

Picture Tour: Dry Beans Diseases

Saginaw Valley Research and Extension Center
agbioresearch.msu.edu

Images of: Blight · Root rot · White mold · Common Mosaic virus · Leaf spot · Rust · Anthracnose

BLIGHT

Common Blight

Bacterial blight is a key pest of dry beans in Michigan. It is a collective term used to describe the symptoms on beans caused by one or more species of bacteria. Plant infection occurs through natural leaf openings, or through wounds created by hail, blowing soil particles, sucking insects, or mechanical injury. Pod infection occurs rapidly, after which immature seeds are invaded by the bacteria.

Common and Fuscous blight symptoms include small water-soaked spots on the underside of leaflets that enlarge and merge, becoming dried and brown. A narrow, bright lemon-yellow border of tissue often encircles the lesion. Infected pod symptoms include circular water-soaked spots and yellow masses of bacteria seen in their centers, when the spots dry they become reddish-brown sunken lesions. Early pod infection may cause shriveled seeds as well as yellowing under the seed coat. Spread from plant to plant is very rapid and warm weather favors infection.



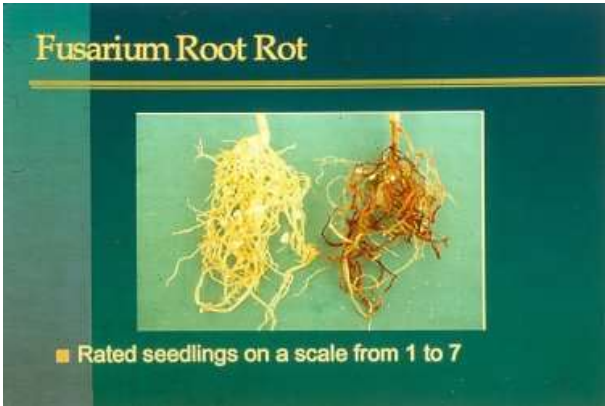
ROOT ROT

Fusarium Root Rot

Root rot is a key problem for Michigan growers. Fusarium root rot initially appears as red to reddish brown streaks (lesion) on the hypocotyl and primary root (tap root) 2-3 weeks after planting. These affected areas enlarge with age, many merge and gradually become brown. These symptoms may extend up the main root and hypocotyl to the soil surface, and longitudinal cracks can develop in older lesions. Severely infected primary and secondary roots are commonly killed but can persist on the plant as dried remnants. Lateral roots can develop from the hypocotyl above the initial infection site if sufficient soil moisture is available. Plants are seldom killed by the fungus, but may be stunted with yellow leaves.

Root rot severity depends on factors such as cropping history, plant spacing, moisture and temperature stresses, and soil compaction. In general, any factor which contributes to a reduced rate of root growth increases the plant's susceptibility to Fusarium root rot. Early planting in cool, moist soil favor the disease, as does soil compaction in the form of tillage or hardpan layers. Improper cultivation, other soil-borne pathogens, and various herbicides are also know to induce injury of young roots and aggravate Fusarium root rot damage. The effect of Fusarium root rot is usually more apparent during blossoming and early pod set when the plant and its productivity are most sensitive to stress.

Certified seed of Fusarium root rot tolerant or resistant varieties is recommended. Rotation of beans with non-host crops such as corn, wheat, barley, or alfalfa will usually reduce root rot severity. Plants are spaced within the row to reduce plant competition for water. Soil is tilled around the base of infected plants to enhance lateral root development above infected portions of the hypocotyl.



WHITE MOLD

White Mold

White mold is a key pest of dry beans in Michigan. White mold infections initiate at the flowers and enter the stem. Stem infection causes that part above the point of infection to wilt and die. Affected stems appear bleached and dry which differs from the tan color characteristic of mature, dry plant tissue.

Certified seed of recommended bush or upright type varieties is planted if land has a history of white mold. Rotation for at least three years to non-host crops such as sugarbeets, corn, sorghum, barley, and other small grains is recommended to reduce the number of white mold sclerotia. Growers use recommended plant populations and row widths to promote rapid drying of the plants and soil surface after rain or irrigation, especially immediately before and during the flowering period. Apply only the recommended amount of fertilizer where needed to avoid excess canopy development. Irrigation is scheduled only as required by the crop for satisfactory growth since disease development depends on a moist soil surface beneath the plant. Late in the season the only way to slow down a white mold epidemic is to extend irrigation intervals or cease irrigating.

Because white mold is not a problem every year, but only when there is abundant rainfall and an extensive canopy cover, chemical control may not be advisable as a normal management practice. However, chemical control can be effective when the chemical is applied before the infection has occurred or if the chemical adheres to the plant for a considerable period of time. Chemical applications can also be effective if the chemical penetrates the canopy and reaches the flowers, which are the most important sites of initial infection. These conditions require that the timing of sprays be adjusted so that a maximum number of flowers are protected by a chemical that moves into the canopy before the canopy closes. Spraying is done between the onset of flowering and peak bloom. The timing of chemical applications is critical.



White Mold Sclerotia

Hard, black, irregularly-shaped resting structures (sclerotia) of the fungus form on and within the infected plant parts. Sclerotia which fall to the soil during harvest, germinate the following season as small (1/4 inch or 6 mm diameter) beige-colored mushroom-like structures (apothecia) which release spores that are spread to dead blossoms or leaves. These spores germinate on and utilize this dead tissue as an energy source before the fungus invades healthy tissue.



COMMON MOSAIC VIRUS

Common Mosaic Virus (BCMV)

BCMV can cause a systemic mosaic or darkening (necrosis) in infected plants, depending on the variety and its genetic background. The systemic mosaic symptom occurs in susceptible plants infected by the virus. Symptoms appear as green to bluish-green mottled or mosaic pattern on leaves which usually exhibit a downward curling or cupping. This mosaic symptom is often associated with and follows the network of leaf veins which become slightly darker than the areas between the veins. This symptom can sometimes be more easily observed by shading the leaf from direct sunlight. Severe, early infection can greatly reduce plant vigor and productivity, and increase seed transmission. Plants infected early in the growing season or grown from infected seed may have fewer pods and fewer seeds per pod than healthy plants. Plants infected through secondary means later in the season usually produce near normal yields, but a high percentage of the seed may be infected.



The systemic necrosis symptom (black root reaction) occurs in varieties with a specific gene which is being used frequently in the development of new bean varieties with more stable forms of resistance to BCMV. These varieties are resistant to all strains of BCMV under most conditions. However, when plants growing at high temperatures are inoculated with BCMV, the black root reaction may develop. The systemic necrosis begins with a slight wilting of young leaflets at any stage of plant growth, followed by a browning or

blackening of the vascular tissue and various plant parts, wilting of leaves, and eventually plant death. Discoloration of the water conducting tissue of stem and pods can be observed by making a cross sectional cut through them. The rapid wilting and death of plants prevents them from serving as sources of infection for healthy plants. However, when large numbers of plants are affected by black root, yield losses are substantial.

BCMV may be severe when susceptible varieties are grown near a virus source (i.e. infected plants in the field or nearby field) and are subjected to aphid infestations. BCMV generally does not cause serious problems east of the Rockies, unless seed stocks of susceptible varieties are badly contaminated and unusually high populations of aphids exist. Yield losses from BCMV are generally more severe when infection occurs earlier in the growing season.

Certified seed of BCMV resistant varieties is available in areas where this disease is a problem. Even a low percentage of infected seed (1-5%) can result in the introduction and buildup of new strains of BCMV in Michigan that could induce the black root reaction in resistant cultivators. Crop rotation, early planting, and deep plowing of infected fields are NOT effective in controlling BCMV, but are recommend practices for other diseases of dry beans. Adjustment of cultivation equipment and timing is important to minimize mechanical rubbing and injury of plants, especially if BCMV or any bacterial is present in the field.

LEAF SPOT

Angular Leaf Spot of Dry Beans

Angular leaf spot is caused by the fungus *Isariopsis griseola*, which overwinters in crop debris in tropical and subtropical climates. It is not know, however, whether this fungus overwinters on crop debris in Michigan. ALS attacks kidney beans and the dark red kidney bean variety, Montcalm, in particular. It does not attack other bean market classes or varieties. Symptoms are generally evident at late flowering or early pod fill. Leaf lesions, initially gray or brown, become necrotic and well defined with the typical angular shape occurring by 9 days after infection. Plant stems, petioles and branches may also be infected. Pod



lesions are oval to circular with reddish-brown centers surrounded by darker colored borders. Infected pods may contain poorly developed or entirely shriveled seeds, and the fungus can be carried on or in the seed. These symptoms should not be confused with bacterial blight. Angular leaf spot is characterized by fluffy growth of the fungus (synnemata which bear spores) in the lesions on the underside of the leaf.

Although generally rare in Michigan, angular leaf spot was a serious problem on the Montcalm red kidney bean variety in the northern production areas, chiefly Presque Isle County. The Montcalm red kidney bean is the dominant variety in northeast Michigan and, therefore, the most severely infected. It was a concern in the mid to late 1980's and was found on kidney beans in Presque Isle county this year, but the incidence was low and not considered epidemic.

Severely infected fields should be rotated out of susceptible bean crops for at least one year. Of the various commercial classes of dry beans, red kidney and cranberry are most susceptible. Until more is know about this disease, rotation to another crop is recommended.

The fungus has been identified on seed used for planting. Therefore, seed treatment with the standard combination of fungicide, antibiotic, and insecticide is recommended. Application of a fungicide to the foliage of bean plants may be beneficial if applied early. Once infections are well advanced, fungicides will be of little benefit. Fungicide spray trials have not been done in Michigan, but benomyl and thiophanate methyl reportedly control angular leaf spot. Fungicides are used only when the disease is positively identified and detected early.



RUST

Rust

Rust symptoms first appear as small yellow or white slightly raised spots on the upper and/or lower surfaces of leaves. Those spots enlarge and raise further to form reddish-brown or rust colored pustules which are about 1/8 inch (1-3 mm) in diameter and contain thousands of microscopic spores called summer spores (urediospores). Pustules may be surrounded by a yellow boarder. Spores are released from the pustule readily giving a rusty appearance to anything they contact; they fell like talcum powder when rubbed between the fingers. Severe infection results in premature leaf drop. Pod set, and especially pod fill, can be reduced if infection is sever during early reproductive development of the bean plant. Green pods, and occasionally stems, may also become infected and develop typical rust pustules. Near the end of the season, pustules undergo a subtle change and form dark brown to black winter spores (teliospores), which signify the end of the currnt infection cycles.

Rust development is favored by cool to moderate temperatures with moisture conditions that result in prolonged periods of free water on the leaf surface. Multiple disease cycles may occur at 10-14 day intervals under favorable conditions. The earlier the plant becomes infected during its development, the greater the chance for yield loss. Anything that delays plant maturity, such as hail damage, excess nitrogen, or late planting may increase the potential for significant yield losses in the event that a rust epidemic occurs.

Certified seed of varieties resistant to the prevalent races of rust in the area is used. When late planting is necessary, susceptibl varieties are avoided. Incorporation of infected bean debris into the soil after harvest and rotation with non-host crops for a least two years is recommended.

Various fungicides are available that can prevent or reduce rust infection if applied early in the epidemic and coverage is thorough. Fields aremonitored frequently during blossom and early pod development for the initial signs of rust. Effectiveness of fungicides will also depend on environmental conditions and irrigation methods. Center pivot systems and frequent rains may wash protectant fungicides off leaves before they can affect the rust spores.



ANTHRACNOSE

Anthracnose

Anthracnose is a seed-transmitted disease caused by the fungus *Colletotrichum lindemuthianum*. Although once a severe problem for Michigan bean growers, development of resistant, improved seed production and certification programs has reduced the treatment of Anthracnose. However, the disease is still found in a few fields every year and occasionally causes severe losses. Black beans are especially susceptible. In 1981 and 1994 the use of contaminated seed caused severe disease problems. There are numerous strains or races of the bean anthracnose fungus which are distinguished by their ability to attack certain bean varieties. The alpha, beta and gamma strains are found in Michigan. Disease symptoms produced by all strains are identical. The initial symptom of an infection is a dark brown to black lesion along the leaf veins on the underside of the leaves. Leaf petioles and even stems may also show this symptom. The plants may appear fairly normal until the disease is well advanced because infections are initially restricted to the lower leaf surface.

Symptoms of pod infection appear as circular, reddish-brown to near-black lesions on the pods. The spots develop a sunken center as the lesions enlarge. The center first shows brown, dead tissues which are quickly replaced by pink fruiting structures which contain the spores of the fungus. The fungus may then penetrate seeds. Such infected seeds, when planted, serve as the source of infection for succeeding crops. Because anthracnose infrequently overwinters in Michigan, infected seeds serve as the primary source of inoculum. Anthracnose development is favored by cool to moderate temperatures and prolonged periods of high humidity or free water on foliage and young pods. The pathogen can be easily transmitted to healthy plants by storms, people, and machinery moving through the field when plants are wet. Anthracnose is usually not a problem in semi-arid regions. It is important to plant treated, disease-free seed to minimize the risk of infection. Some Michigan growers use western grown seeds to control possible outbreaks of anthracnose.

A one year rotation out of beans is recommended because studies indicate the fungus may overwinter. It is recommended that fields remain clear of walking and scouting when plants are wet.



If anthracnose is found in a field, spread of the disease can be limited by the use of fungicides. A single application of benlate when disease first appears is important. However, chemical control is dependent on identifying the disease early and will be ineffective once the disease is well established. Chemical control is often erratic and satisfactory control may not be achieved.