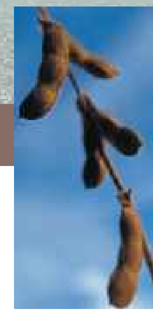

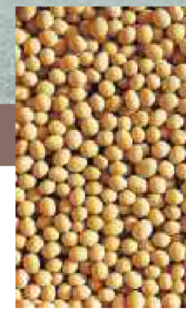

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Brown Stem Rot: Management and Variety Options

As growers adopt new management practices to achieve profitable soybean production, they run the risk of being disappointed if brown stem rot is active, but not recognized as a threat to yield potential. Resistant varieties are the foundation to a multifaceted management approach to reduce yield loss due to brown stem rot.

Brown stem rot management

Brown stem rot is a soybean disease caused by a fungus that infects roots early in the season, but over time, moves into the vascular system (water- and food-conducting system) of the soybean plant. The pathogen causes a gradual disruption of the vascular system, resulting in symptoms during reproductive growth stages of the plant. The increased incidence of brown stem rot has been attributed to an expansion of soybean acres and the common practice of having fewer years of nonhost crops between soybean crops. Yield loss is generally greatest when foliar symptoms develop, but yield loss does occur if only stem symptoms are present. Symptoms of brown stem rot are frequently confused with maturity or other late season disorders or occur at a time when soybean fields are not monitored regularly. Leaf symptoms frequently are not obvious, thus the disease is missed if stems are not inspected as the crop approaches maturity. These situations lead to an underestimation of the occurrence and yield-robbing ability of brown stem rot. Several recent discoveries have expanded the information base on brown stem rot, and management options to control brown stem rot have increased dramatically, allowing growers to minimize losses caused by the disease.

The management of brown stem rot requires knowledge of crop rotation, tillage systems, and presence or absence of soybean cyst nematode (SCN). The final component of a brown stem rot management plan is matching soybean varieties to meet brown stem rot potentials created by crop management, soil factors, and climatic conditions. Combinations of these management factors can provide adequate to excellent control of brown stem rot. Specific management practices may raise brown stem rot potential; however, advances in other control tactics can frequently counteract practices that favor the disease.

Brown stem rot pathogen survives in soybean residue

The brown stem rot pathogen survives in soybean residue. The brown stem rot pathogen does not form structures that enable it to survive for long periods in the absence of a host. Thus, crop management systems that slow the decay of soybean residue favor the survival of the pathogen. Because the

The increased incidence of brown stem rot has been attributed to an expansion of soybean acres and the common practice of having fewer years of nonhost crops between soybean crops. Yield loss is generally greatest when foliar symptoms develop compared with only when symptoms are evident inside stems. Symptoms of brown stem are frequently confused with maturity or other late season disorders or occur at a time when soybean fields are not monitored regularly.

Field scene with brown stem rot-susceptible variety on left and resistant on right.

host range of brown stem rot pathogen is limited to soybean and several other bean crops not grown in the Midwest, extended periods of cropping to nonhosts effectively lower inoculum levels of the pathogen. The rate of inoculum decline is directly related to rate of soybean residue decomposition. The incidence and severity of brown stem rot is modified by above-ground and soil environments, and crop management systems. The brown stem rot pathogen is not carried with seed and minimal amounts of inoculum is carried with soil adhering to farm equipment.

Crop rotation reduces brown stem rot

The incidence and severity of brown stem rot is suppressed effectively by two or more years of corn or another nonhost crop (Table 1). Current economic and environmental concerns are in conflict with continuous corn for two or more years as a means to control brown stem rot. However, the popular rotation of alternating soybean and corn on an annual basis is better than continuous soybean culture, but still maintains a risk of yield loss caused by brown stem rot. Other management practices, soybean varieties planted, and climatic conditions modify the risk involved with the annual alternating rotation of soybean and corn.

Tillage systems and brown stem rot

The brown stem rot pathogen survives in soybean residue and does not form long-term survival structures. This situation places importance on how soybean residue is managed. The severity of brown stem rot is frequently, but not always, greater for soybean grown in no-till systems (Table 2). Greater severity in no-till or minimal tillage systems is probably related to higher population densities of the brown stem rot pathogen. However, cool soil conditions may be a contributing factor to why brown stem rot is favored by no or reduced tillage.

Date of planting and row width

The impact of brown stem rot is greatest when the environmental conditions and management are favorable for high yield potential of soybean. The severity of brown stem rot is generally not greater in management systems using early planting dates or narrow rows. However, the yield advantage of resistant soybean varieties to susceptible varieties increases with increasing yield potential. For example, it is unlikely that yield of a brown stem rot-susceptible variety will increase if narrow rows and an early planting date are employed in fields with high potential for brown stem rot. However, in the presence of brown stem rot, a brown stem rot-resistant variety can have a decisive yield advantage over a susceptible variety if planted early and in 7- versus 30-inch row widths.

Soil pH modifies severity of brown stem rot

The severity of brown stem rot is greatest when soil pH is near 6.0 and is less severe when soil pH is 7.0 or greater (Figure 1). This conclusion is based on several years of small-plot and large-scale on-farm trials. Furthermore, the effect of soil pH is significant and modifies the effects of crop rotation and tillage on brown stem rot potential.

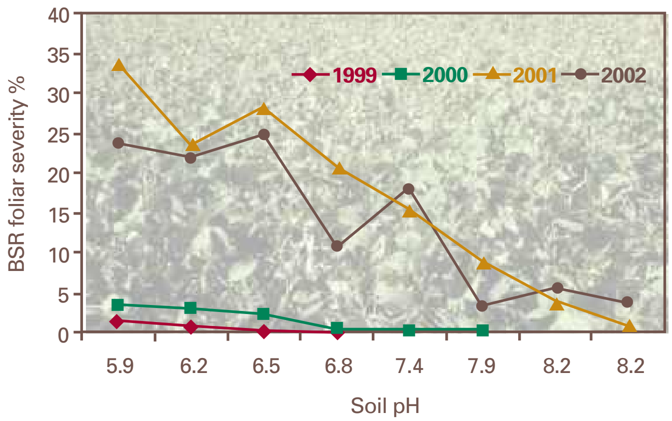

Figure 1. Severity of brown stem rot decreases with rising soil pH. Data are from 4 years of field studies in Wisconsin.

Brown stem rot-resistant varieties

The genetic yield potential of soybean varieties has increased through the efforts of soybean breeders. Much of the increased yield potential is linked to increased pod set and seed numbers. There is evidence that improved disease resistance is contributing to yield components correlated to increased yield potential. Resistance to brown stem rot is thought to be a contributing factor of greater yield potential of modern soybean varieties. The majority of yield loss due to brown stem rot is due to a reduction in seed number. Severely diseased plants lodge, which results in greater mechanical harvest loss in addition to physiological yield loss. The majority of newly released soybean varieties do not express a high level of susceptibility that was common a decade ago. Variety selection to manage brown stem rot relates to the degree of resistance needed to match disease potential. The release of brown stem rot-resistant varieties has opened new avenues of flexibility for farmers experiencing problems with brown stem rot.

Complete resistance to brown stem rot has not been reported, but several sources of partial resistance are available to soybean breeders. Thus, many soybean varieties on the market today express good to excellent resistance to brown stem rot that minimizes yield loss even in high brown stem rot potential fields. Incomplete resistance is available and results in the delay or lack of symptom expression during mid-to-late reproductive growth stages of the plant.

Soybean varieties have improved greatly for resistance to both brown stem rot and the SCN. Resistance to both brown stem rot and SCN comes from several different and independent sources. Many SCN-resistant varieties also express resistance to brown stem rot. Often, SCN-resistant varieties with resistance derived from PI88788 are also resistant to brown stem rot, but varieties with SCN resistance derived from Peking are susceptible to brown stem rot.

It has been established that brown stem rot-resistant varieties significantly reduce brown stem rot and protect yield potential. Furthermore, brown stem rot-resistant varieties are an important component of a comprehensive and long-term management plan to maximize soybean yield. There is evidence that brown stem rot-resistant varieties provide a "rotation effect" that is similar to corn and other nonhost crops (Table 3), reducing brown stem rot severity and improving soybean yield in the following soybean crop (Table 3).

Variation in severity of brown stem rot symptoms has been attributed primarily to climatic or other environmental conditions. Two strains of the brown stem rot pathogen are present in the Midwest. Strain A is a highly aggressive strain and strain B is a mild strain that causes mild symptoms. There is mounting evidence that yield loss is primarily caused by strain A. Furthermore, strain A is more commonly associated with susceptible varieties and strain B with brown stem rot-resistant varieties. The occurrence and behavior of both strains of the brown stem rot fungus is a focus of ongoing research.

Table 1. Effect of crop rotation on the severity of brown stem rot and on the yield of soybean grown in presence of brown stem rot. Data are for last crop of soybeans in each rotation.

	Disease Severity (%)		Yield (bu/acre)	
Rotation	Susceptible	Resistant	Susceptible	Resistant
CCCCCS	9	1	62	69
CCCCCSS	44	2	50	63
SSSSSSS	68	2	47	62
CSCSCS	41	1	54	64

C, corn; S, soybean.

Disease severity rated as percent of crop canopy expressing foliar symptoms of brown stem rot. Eight rotation sequences were used, four using a resistant variety and four using a susceptible variety. Disease severity and yield values are the means of 4 years of data from Arlington Agricultural Research Station, Arlington, WI.

Table 2. Effect of tillage and crop rotation on the severity of brown stem rot and soybean yield.

	Disease Severity (%)		Yield (bu/acre)	
Tillage	Susceptible	Resistant	Susceptible	Resistant
Conventional	21	1	51	59
No-till	67	2	44	55

Disease severity rated as percent of crop canopy expressing foliar symptoms of brown stem rot. Eight rotation sequences were used, four using a resistant variety and four using a susceptible variety. Disease severity and yield values are the means of eight location-years of data from 1989 to 1992 at the Arlington Agricultural Research Station, Arlington, WI.

Table 3. Effect of previous crop, corn or soybean variety, on the severity of brown stem rot and yield of soybean grown in the presence of brown stem rot at four locations in Wisconsin.

	Disease Severity (%)		Yield (bu/acre)	
Previous Crop	Susceptible	Resistant	Susceptible	Resistant
Soybean BSR resistant	69	2	43	58
Soybean BSR susceptible	92	2	39	54
Corn	43	1	48	54
LSD (p = 10%)	15	NS	4	4

BSR, brown stem rot. NS, not significantly different.
Disease severity rated as percent of crop canopy expressing foliar symptoms of brown stem rot.

Page 1 photos courtesy of the USDA Natural Resources Conservation Service (NRCS).

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