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# Impacts of Drought on Disease Development and Management

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# Impacts of Drought on Disease Development and Management

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Drought conditions such as those that occurred in Nebraska in 2012 can impact the development of plant diseases. In general drought slows down or prevents the development of plant diseases caused by pathogens that thrive under moist conditions. However, some diseases are favored by drought. This is because when plants are stressed due to lack of moisture or excessive heat, they become more susceptible to these diseases. This article presents examples of diseases of agronomic crops favored by drought and how to manage them. Data are provided on the effect of dry or wet conditions on the profitability of applying fungicides to control foliar fungal diseases of wheat.

## Charcoal Rot Diseases of Field Crops

Charcoal rot, also known as dry-weather wilt in soybean, is caused by the fungus *Macrophomina phaseolina* and can affect corn, sorghum, soybean, sunflowers, and dry beans (for which it is has been named ashy stem blight). The fungus has a widespread distribution and wide host range. Microsclerotia (hardened fungal survival bodies) are formed inside infected crop tissue. These microsclerotia are how the fungus overwinters in infested crop debris and soil. Survival of microsclerotia is several years in dry soil but only a few weeks in wet, saturated soils. As most rotations include hosts for this fungus every year, the potential for the pathogen to be present in many fields is high and will be favored by dry conditions.

*Favorable Environmental Conditions.* Charcoal rot thrives in the hottest, driest part of the growing season. This is why it was more common in the 2012 production season. Charcoal rot develops when there is a high level of the pathogen in the soil and when plants are under stress from hot dry weather. Infection of soybean typically occurs early in the season at the emergence and early seedling growth stages. These seedling infections remain latent until environmental stresses (drought and high ambient temperatures) occur during the R1 (flowering) -R7 (mature pod) growth stages. In corn, high soil temperatures (98°F) and low soil moisture during grain fill are known to be related to higher levels of charcoal rot.

*Symptoms of Charcoal Rot.* Seedling damage has been found in soybean when infected seed is planted, but this has not been observed in Nebraska. Typically, symptoms occur after midseason during the reproductive stages of crop development. Infected plants produce slightly smaller leaflets than healthy plants and have reduced vigor. As the disease advances, leaflets yellow, then wilt and turn brown. The brown leaves remain attached to the petioles (leaf stems). A light gray or silver discoloration will be visible in the taproot and lower stem when plants are split open. Black specs (microsclerotia) will be visible in this tissue of the stem and tap root. Outer tissues will have black, dusty microsclerotia. Plants in the driest parts of the field will typically show symptoms first. Upper pods may have poor fill and general low plant vigor. In some cases, the upper one-third of the plant may have only flat pods without seed.

In corn and sorghum, internal shredding of the lower nodes will occur with dark black sclerotia being very visible when the stalks are split. Like the name of this disease, the plant will look like charcoal inside the stem and the microsclerotia will be attached to the vascular tissue strands in the stalk.

## Management of Charcoal Rot

- Seed treatments have not been demonstrated to be effective even though early season infections are common and symptoms develop at grain fill.
- Reducing plant density will reduce drought stress and reduce charcoal rot.
- Tillage does not affect this disease, as the microsclerotia will survive several years.
- Use of resistant varieties and hybrids.
- Crop rotation to non-hosts such as wheat can help reduce microsclerotia numbers.

## Aspergillus Ear Rot and Aflatoxin Contamination

Aspergillus ear rot of corn is another important disease in drought-damaged and non-irrigated fields. This disease receives attention because the fungal species that cause it (usually *Aspergillus flavus* and *A. parasiticus*), can

also produce aflatoxin, which can be toxic to animal and human consumers of contaminated grain. You can find more details on this disease and the mycotoxin, as well as how to manage stored grain to minimize contamination in grain in other articles in the CPC Proceedings:

- *Corn Disease Update*
- *Grain Storage To Minimize Mold And Mycotoxins*

### Fusarium Diseases

Fusarium pathogens are microbes which exist in soil and on crop residues for a long time. Many factors can lead to diseases caused by *Fusarium*. Plant stress, such as drought, is one of the factors that increase the incidence and severity of these diseases. *Fusarium* species have been associated with many important diseases of corn, wheat and soybean, causing significant yield losses. Drought can significantly impact these diseases. Fusarium stalk rot, ear rot, and kernel rot of corn caused by *Fusarium verticillioides* can cause significant yield losses and mycotoxin contamination under drought conditions. Wheat root diseases, such as common root rot caused by *Bipolaris sorokiniana*, and Fusarium crown rot caused by *Fusarium* spp., are also more severe under drought conditions. Early root infections by these pathogens can cause severe yield reduction in dry soils. However, drought will reduce the potential for sudden death syndrome (SDS) in soybean but can favor other Fusarium infections causing Fusarium wilt.

#### Management of Fusarium Diseases

- Minimize stress and injury by herbicides, foliar diseases, hail damage or drought
- Optimize the soil fertility level
- Minimize soil compaction
- Use fungicide-treated seed
- Crop rotation with non-host crops can reduce pathogen inoculum
- Plant resistant/tolerant cultivars

Additional information on Fusarium diseases can be found in the NebGuide “Major Fusarium Diseases on Corn, Wheat and Soybeans in Nebraska”.

### Phoma Black Stem of Sunflower

Phoma black stem is a stalk rot disease caused by the fungal pathogen *Phoma macdonaldii*. It is characterized by large, black shiny lesions that may reach several inches in length. Infection generally starts on leaves from airborne or rain-splashed conidia. The pathogen makes its way down the petiole to the point of attachment on the stem before causing the black lesions on stems.

Although moist weather shortly before and after flowering is beneficial to the pathogen, periods of stress prior to this such as drought, predisposes the plants, making the potential damage from the infection greater. The pathogen may also girdle the stems at the soil line,

causing premature maturation, reduction in head size and poor seed fill in heads. Stem infections also become more prone to lodging.

The pathogen is residue-borne, so rotation and some type of tillage will help reduce inoculum in the soil. Insect control can also limit spread since their feeding can also provide openings for the pathogen to initially infect plants.

### Root and Crown Rot Diseases of Wheat

Root and crown rot diseases in wheat are often overlooked because of the absence of obvious above-ground symptoms. These diseases are caused by several different fungi. The diseases caused by fungi in the genera *Bipolaris* and *Fusarium* are favored by dry soil conditions. Therefore, there is an increased risk for the occurrence of these diseases in the 2012 fall-sown winter wheat crop due to the drought of 2012. When seedlings are attacked by these fungi, winter survival is reduced due to seedling blights. Later in the growing season, root and crown rots develop. The fungus *Bipolaris sorokiniana* causes common root rot. The disease is characterized dark-brown to black necrotic lesions on roots, subcrown internodes, and stem bases. Discoloration of the subcrown internode is diagnostic of the disease. Several *Fusarium* species cause Fusarium foot rot and dryland foot rot. The most common symptom of Fusarium foot rot is a dark-brown lesion around the node of mature plants. Long and thin dark-brown vertical streaks are also commonly seen on the lower stem. In dryer areas, dryland foot rot may develop. It is characterized by a dark-brown lesion that girdles the entire stem base. Affected tissue becomes soft and white, and a pink fungal growth bearing orange spore masses may develop.

#### Management of Root and Crown Rot Diseases of Wheat

- When possible, irrigate fields to reduce stress due to inadequate moisture.
- Avoid excessive nitrogen fertilization. Under dry conditions, excessive nitrogen promotes vegetative growth (especially tiller formation) to levels that cannot be sustained through heading and grain-fill. The excessive growth prematurely depletes available soil water. This increases water stress which predisposes plants to severe root and crown rot diseases.
- Severely affected fields in the current cropping cycle (2012-2013) should be rotated to a non-cereal crop in future cropping cycles to reduce fungal inoculum for root and crown rot diseases.
- Damage from these diseases can further be reduced by planting pathogen-free, fungicide-treated seed.
- Planting drought-tolerant varieties can also help to reduce loss due to root and crown rot diseases.

### Management of Foliar Diseases of Wheat with Fungicides in a Dry versus a Wet Growing Season

Foliar fungal diseases of wheat are favored by moisture. They include the rusts (leaf, stripe, and stem rust) and the leaf spots such as tan spot, spot blotch, and Septoria leaf blotch. Field experiments were conducted in Nebraska in 2006 (dry year) and 2007 (wet year) to demonstrate the effects of applying foliar fungicides on disease severity, yield, yield increase, and economic returns under these two environmental conditions. In both years, the experiments were conducted at Mead, Clay Center, North Platte, and Sidney. The fungicides applied were Quilt, Headline, Tilt, Quadris, and Stratego. They were applied to winter wheat cv. Millennium at the stem elongation or the flag leaf growth stage. Table I shows

average total rainfall in the months of May, June, and July and averages of disease severity, yield, yield increase, and net return across fungicides and locations in each year.

The data show that net returns from fungicide application to control foliar fungal diseases of wheat were almost negligible in the dry year, but were substantial in the wet year. Therefore, when foliar fungal disease development is limited due to dry conditions during the wheat growing season, fungicide application may not be profitable and may actually result in a net loss.

**Table I. Summary data from experiments conducted to determine the effects of fungicides on foliar fungal disease severity, yield, yield increase, and net return in winter wheat cv. Millennium in Nebraska in 2006 and 2007.**

	<b>2006 (dry)</b>	<b>2007 (wet)</b>
<b>Avg total rain (in): May-July</b>	6	12
<b>Avg temp (°F): May-July</b>	70	69
<b>Avg disease severity (%)</b>		
Sprayed plots	2	22
Unsprayed plots	4	59
<b>Avg yield (bu/A)</b>		
Sprayed plots	44	69
Unsprayed plots	38	49
<b>Avg yield increase (bu/A)</b>	6	20
<b>Average net return (\$/A)<sup>a</sup></b>	5	76
<b>Probability of a profit</b>	0.63	1.00

<sup>a</sup>Net return was calculated based on a wheat price of \$3.87/A in 2006 and \$4.83/A in 2007.