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report on
PLANT
DISEASE

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ONION LEAF BLIGHTS

(Downy Mildew, Botrytis Leaf Blight, and Purple Blotch)

Downy mildew, Botrytis leaf blight, and purple blotch may cause onion leaves to become blighted and die prematurely. The result is undersized and immature bulbs and reduced yields. The destructiveness of all three diseases varies widely with locality and season, depending on how often and how long onion foliage is wet by dew, fogs, or showers. Leaves that are blighted and killed prematurely are often covered later by secondary olive-green to black molds, such as *Alternaria* and *Macrosporium*.

Figure 1. Downy mildew on older onion leaves.

DOWNY MILDEW

Downy mildew, caused by the fungus *Peronospora destructor*, may cause local infections on onion leaves or be systemic and infect the entire plant. Additional hosts of the fungus include Egyptian onion, the potato or multiplier onion, Welsh or Spanish onion, chives, garlic, leek, shallot, and possibly other species of *Allium*. Red onions have some resistance.

Local infections usually appear as pale green, oval to elongated, slightly sunken spots (lesions) on 6-inch or taller leaves and seed stalks (Figure 1). Alternating bands of yellowish and green tissue may be evident. In moist weather these areas are covered with a fuzzy, pale purplish mold composed of masses of microscopic spores (sporangiospores) of the causal fungus (Figure 2). Later, the whole leaf gradually turns a dull pale green and then yellow. Usually the older and outer leaves become diseased first. Affected foliage often breaks over and shrivels. Systemically infected plants are stunted with distorted, pale green leaves. Downy mildew commonly starts in spots within a field and soon spreads to surrounding plants. If the weather turns dry after disease appears, onion plants can produce new leaves and partially recover. If humid conditions return, however, the fungus quickly revives and new growth becomes blighted. When progressive leaf death occurs, bulb size is reduced. Bulbs on diseased plants can remain small with succulent necks which are subject to attack by a variety of fungi and bacteria in storage.

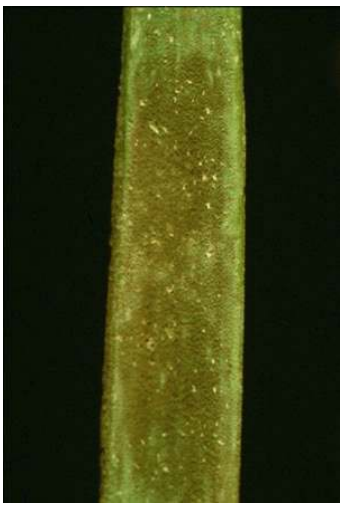

Figure 2. Downy mildew fruiting on an onion leaf.

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Lesions on seed stems are circular and may weaken the stalks causing them to break from the weight of the seed cluster (umbel). As a result the seeds will shrivel. Both the floral parts and seed may also become infected by the purple blotch fungus (see Purple Blotch below).

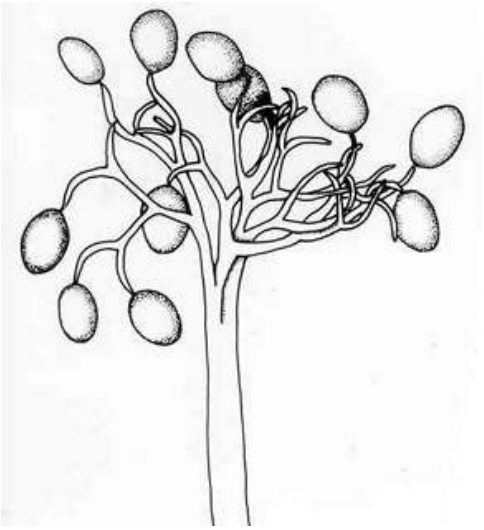

Figure 3. Peronospora destructor, the cause of onion downy mildew as it would appear under a high-power microscope. Branched, treelike sporangiophore bearing lemon-shaped sporangia (conidia) at the curved pointed tips (drawing by Lenore Gray).

The downy mildew fungus overwinters as mycelium on onion bulbs, sets, perennial (winter) onions, seed, and as oospores (thick-walled, sexually produced spores) in diseased foliage. These overwintering sources serve as initial inoculum along with violet, lemon-shaped sporangiospores (conidia) which are produced on long, branched sporangiophores (Figure 3) on the foliage of weed, volunteer, European or multiplier, and home-garden onions when the overwintering mycelium resumes growth in the spring. The spores are produced within a temperature range of 43° to 80°F–6° to 27°C–(optimum 52° to 55°F or 11° to 13°C). The spores can be transported considerable distances by moist air currents. If the spores land on susceptible onion tissue, the temperature is 50° to 54°F (10° to 12°C), and the onion foliage is wet, they germinate in 1.5 to 7 hours. Infection, disease development, and reproduction are favored by cool, humid, overcast weather with frequent heavy dews, fogs, or light showers.

A complete disease cycle from infection to sporangiospore formation (Figure 1), can be completed in 11 to 15 days. Sporangiospores cannot withstand desiccation and quickly die when confronted with dry weather. If favorable environmental conditions persist, however, several cycles can occur producing an epidemic.

After the sporangiospore cycles are completed, oospores are formed in the tissues of infected plants. The oospores are capable of withstanding most adverse weather and soil conditions and serve as the primary survival (overwintering) structures, remaining viable in the soil for 4 or 5 years. They also provide a source of genetic diversity for the fungus since they result from sexual (meiotic) recombination.

BOTRYTIS LEAF BLIGHT

Botrytis leaf blight, also sometimes called tip and leaf blight or tip dieback, is caused by two species of the fungus *Botrytis* and occurs in two phases, leaf fleck and blast. Leaf fleck is caused by both *Botrytis cinerea* and *B. squamosa*. This phase is characterized by the appearance of white to light tan flecks or spots (lesions) on the leaves which are mostly less than 0.25 inch in length (Figure 4). Most lesions have greenish halos that may appear to be water-soaked. The surface of leaf tissues near the spots is typically silvery in appearance. Spot centers tend to become sunken and straw colored. These symptoms are often confused with thrips injury, downy mildew, drought, or excessive soil moisture.

Figure 4. Onion leaves with leaf fleck caused by Botrytis cinerea.

The second phase, blast, is caused only by *B. squamosa*. The fungus invades the onion leaf from the initial infection site (fleck) causing the foliage to turn light tan and then brown, collapse, and die within 5 to 12 days after the flecks are observed (Figure 5). The foliage in entire fields may be killed ("blasted"). Premature death of the foliage results in immature and undersized bulbs. The necks also dry improperly, providing entrance for Botrytis neck rot and other fungi.

Figure 5. Leaf blight or blast of onion sets caused by Botrytis squamosa..

The *Botrytis* fungi can only infect onion leaves that are wet. A source of this free moisture is condensation, which forms on the leaf surfaces when long (16 hour), warm days (75° to 85°F or 24° to 29°C) are followed by short (8 hour), cool nights (54°F or 12°C). At least a 24-hour period of close to 100 percent relative humidity is required for the leaf fleck phase to develop. Progression into the leaf blight or blast phase requires temperatures above 80°F (27°C) and prolonged wet weather. Lesion production and blighting are usually more severe on older than younger leaves. Leaf blighting increases as the length of the condensation or dew period increases. During dry weather, when the leaves are wet only from dews at night, disease development is restricted to the production of leaf flecks, and leaf blighting is minimal. During prolonged wet periods the numbers of lesions, as well as the amount of leaf blight, greatly increase.

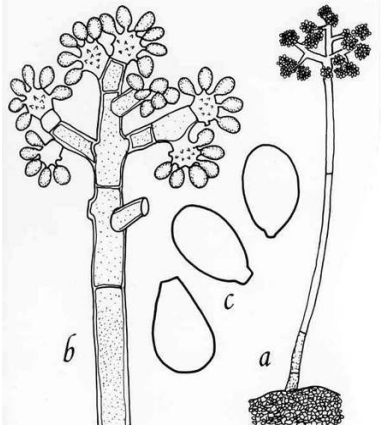

Figure 6. Botrytis cinerea, the cause of leaf fleck of onion, as it would appear under a high-power microscope. (A) Tall conidiophore developing from a sclerotium and bearing grapelike clusters of conidia at its apex; (b) close-up of a conidiophore bearing conidia; (c) conidia. (Drawing by Lenore Gray).

Botrytis cinerea cannot invade healthy tissues. It merely causes flecks by producing pectolytic enzymes when microscopic spores (conidia) germinate on an onion leaf. *B. squamosa*, however, can invade the onion leaf by enzymatic action following lesion formation. *B. squamosa* grows intercellularly and on the inner surface of the onion leaf. The leaves wither soon after the primary symptoms (leaf flecks) appear because the fungus has the ability to grow rapidly in the inner leaf environment.

Botrytis also infects onion leaves through leaf spots caused by ozone pollution. Botrytis will often show up after lightning storms or periods of high air pollution because of the resulting ozone damage.

The causal fungi generally overwinter as mycelium in onion cull piles or leaf debris in the soil, and as small, hard, black bodies (sclerotia) in soils recently cropped to onions and in onion seed-producing fields. The sclerotia germinate in moist weather to produce gray masses of conidia (Figures 6 and 7). These spores are carried by air currents, splashing rains, tools, insects, clothing, and so on to onion leaves, where they

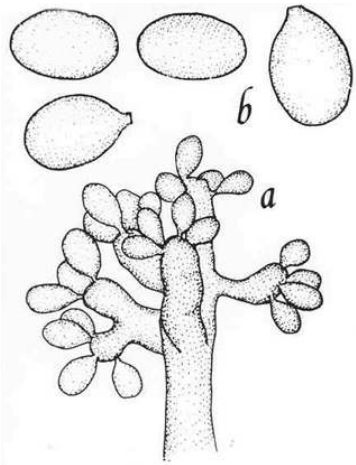

Figure 7. Botrytis squamosa, the cause of Botrytis leaf blight and small sclerotial neck rot of onion, as it would be seen under a high-power microscope. (A) Conidiophore bearing conidia; (b) conidia. (Drawing by Lenore Gray).

germinate and penetrate the leaf in warm, humid weather. Conidia are produced on the resulting lesions, and serve as a source of secondary inoculum. High numbers of conidia are released following 2 to 3 days of moderate (53° to 68°F or 12° to 20°C) temperatures.

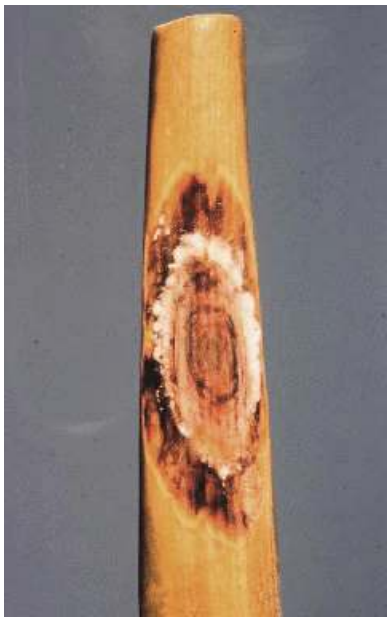

Figure 8. Close-up of purple blotch lesions on onion leaves. Note the dark and light zonation caused by fruit of the Alternaria porri fungus.

PURPLE BLOTCH

Purple blotch is caused by the fungus *Alternaria porri* which commonly follows injury produced by downy mildew and Botrytis leaf blight infections. Besides common onion, the Egyptian onion, Welsh or Spanish onion, garlic, leek, false shallot, and possibly other members of the onion family may become infected. Yellow Globe cooking-type onions are less affected than Sweet Spanish types.

Purple blotch first appears as small, whitish sunken lesions. Almost immediately, the spots turn brown, enlarge, become zoned, somewhat sunken, and more or less purplish (Figure 8). The lesions occur on the leaves, flower stalks, and floral parts of seed onions. The lesion borders are reddish and surrounded by a yellow "halo." If conditions are favorable for disease development, the lesions quickly girdle the leaves and seed stems. Affected leaves and stems may turn yellow, die back, collapse, and die within several weeks after the first lesions appear. In moist weather, diseased tissues are covered with a dense, dark purplish black mold composed of large numbers of microscopic, dark multicelled spores (conidia) (Figure 9). The conidia are carried to other onion leaves by air currents, splashing rains, tools, and so on. When the spores land on susceptible onion tissue they germinate in a film of water, and the germ tubes penetrate the stomates or penetrate directly through the epidermis. Early symptoms can appear 1 to 4 days after penetration has occurred. A new generation of conidia may be produced every 5 days in warm, moist weather. Infection, reproduction, and spread of the disease may follow in rapid succession as long as favorable conditions persist. Free moisture, in the form of rain, persistent fog, or dew, is required for infection and spore production. Mycelial growth of the *Alternaria* fungus occurs over a temperature range of 43° to 93F°–6° to 34°C–(optimum 77° to 81°F or 25° to 27°C) at a relative humidity of 90 percent. Almost no infection occurs below 55F 924C).

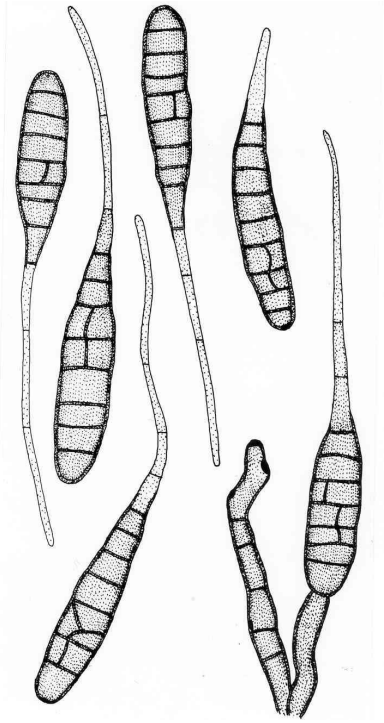

Figure 9. Alternaria porri, the cause of purple blotch of onion and other Allium species, as it would appear under a high-power microscope. Two short conidiophores, one bearing a multicellular conidium at the tip, and typical "long-tailed" conidia. (Drawing by Lenore Gray).

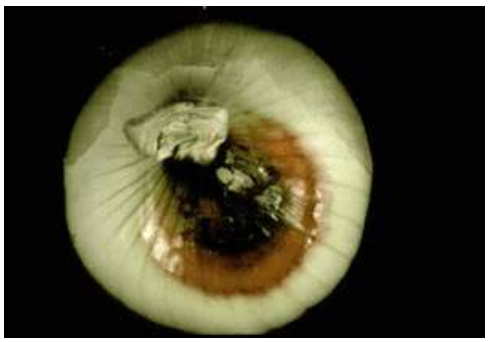

Figure 10. Alternaria bulb rot. The black mold is composed largely of Alternaria porri spores.

Onion bulbs become infected at harvest or later in storage through the neck or through wounds in the fleshy bulb scales. The rot is first semiwatery and a deep yellow but gradually turns

a wine-red, finally becoming dark brown to black (Figure 10). Often only one or two outer scales are affected. Diseased bulb tissue gradually dries out and becomes "papery." Sweet Spanish onions are very susceptible, while varieties with waxy foliage have some resistance.

CONTROL OF DOWNY MILDEW, BOTRYTIS LEAF BLIGHT AND PURPLE BLOTCH

1. Plant only disease-free seed or sets in well-drained soil, away from windbreaks and other obstructions, where air circulation is good. Treat seed with hot water or a fungicide before planting.

2. Where feasible, grow onions and related crops in the same area or field only once in four years.

3. Where possible, eliminate onion cull piles and collect and burn or cleanly plow under all remaining plant debris after harvest. Isolate onion seed fields as far as possible from onion crops.

4. Eradicate weeds, particularly those in the onion family.

5. Avoid overcrowding and overfertilizing with nitrogen. Fertilizer use should be based on a soil test.

6. Fungicides are available for controlling all the fungi that cause these diseases. For current recommendations, refer to Circular 1373, Midwest Management Guide for Commercial Vegetable Growers. To obtain control add a commercial spreader-sticker at the rate of 2 to 5 ounces per 100 gallons of spray (1/4 to 1/2 teaspoonful per gallon). Apply sprays at 5- to 7-day intervals during cool, rainy weather and stretch the spray interval to 10 days in warm-to-hot, dry weather. Dusting is inferior to spraying and should be used only in an emergency. About twice as many dust applications as sprays are needed to get the same degree of control. Where possible, make fungicide applications just before rainy periods when the majority of infections occur. Carefully follow the manufacturer's directions regarding amount o use and the interval between the last spray and harvest. Four to ten applications may be needed during the season. Start when the plants are 3 to 5 inches tall (or the first ozone alert) and continue until the tops dry down.

7. Controlling insects will prevent wounding and additional sites for infection, particularly by *Botrytis* and *Alternaria*. Onion maggots, thrips, cutworms, and other insects can be controlled with insecticides. For current information concerning these insects and recommendations for their control refer to Circular 1354, Illinois Homeowner's Guide to Pest Management.

8. There are a few onion cultivars with resistance to downy mildew, but none are available with resistance to Botrytis leaf blight or purple blotch. However, cultivars suggested for growing in Illinois will reduce any stress-related losses to disease. Consult above mentioned publications, current seed catalogs and trade publications for recommendations.

The publications mentioned above can be obtained from your nearest Extension office or ITCS, University of Illinois P345, 1917 S. Wright St., Champaign, IL 61820.