Anthracnose of Dry Beans

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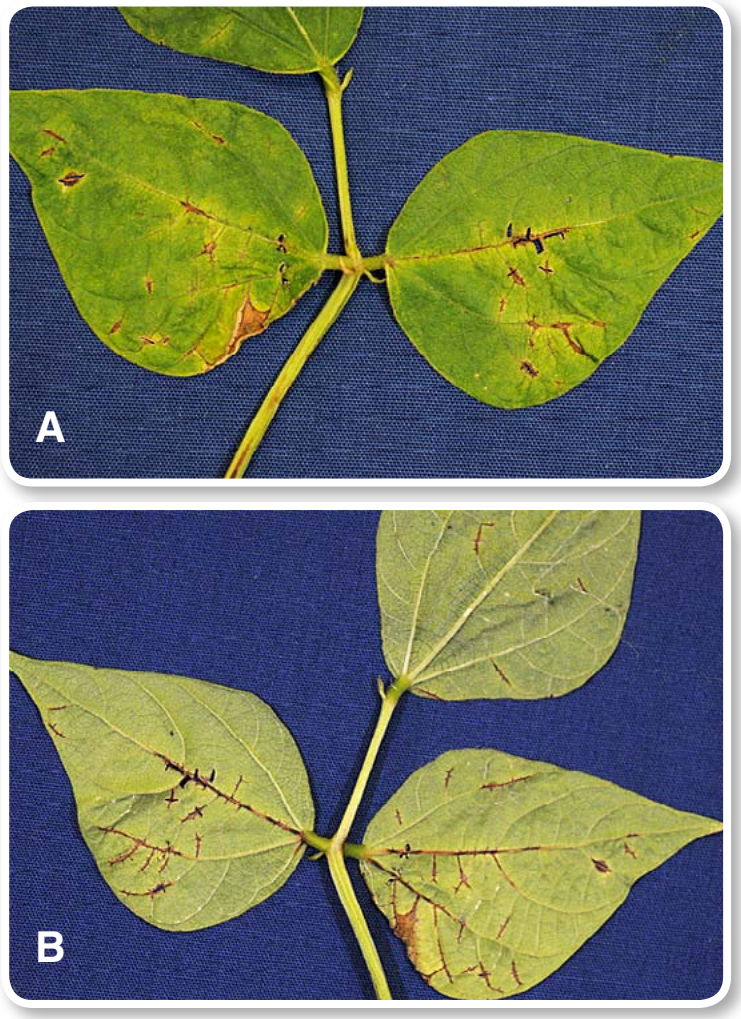

Figure 1. Early infection of anthracnose on A) top side and B) underside of a bean trifoliate.
(Photos by Sam Markell)

Anthracnose is an economically damaging disease of dry beans that can cause significant levels of seed discoloration and large reductions in yield. The disease is readily transmitted from infected seed to seedlings, which will result in fieldwide epidemics that can spread to nearby fields when the environment is favorable for infection and spread. Because infected seed is not always discolored, the use of certified disease-free seed is critical for management of anthracnose. Further, the disease is difficult to control with foliar fungicides and seed treatments, and the pathogen can develop new races that overcome genetic resistance, making prevention the best disease management strategy.

Anthracnose first was identified in North Dakota in 2001 but was infrequently observed until 2010, when the disease was confirmed in Wells County. In 2011, anthracnose was identified in Wells, Eddy and Ramsey counties. In a year-end survey of dry bean fields in the region, anthracnose was detected in more than 20 percent of surveyed fields, with severity ranging from minor to near total crop loss. In neighboring Manitoba, anthracnose has occurred in eight of the past 10 years, often at economically damaging levels. Unless improved management practices are adopted, the disease likely will become a recurring problem in North Dakota as well.

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Figure 2. Close-up of an anthracnose lesion on a leaf vein. (Photo by Sam Markell)

Figure 3. Lesion of anthracnose on bean petiole. (Photo by Sam Markell)

Cause

Anthracnose is caused by the fungal pathogen *Colletotrichum lindemuthianum*. Different races of the pathogen exist, and several have been identified in North Dakota. The pathogen has a narrow host range and does not infect soybeans or other commonly grown crops in North Dakota. However, anthracnose will cause disease on all classes of dry edible beans, as well as Mung beans, cowpeas, fava beans and several other beans not commonly grown in our region.

Signs and Symptoms

The pathogen can cause infection on all above-ground parts of dry bean plants. Anthracnose symptoms are most recognizable on the leaves. Symptoms are more severe on the underside of the leaf and appear as dark brown-black, slender lesions that follow the leaf veins (Figures 1A and B, 2). Older lesions may appear sunken and can occur on both sides of the leaves. On petioles and branches, lesions are brown-black and are commonly slender to oval-shaped (Figure 3).

When the pathogen infects the pods, the lesions will appear as circular and sunken cankers about 1/8 inch in diameter, although the size of lesions can vary significantly (Figure 4). The margins of the cankers are a slightly raised, well-defined black ring often surrounded with a thin red-brown halo. The interior of the lesion will appear light to dark brown. When lesions are wet for a prolonged period of time, white to salmon-colored spore masses may appear as ooze in the center. When spore masses dry, they may appear as gray to black grains of sand.

When pod infection is visible, the seeds likely are infected as well. When seeds are infected early in their development, they may be shriveled and discolored, and have dark brown to black cankers (Figure 5). When moist, white fungal growth may be visible on infected seeds. When seeds are infected at the end of their development, they may not express any visible symptoms. For this reason, clean-looking seed harvested from a field with even a low amount of anthracnose should be assumed to be infected and never used for planting.

Distribution of anthracnose throughout a field may be related to the inoculum source. When inoculum comes from infected seed, the disease often appears uniform in the field. In a favorable environment, severity may appear to increase quickly and a complete crop loss is possible. When the pathogen moves into a field from somewhere else (blowing spores, machinery, etc.), infection is often less uniform (for example, a localized spot or edge) and less severe, and usually will not be observed until later in the growing season.

Figure 4. Sunken and necrotic lesions of anthracnose on bean pod. (Photo by Sam Markell)

Figure 5. Lesion of anthracnose on navy bean seed. Note broad discoloration, sunken necrotic lesions and white fungal growth. (Photo by Sam Markell)

Disease Cycle

Anthracnose is introduced into fields through infested seed, overwintered infested crop residues, movement of spores on contaminated equipment and, over short distances (for example, from an adjacent field), by wind- or splash-dispersed spores. The pathogen is able to overwinter on infested residue for up to two years and can survive in infected seed for up to five years

Infections resulting from infected seed may be apparent at emergence, while infection occurring from residue may not appear until conditions are favorable. Free moisture on the plant surface is needed for spores (conidia) to infect the plant and cause a lesion. Fungal structures (acervuli) will form in the lesion and release spores in a mucilaginous ooze. Under favorable environmental conditions, the time from infection to production of new spores is seven to 14 days.

Spores primarily are splash-dispersed and most will spread only a short distance (5 feet or less) in gentle rain storms. However, they can spread much farther when wind-driven rain occurs. When wet, the spore ooze can be sticky and can be moved through a field on humans or machinery.

Frequent rainfall is the most critical environmental factor needed for the development and spread of anthracnose. Free moisture is needed for spore release and infection, and splashing is needed for spore dispersal. Cool to moderate temperatures (55 to 80 F) are favorable for disease development. Temperatures above 85 F temporarily will stop fungal growth, which resumes when temperatures cool. Temperatures in North Dakota are not often limiting for disease progression and are unlikely to impact management strategies.

Management

Prevention is the key to effective management for anthracnose.

Clean Seed – The most important prevention and management strategy is to use certified clean seed.

If you have *any* anthracnose in your field, **never** use the harvested seed for planting. Infected seed can be symptomless, and fungicide seed treatments do not eliminate seed-to-seedling transmission. Although data on the efficacy of seed treatments are limited, results from Canada suggest that commonly used seed treatments such as Apron Maxx (fludioxonil + mefenoxam), captan, thiram and Dynasty (azoxystrobin) do not confer satisfactory control.

Even if anthracnose is not observed, planting bin-run seed is still risky. If anthracnose is introduced into a field at low levels, the weather is unfavorable for disease development that season and/or anthracnose is introduced late in the season, the disease may go undetected. In all of these cases, the occurrence of anthracnose may be limited to a few isolated spots in the field, and disease severity may be low. However, even low levels of anthracnose result in infected seed. If the seed is planted, disease levels almost certainly will be higher the subsequent year.

Rotation – Anthracnose has been shown to overwinter on crop residues in other regions. It can survive on infested residue for up to two years, although persistence of the pathogen may be longer in dry environments. If anthracnose is found, dry beans should not be planted for three years (a four-year rotation). Additionally, dry beans should not be planted into fields adjacent to a field infected in the previous year. Although no firm

recommendations on planting distances exist, the further a crop is from infested residue, the less likely the new crop is to become infected. Keep in mind that spores do not travel great distances, but infection can occur from as far away as infested residue can move.

Limit Field-to-field Spread – If infection is found in a field, limiting the field-to-field spread of the disease is very important. Spores may attach to equipment as a sticky ooze and be spread throughout a farm. Power-washing equipment to remove debris likely will remove most of the inoculum, but if you suspect anthracnose in a field, cultivate, spray and harvest that field last. Also, stay out of that field while it is wet (morning dew, after rain). Data from Canada suggest that the risk of anthracnose spreading is particularly high after rain events exceeding 0.39 inch, and extreme caution is advised after such rain events.

Resistance – Genetic resistance to the pathogen is a critical management tool. However, different races of the pathogen exist and can change through time. Periodic evaluation of cultivars for their resistance to anthracnose is conducted at NDSU, and some seed companies may know the races of the pathogen to which their cultivars have resistance. Make sure to consult the most recent information when considering resistance as a management tool.

Seed Treatments – Fungicide seed treatments reduce but do not eliminate the incidence of seed-to-seedling transmission from infected seed. The pathogen is harbored beneath the seed coat, which means that obtaining satisfactory control with a seed treatment is difficult. Some evidence suggests that seed treatments reduce the initial severity and can delay the onset of an epidemic that results from infected seed, but they cannot be relied upon for preventing disease transmission.

Tillage – Utilization of tillage as a management tool for anthracnose provides mixed results. Tillage of infested residues will reduce the risk of disease transmission to dry beans planted in adjacent fields the subsequent year. With fewer residues remaining on the soil surface, less disease transmission occurs to the new crop, and fewer residues are available for wind-borne dispersal to adjacent fields. However, the pathogen persists longer when buried in the soil, and when subsequent tillage operations bring the buried residues back to the surface, disease transmission can occur from the previously buried residues. Research conducted in upstate New York suggests that *C. lindemuthianum* can persist for one year on residues that remain on the surface but for up to two years on residues that are buried.

Foliar Fungicides

Data from Manitoba suggest that Headline (pyraclostrobin), when applied at 6 fluid ounces per acre, may be a useful tool for reducing, but not eliminating, anthracnose. Appropriately timed applications of Headline did not confer complete control of anthracnose, but they reduced seed discoloration to between three-quarters and one-quarter of the level found in the nontreated check and increased yields by approximately 10 to 50 percent.

The most consistent results were obtained by applying Headline twice: once at early bloom and then again at late bloom. Nearly equivalent results were obtained by an appropriately timed single application of Headline, but the optimal timing – either early bloom or late bloom – differed between sites and years that the experiment was conducted, and how to choose the appropriate timing in a specific situation or year was not immediately clear.

Very little additional data are available on the efficacy of fungicides to control anthracnose on dry beans. Testing conducted in the greenhouse suggests that Quadris (azoxystrobin) and Topsin/generics (thiophanate-methyl) may have some efficacy but that Dithane (mancozeb) and Bravo WS (chlorothalonil) may be less effective. No data are available on the efficacy of other fungicides commonly used on dry beans, including Endura (boscalid), Folicur/Tebuzol (tebuconazole) and Proline (prothioconazole). In all cases, foliar fungicides are likely best as preventative applications.

This publication is based in part on publication PP-1233, “Anthracnose of Dry Beans,” by L. del Rio and C. Bradley, 2002.

For more information on this and other topics, see www.ag.ndsu.edu

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