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report on
PLANT
DISEASE

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EARLY BLIGHT, SEPTORIA LEAF SPOT, AND ANTHRACNOSE RIPE ROT OF TOMATO

All three of these common and important diseases are caused by fungi: early blight by *Alternaria solani*; Septoria leaf spot by *Septoria lycopersici*; and anthracnose ripe rot by *Colletotrichum coccodes*. These diseases are considered collectively here because: 1) early blight (Figure 1) and Septoria leaf spot (Figure 2) cause defoliation, exposing the fruit to sunscald, which contributes to the development of anthracnose; and 2) the same control practices and fungicide program are used for all three diseases. The losses from these diseases may approach 100 percent in warm, wet seasons where control measures are not practiced. Harvestable fruit numbers, size, and quality are all reduced by these diseases.

Figure 1. Alternaria early blight.

Figure 2. Septoria leaf spot

The greatest damage from early blight and Septoria leaf spot results from loss of foliage and the exposure of ripening fruit to sunscald. During July and August, the internal temperature of fruit exposed to direct sunlight may reach 122°F (50°C). In addition, the red pigment (lycopene) in tomato fruit does not develop at temperatures above 86°F (30°C). Thus, plants severely defoliated in midsummer will not produce good quality fruit. Such fruit may be small, flabby, cracked, orange instead of red, and off-flavor (Figure 3).

Figure 3. Anthracnose ripe rot.

1. **Early blight** can affect plants at any stage of development. All aboveground parts are susceptible. Common names used for the disease at various stages of plant and fruit development include seedling blight and damping-off, foot and collar rot on young plant stems, stem blight and canker on stems and branches of older plants, early blight and Alternaria or target leaf spot, blossom blight, black rot and hard fruit rot, and fruit drop of fruit and petioles. The "early" in early blight was used to

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distinguish Alternaria blight from Phytophthora late blight, referring to the time when disease appears relative to the age of the plant.

Pre- and postemergence damping-off occurs in seedbeds resulting in poor stands. Collar or foot rot may develop on young seedlings and transplants. Collar rot is characterized by a large, girdling, dark brown, slightly sunken, irregular lesion at the base of the stem. Similar but smaller stem cankers may develop further up the stem. Affected seedlings may be stunted, wilt and die, or be unproductive when set in the greenhouse or field. Somewhat sunken spots (cankers) develop on the stems and branches. The cankers are dark, often target-like, with grayish white centers.

The most characteristic symptom of early blight is expressed as small, brown spots on the lower or older leaves (Figure 1). The circular to angular spots enlarge until they are 1/4 to 1/2 inch in diameter and soon develop dark, concentric rings or ridges, producing a "target-board" effect. Affected leaves develop yellow areas around the lesions. Spotted leaves soon turn yellow, wither, and drop off. In severe cases plants can become completely defoliated late in the season.

The fungus may cause lesions on the fruit around the stem end and shoulder. The lesion is usually dark brown to black, up to an inch in diameter, leathery, depressed, and with distinct concentric rings. The Alternaria fungus often covers fruit lesions as a dark brown, velvety layer of spores. Lesions on the flower stems cause some blossom drop and loss of young fruits.

2. **Septoria leaf spot** can also affect plants at any stage of development. Numerous small, water-soaked spots first appear on the lower leaves. These spots soon become circular to angular with dark margins and grayish white centers often bearing one or more tiny black bodies called pycnidia, which are spore-bearing structures. Individual lesions are seldom more than 1/8 inch in diameter and are usually quite numerous on an infected leaf. Heavily diseased leaves turn yellow, wither, and drop off in large numbers, starting at the base of the plant. Defoliation can be severe during prolonged periods of warm, wet weather.

   Lesions also appear on the leaf petioles, stems, blossoms, and flower stalks. The lower leaves of seedlings may become severely spotted in the seedbed if plants are crowded, the foliage is wet for extended periods, and the plants are held too long before transplanting.

3. **Anthracnose ripe rot**. The most characteristic symptom develops on ripe or over-ripe fruit. Although many infections occur when the fruit is green, the disease is generally not evident until the fruit is ripe or nearly so. Initially, fruit lesions are small, circular, water-soaked, and slightly sunken (Figure 3). However, in warm weather, the lesions expand rapidly to a diameter of about 1/2 inch, sometimes marked with concentric rings. The center of each lesion may be blackish due to a large number of black specks, which are the spore-producing bodies (acervuli) of the anthracnose fungus. In moist weather the acervuli produce large numbers of slimy, cream- to salmon-colored spores (conidia) on the surface of the lesions. If conditions are favorable, the entire fruit may be almost completely covered with anthracnose spots within 24 hours after harvest. Spotted fruits may rot completely, often due to invasion of anthracnose lesions by secondary soft-rot organisms.

   The fungus is also able to infect the leaves, stems, and roots. Foliar symptoms are uncommon, but are seen as tiny, circular to angular necrotic lesions surrounded by a yellow halo. The anthracnose fungus often becomes established in early blight lesions or insect-feeding injuries. When tomato seeds germinate, the anthracnose fungus can cause brown lesions on the hypocotyl and radicle if there is sufficient inoculum in the soil. Roots on senescing plants usually are affected, and said to have black dot because of the tiny, black specks (sclerotia) which form on the roots. These sclerotia,

which are survival structures, may also form on and in the stems, leaves, and fruit skins of tomato refuse. The sclerotia can persist in soil for many years.

Several species of *Colletotrichum* are reported to cause typical anthracnose lesions on tomato. *C. coccodes* (synonyms *C. atramentarium*) is the most common species, and is capable of infecting all parts of the plant including the roots. Isolates that cause black dot on roots may or may not be able to cause fruit rot. The disease this species causes is called anthracnose ripe rot to differentiate it from anthracnose diseases caused by other species. Other fungal species, primarily associated with fruit-rot symptoms, include *C. dematium* and *C. gloeosporoides.*

Anthracnose is most common on plants in poorly drained, unfertile soils and on plants that have lost much of their foliage from early blight, Septoria leaf spot, or other defoliating diseases. Several explanations have been given for this association: 1) warm, moist weather favors each disease; 2) defoliation results in physiological changes in the fruit which makes them more susceptible to infection; 3) defoliation results in temperature and/or dew conditions that promote invasion and development of the anthracnose fungus; or 4) large amounts of fungus inoculum develops on defoliated parts of tomato plants. Anthracnose is most prevalent on late-season fruit, probably because the air-soil environment at this time is most conducive to disease development and/or high levels of inoculum are present.

Disease Cycles

Frequent showers, heavy dews, temperatures of 68° to 85°F (20° to 29°C) and over-crowding of plants favor the spread and development of all three of these diseases. Early blight tends to be somewhat more destructive during hot, dry seasons than do Septoria leaf spot and anthracnose ripe rot.

The fungi causing all three diseases may be carried on or in the seed and may overwinter in the soil or crop debris. In addition, the fungi also infect and over-winter on several species of weeds (such as groundcherries, horsenettle, Jimsonweed, and nightshades) as well as crops in the tomato family (Solanaceae). The host range of the anthracnose fungi includes 13 or 14 families, most of the hosts occurring within the plant families Solanaceae, Cucurbitaceae, and leguminosae. Examples include: 1) the fruit of eggplant, pepper, apple, grape, canna, and mango; and 2) the roots of such diverse plants as bittersweet, black or deadly nightshade, cabbage, chrysanthemum, cress, false Jerusalem cherry, lettuce, marrow, oats, wheat, white mustard, winter cherry, and probably many other plants.

The spores, sclerotia, and other fungal structures are spread by water splash, on tools and farm equipment, by insects, by handling wet plants, and by any agency that moves infested soil and plant debris from one place to another (such as wind and water). Infection may occur through natural openings (largely stomata), wounds, or directly through the surface of leaves, stems, fruit, and roots.

Control

To control these diseases, a grower needs a complete disease management program. The following practices are all important in keeping fruit losses to a minimum.

A. **For Transplant Growers**

1. Purchase **only** disease-free seed, certified if possible, from a reputable firm. Ask if the seed has been hot-water treated.

2. If you suspect the seed is infected, and not hot-water treated, soak the seed in hot water (**exactly** 122°F [50°C] for 25 minutes), and then dust with a seed-protectant fungicide before planting.

3. Treat the seedbed soil with steam or chemicals before planting. For information on procedures and soil fumigants recommended for freeing the soil of disease-causing organisms, weeds, and insects, refer to University of Illinois Extension Circular 1213, Soil Disinfestation–Methods and Materials (available at your nearest Extension Center).

4. Provide ample ventilation for plants in the seedbed. Do not overhead water, or water in the evening, and avoid overcrowding the seedlings. Fertilize based on a soil test.

5. Do **not** hold plants in the seedbed or in storage any longer than is absolutely necessary after they have reached the proper stage for transplanting.

B. **For Field Growers**

1. Purchase only disease-free transplants, certified if possible. When transplanting, discard all seedlings with cankers or lesions on the stem and leaves. Space the plants so the tops will not be crowded at maturity.

2. Eradicate all weeds preferably before planting and during the season, particularly those in the family Solanaceae. Examples include groundcherries, horsenettle, nightshades, and Jimsonweed. It is also important to keep down all weeds as far around the field or garden as is practical.

3. Do not cultivate or work with plants when the foliage is wet with rain or dew.

4. Some losses from these diseases can be avoided if a high, balanced soil fertility is maintained and tomatoes are planted in well-drained soil. Staking, caging, or mulching plants to keep fruit off the soil will reduce losses from all three diseases as well as other fruit rots.

5. Routine applications of fungicides is essential in controlling all three diseases. Applications should start a week or two after transplanting and continue close to harvest. Thorough coverage of the foliage, stems, and fruit is essential with each application. Sprays in general are much more effective than dusts. Dusts may be used effectively, however, if applied frequently (every 5 to 7 days) and diligently. Apply dusts and sprays in the early morning or evening when the wind is usually at a minimum (less than 5 miles per hour for dusting and 10 miles per hour for spraying) and leaf surfaces are damp with dew. Dusts should contain at least 5 to 10 percent fungicide. Be sure to follow directions and precautions for mixing and applying as printed on the container label.

6. TOM-CAST, a weather-timed fungicide spray program, is available to commercial tomato growers to help determine when applications are warranted. Daily disease severity values (DSV) are calculated from surface wetness and temperature data. Fungicide sprays are recommended only when specified accumulated DSVs have been reached.
7. In the home garden, harvest all ripe fruit at each picking. If left in the field, such fruit will soon decay and serve as a major source of infection for the remaining fruit.

8. After harvest is completed, spade or cleanly plow down, compost, or burn all tomato vines and unharvestable fruit.

9. Rotate three or four years before planting tomatoes, eggplant, peppers, or potatoes in the same area. This helps prevent buildup of the causal fungi in the soil.

10. Plants with resistance to one or more of these fungi have been identified and may be commercially available. Consult current seed catalogs and trade publications.