Tobacco mosaic can be carried from one plant to another by this insect. Severe stunting of plants may result from early infection with mosaic, and yield may be drastically reduced.

### **Control of the Insects**

In experiments on the control of tomato fruitworm, the following insecticides have been tested as dusts and/or sprays: cryolite, methoxychlor, TDE (DDD), DDT, toxaphene, parathion, rotenone, dilan, isodrin, endrin, and heptachlor. The use of TDE and methoxychlor has consistently resulted in the highest yields of marketable fruits. In limited tests endrin, dilan, and parathion have also proved effective. In severe infestations TDE has increased the yield of marketable fruits as much as 123 bushels per acre; under similar conditions, methoxychlor has increased the yield of marketable fruits as much as 86 bushels per acre. For fruitworm control, the use of 5 per cent dusts of TDE or methoxychlor are recommended. As sprays, 4 pounds of 50 per cent wettable powder or 1 gallon of 25 per cent emulsifiable concentrate per 100 gallons should be used. For effective fruitworm control, the application of insecticides should be started as soon as the plants begin to bloom freely. Applications should be made at weekly to 10-day intervals as long as protection of the fruits is required.

Against the pinworm, the use of DDT, TDE, and cryolite has resulted in the fewest number of fruits being discarded due to this pest. Methoxychlor has not been as effective as the above-mentioned insecticides against the pinworm. Parathion and toxaphene have shown promise in limited tests, but were not as effective as TDE, DDT, or cryolite. DDT and TDE should be used as 5 per cent dusts or as sprays containing 4 pounds of 50 per cent wettable powder or 1 gallon of 25 per

cent emulsifiable concentrate per 100 gallons of water. Cryolite may be used as a 50 per cent dust or as a spray containing 8 pounds per 100 gallons.

The tomato hornworm has been effectively controlled in all plots where insecticides have been applied for fruit-worm control. TDE, methoxychlor, DDT, or toxaphene were all highly effective when applied to tomatoes for hornworm control alone. Toxaphene was used as a 20 per cent dust and at the rate of 10 pounds of 40 per cent wettable powder per 100 gallons of water.

The potato aphid has been effectively controlled with dusts of 3 per cent nicotine, 1 per cent parathion, or 1 per cent lindane. These materials are also effective when used as sprays at the following rates: 1 pound of 15 per cent wettable powder of parathion, 1 pound of 25 per cent wettable powder of lindane, or 1-1½ pints of 40 per cent nicotine sulphate in 100 gallons of water. One of these aphicides should be applied when aphids become a problem on tomatoes. The insecticides must be applied to give thorough coverage, especially on the undersides of the leaves.

## FOLIAGE DISEASES of TOMATOES

The important foliage diseases of tomatoes in Alabama are early blight, caused by *Alternaria dauci* (Kuhn) Groves and Skolko f. *solani* (E. and M.) Neergaard; late blight, caused by *Phytophthora infestans* (Mont) DeBary; and Septoria blight, caused by *Septoria lycopersici* Speg. These fungus diseases cause severe defoliation of tomatoes, and late blight also causes a destructive rot of the fruit. Early blight is prevalent almost every year in some areas of Alabama. When present in cool, wet seasons, late blight is by far the most destructive disease of tomatoes. Septoria blight has caused only occasional damage in Alabama.

The fungus that causes early blight of tomatoes and potatoes may overwin-

ter on the seed, in the soil, and in old crop refuse. Seedling infection occurs most rapidly during warm (75° F.), humid weather. The first symptoms usually appear on the older leaves and consist of irregular, brown to black, dead spots, which enlarge up to one-half inch in diameter showing a target pattern of ridged concentric rings. The greatest leaf injury usually occurs near harvest time. The stems of seedlings are often girdled by the collar-rot phase of the disease. Dark, circular, sunken areas or cankers also develop on older stems. *Alternaria tomato* (CKe) Weber causes a disease with leaf and stem symptoms almost identical to early blight. This disease produces a small "nail-head spot" on the fruit which is quite distinct from the dark, leathery, concentric-ringed, sunken lesions arising near the stem scar on the tomato fruit caused by the early blight fungus.

The late blight fungus of tomatoes may overwinter in infected potato tubers. Primary infection may be initiated by wind-blown spores from distant tomato or potato fields or from infected transplants. Late blight spreads most rapidly during periods of heavy dew or high rainfall and low temperatures from 40-70° F. In dry weather temperatures above 75° tend to check disease development. The first symptoms are greenish-black, water-soaked patches on the leaves that enlarge rapidly to envelop the whole plant. In damp weather the dark patches show a white downy growth of fungus on the lower side of the leaf. Stems develop similar water-soaked areas of infections. Infected fruits show grayish-green, water-soaked spots, which turn brown to purplish-black and have a firm rough surface. Any part of the plant may become infected at any stage of growth.

The Septoria blight fungus overwinters on tomato refuse and weed host plants (horse nettle, Jimson weed, ground cherry). It is most severe in periods of abundant rainfall and 60-80° F. temperatures. The first symptoms are small, water-soaked spots seldom

enlarging to more than one-eighth inch in diameter. These spots become roughly circular with gray centers surrounded by dark margins. Tiny dark specks appearing in the light centers produce the spores of the fungus. With environmental conditions favorable for the disease, severe defoliation of the tomato plants occurs.

### Control of the Diseases

Experiments in the past 5 years have shown that tomato blights can be controlled in Alabama by the application of fungicides. The chemical deposit or coating on the foliage of the plant is toxic to the spores and thus prevents their germination and subsequent infection of the tomato plant. The following materials have been tested as dusts and/or sprays: captan, Copper A, Crag 658, maneb, nabam, Phygon XL, tribasic copper sulfate and zineb. Of the fungicides evaluated, the dithiocarbamate salts and the "fixed" copper compounds have consistently given disease control and increases in yield of 15 to 120 per cent of marketable tomato fruit over the untreated plots. Sprays or dusts with a fixed copper compound (tribasic copper sulfate or Copper A) or a dithiocarbamate derivative (zineb, nabam, maneb) as the active chemical ingredient have both been effective.

Dusts should contain 6 to 7 per cent (metallic) copper or 6 to 7 per cent zineb or 7 per cent maneb. Sprays should contain 2 pounds of (metallic) copper or 2 pounds of zineb or maneb concentrate or 2 quarts of nabam plus 1 pound of zinc sulfate per 100 gallons of water. These materials should be applied with equipment that produces a good "fog" of spray or dust adequate for thorough coverage. Applications should be made every 7 to 10 days; the frequency depending on the weather and disease conditions. Dusts should be applied at rates of 15 to 45 pounds per acre per application depending on the size of the plants. About 100 to 150 gallons of spray per acre is required for adequate coverage.

### SUMMARY

1. The tomato fruitworm is the most important insect pest of tomatoes in Alabama. Other insects that may do severe damage are the tomato hornworm, the tomato pinworm, and the potato aphid.

2. The use of TDE and methoxychlor, when used for fruitworm control, has consistently resulted in the highest yields of marketable fruits.

3. The best control of pinworm has been obtained with TDE, DDT, and cryolite as dusts or sprays.

4. The hornworm was effectively controlled with TDE, DDT, methoxychlor, or toxaphene as dusts or sprays.

5. The potato aphid was effectively controlled on tomatoes with dusts or sprays of nicotine, parathion, and lindane.

6. Certified, disease-free tomato plants give best results.

7. Tomatoes planted after tomatoes or Irish potatoes are more likely to be infected by foliage diseases than when planted after other crops. If possible, plantings of tomatoes and Irish potatoes should be widely separated.

8. The major foliage diseases of tomatoes (early and late blight) may be controlled by applying fungicides frequently at recommended concentrations. After the tomato plants are established, they should be sprayed or dusted with zineb or nabam, maneb, or tribasic copper sulfate. The treatment should be repeated at intervals of 7 to 10 days or more frequently, depending on weather and disease conditions.

9. For the most effective and economical control of tomato diseases and insects, a combination insecticide-fungicide formulation should be used. Such formulations are commercially available. Since a fungicidal program must usually be started before the insecticide is needed, the commercial producer of tomatoes will probably save money by using a fungicide alone until the plants begin to bloom freely. For small growers, the combination is recommended throughout the season.