Alternaria Diseases of Crucifers

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Cause and Symptoms

Alternaria leaf spots of cruciferous crops are common in Florida. The leaf spot phase reduces plant vigor and renders the crop unsalable or unuseable where leaves are the edible portion of the plant. Besides the leaf spot phase, edible flower parts of broccoli heads, cauliflower curds, seedlings, and flower parts related to seed production can be diseased. In Florida, the leaf spot phase is the most common aspect of these diseases.

In Florida, cabbage, cauliflower, broccoli, collards, turnips and mustards are infected commonly. Kohlrabi, Brussels sprouts, kale, Chinese cabbages (including Napa and bok choy), rape and other crucifers are susceptible.

Alternaria diseases of crucifers in Florida are caused by three fungal species, *Alternaria brassicicola, A. brassicae,* and *A. raphani.* In addition, *A. herculea, A. olercea,* and *Macrosporium* sp. are names of fungi identified as causes in locations outside of Florida. Even if the former three species are the only ones involved in Florida, a diverse array of pathogens must be considered when establishing control measures. Alternaria leaf spots of crucifers are occasionally referred to as black leaf spot, gray leaf spot or dark leaf spot depending on what fungus species is involved. Because species identification cannot be done reliably by symptom expression, such a classification will not be utilized in this publication.

Alternaria species that cause disease in cruciferous plants can be seedborne via mycelium within the seed or transitory spores on the seed. Low vigor, shriveled and dark-spotted seed are the first symptoms associated with these diseases. Such seed is difficult to identify because other factors can cause similar symptoms and seed treatments may mask seed coat appearance. Pre-emergent or post-emergent seedling blight can be caused by these *Alternaria* species. Pinpoint dark spots on the young stem may enlarge and kill the seedling. Stem lesions may enlarge only to a size sufficient to debilitate the plant, resulting in substandard produce size. Stem lesions may be confused with those caused by Rhizoctonia or other pathogens. Seed leaves (cotyledons) can be infected, resulting in dark brown to black, circular to semicircular or somewhat elongate spots on the underneath side of the cotyledon. In Florida, seedling infections with *Alternaria* species occur but are not common.

Leaf-spotting is the most common aspect of these diseases. Petioles (leaf stems) display elongate dark spots when infected. Such lesions can be confused with black speck, a disease of unknown origin and common on petioles of Chinese cabbage types. Spots on leaf blades

vary in size from pinpoint-size dark circular spots, when young, to black, brown or tan spots 2 to 3 inches (5 to 7.5 cm) when older (Figs. 1 & 2). Leaf-spotting on margins of leaf blades (Fig. 4) can be confused sometimes with black rot symptoms (see PP Fact Sheet No. 13). A yellow halo around brown lesions on the leaf margin are more indicative of *Alternaria* leaf spot rather than black rot (Fig. 4). Yellow halos may or may not surround leaf lesions (Figs. 2, 3, 4, & 5). Sometimes the leaves will have a purplish cast. Larger spots may have a dark green-black coloration of fuzzy growth in the spots, usually concentrated in the center (Fig. 3). This fuzzy and dark growth consists of the fungus spores (conidia) and spore stalks (conidiophores). The fuzzy-dark growth may be interrupted, forming concentric rings within the leaf spot (Figs. 2, 3, & 4). This is a result of interruptions in favorable weather for spore production. For example, as the fungus grows within the leaf periodically in response to temperature and moisture conditions, spore stalks and spores are produced. Usually, spore production occurs at night and spore release occurs during the day but if long periods of overcast weather occurs spore production can be constant, rather than interrupted, resulting in solid masses of fuzzy growth rather than concentric bands. Host nutrition and the species of *Alternaria* can influence the presence or absence of concentric bands. *Alternaria raphani* has been reported to cause smaller lesions with sparse, non-zonate fuzzy growth.

Spotting of broccoli heads and cauliflower curds (sometimes referred to as brown rot) appears as brown-black discolorations and should be expected if the leaf phase of this disease is uncontrolled in the vicinity. Because heads and curds can be infected by other organisms (bacteria and fungi), laboratory diagnosis should be relied upon for these disorders. Often, infections of curds by *Alternaria spp.* are accompanied by soft rot bacteria which liquify the tissue. Such is most likely to occur in the field or in storage at temperatures above 82°F.

Roots of turnips can be infected, especially after harvest, if the leaf spot phase was uncontrolled in the field. Root spots of turnip are nearly circular, zonate and are various shades of brown-black. Wounding of turnip roots promotes infection. Root spots can extend into the center of the turnip root and are firm in texture. In Florida, a soft musky rot caused by soft rot bacteria is common on turnip roots whereas "dry rot", caused by *Alternaria* has not been of any consequence.

Where seed production of crucifers exists, flower infection is another important aspect of this disease and relates to seed infection. Flower stalks, flower parts and pods (siliques) are susceptible tissue. Dark elongate-circular spots occur on flower petals, pedicels (pod stalks) and calyces. Pods are distorted, prematurely dried and prone to shattering. Seed may not form within infected pods or those that do can be shriveled or blemished. Spore production on infected pods may not occur.

The species of *Alternaria* causing disease on cruciferous plants can survive on or in crop debris, seed and possibly weed species in the crucifer family. Spores are produced on old crop debris and leaf spots. In culture, optimum temperatures for spore production are between 75° to 82°F for all three species. Spore production is low below 61°F and above 82°F. However if leaf wetness is prolonged for 20 hours or more, *A. brassicicola* is capable of producing many spores outside the optimum range of temperatures. *Alternaria raphani* produces fewer spores than the other two species (*A. brassicae* and *A. brassicicola*).

Spore production occurs predominately at night or during long overcast periods. Spore production has been observed to be greater in yellowed leaves. Spores are released during the day as the relative humidity diminishes. Movement of equipment or work crews in the field and wind aid in spore release and spread.

Spores have been trapped more than one mile down wind immediately after a crop with *Alternaria* leaf spot was harvested.

After landing on susceptible plant tissue, spores of *Alternaria* are durable enough to remain there until free moisture in the form of dew, rain, or irrigation water occurs at which time the spore germinates. Spore germination of *A. brassicae* and *A. brassicicola* occurs between 34° to 104°F with the optimum being 59° to 95° for *A. brassicae* and 91° to 95°F for *A. brassicicola*.

Penetration of host tissue occurs without wounding the tissue. Infection of cauliflower leaves can occur between 50° to 95°F with *A. brassicae* and the optimum is 82° to 88°F. Infection on cauliflower curds occurs most rapidly at 67°F with *A. brassicae* and from 77 ° to 86°F with *A. brassicicola*. Curd infection can occur between 35° to 86 °F with either species.

Much less is known about weather variables as they relate to disease-producing capabilities *for A. raphani.* However, it is most important to realize that when all three species are considered collectively they have the ability to cause disease at a wide range of temperatures.

As leaf-wetting periods lengthen, due to prolonged dew periods or heavy or frequent rains, the number of infections increases drastically and lesion size increases for *Alternaria* diseases of crucifers. Symptoms of disease can occur within one or two days after penetration especially on curds; this incubation period may take a longer period of time. It is presumed that a 7-10 day period is a typical time period from penetration to new spore production in leaf spots at favorable temperatures.

Control

A coordinated group of individual control measures into a sequential program is most effective in reducing Alternaria diseases of crucifers.

• Purchase high vigor and high germinating seed, preferably hot water-treated. The hot water treatment reduces inocula for this disease complex as well as inocula for black rot. See Fact Sheet PP-13 for specifications on this technique if you plan to do the hot water treatment.

• Seed treatment with a broad spectrum fungicide, after the hot water treatment, will reduce inocula associated with the seed and will reduce pre-emergence seedling blight caused by *Alternaria* species or other fungi.

• Where possible, do not plant cruciferous crops on the same land in succession or in successive years.

• Purchase or produce disease free transplants.

• Use a fungicide spray program during transplant production or after plants are set in the field. Begin the spray program before leaf spot occurs, if from experience or knowledge, you anticipate favorable conditions for leaf spot development. If *Alternaria* leaf spot is present in low amounts, you will still be able to control this disease by initiating a spray program consisting of multiple sprays until the crop is near harvest. If, however, you begin the spray program after the epidemic has gained momentum, control efforts are wasted because currently available fungicides are protectants; they are not therapeutic. Especially on crucifers sold for leafy greens, many individuals begin a spray program too late which results in ineffectual control and conflicts with the minimum days to harvest for which a fungicide can be applied without exceeding legal residues within the crop. If the spray program is initiated early and suppresses leaf spot throughout the early and middle part of the season, late season control will follow accordingly and fungicide residue problems are eliminated.

More frequent applications may be necessary where heavy or frequent rains occur or

where overhead irrigation is used. Ask your County Extension Agent about specifications on labelled fungicides. Read the fungicide label to determine if a spreader-sticker spray adjuvant should be used. Generally, such an adjuvant should be used on cruciferous crops with wettable powder formulations but not with flowable formulations.

Because spores are more apt to be dispersed by wind if produced in old crop residue left on surface of soil, harvested fields should be plowed shortly after harvest in a manner that will bury old crop debris. This is especially important where a succession of planting dates are near to each other.

Figure 1. Alternaria leaf spot in Collards.

Figure 2. Alternaria leaf spot in Cabbage.

Figure 3. Alternaria leaf spot in Cauliflower.

Figure 4. Alternaria leaf spot in Cauliflower.

Figure 5. Alternaria leaf spot in Collards.