POTENTIAL FOR SOYBEAN STEM CANKER RESURGENCE IN WISCONSIN

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In the 1950s and early 1960s, stem canker was the most important soybean disease and slowed the expansion of soybean acres in the Midwest. Highly susceptible soybean varieties were discontinued and replaced by varieties less susceptible or moderately resistant to stem canker. Stem canker is regarded as a warm temperature disease and thus the climate of Wisconsin has been regarded as less conducive for stem canker. However, symptoms typical or suggestive of stem canker have increased in frequency since the late 1990's. Stem canker was observed commonly in 2003 and 2005 in Wisconsin, but was less prevalent in 2004. Stem canker is regarded as part of a stem disease complex that also includes white mold (Sclerotinia stem rot) and brown stem rot. While white mold is often very obvious, brown stem rot and stem canker are often overlooked or confused with stress related to climatic conditions or with seasonal changes in soybean growth and development. If considered as a complex, brown stem rot, white mold and stem canker occur across a range of climatic conditions that essentially ensure a high probability that one of them will be yield-limiting in a given year. Thus, the ideal soybean variety would have resistance to each disease.

Stem canker has increased in incidence and severity throughout the north central U.S. and Ontario, Canada. The recent resurgence of stem canker in the north central region has not been explained. However, likely factors are associated with reduced tillage, shortened rotation systems and changes in soybean germplasm. Additionally, the stem canker pathogen may have undergone genetic changes or related fungi may have emerged and are capable of causing similar symptoms.

Stem canker has been divided into northern stem canker and southern stem canker based on two causal agents. Northern stem canker was first reported in the late 1940s in Iowa, and by the 1950s, the disease had spread into the upper Midwest and Canada. Southern stem canker was reported in the south in 1973, and by 1984, had been detected in all southern states. Northern stem canker and southern stem canker are caused by *Diaporthe phaseolorum* var. *caulivora* and *Diaporthe phaseolorum* var. *meridionalis*, respectively. The host range of both pathogens has not been study extensively, however, over 16 weed species are known to harbor *D. phaseolorum*. Alfalfa and possibly other forage legumes are hosts to the cause of northern stem canker *Diaporthe phaseolorum* var. *caulivora*.

Symptoms

Initial expression of symptoms occurs during the early reproductive stages, with the development of a small, reddish-brown superficial lesion at the base of branches or petioles. The lesion is first observable in the leaf scar after the petiole has fallen. The lesion elongates and becomes dark brown or black, sunken in appearance and often girdles the stem. As a result of an

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uncharacterized phytotoxin produced by the fungus, interveinal chlorosis and necrosis are expressed in the leaves and is soon followed by plant death. Above and below the canker, green tissue is present and the leaves on the dead plant wither but remain attached. A top dieback can occur and results in a characteristic shepherd's crook curling of the terminal bud.

Epidemiology

The stem canker pathogen over winters in colonized stems and infected seed. Long distance dissemination of the pathogen is made possible by the movement of infested soybean residue and to a lesser extent by infected seed. Seed infection by northern stem canker can be as high as 10 to 20%. Short distance dissemination occurs in soybean fields in the spring as pycnidia (fruiting bodies) begin to develop on soybean residue from previous soybean crops. Conidia (spores) are released beginning in late April continuing into June and serve as the primary inoculum. Splashing and wind driven rain disperse spores up to 6 feet from the point inoculum source to petioles, petiole bases, stems, and leaves. The growth stage of the plant at the time of exposure to the inoculum greatly influences the incidence and severity of stem canker. Exposure to inoculum at V3 corresponds to the highest severity of disease. Disease severity is progressively reduced when first contact is delayed from V3 to V10 growth stages. Secondary inoculum is released from pycnidia present in stem cankers, but plants infected by secondary inoculum express minimal yield loss due to delayed infection. Conidia produced at this time however, contribute to the inoculum potential for future soybean plantings.

Environmental conditions during the vegetative stages govern disease development. Temperature greatly influences infection, with the highest levels of infection occurring when the air temperature is between 82 and 93°F, with and optimal temperature of 83.5°F. Temperature and period of wetness are significantly related. Rainfall during plant vegetative growth is critical for the development of stem canker epidemics. Cumulative rainfall, not the number of rainy days, is related to higher disease severity. Severe stem canker has also been observed in irrigated fields. Although rain is needed to disperse spores and is required for infection of plants, stem lesions and plant mortality have been greater in years with a dry period during later reproductive growth stages. It is this relationship with dry weather that may lead to stem canker being misdiagnosed as stress caused by a deficit of soil moisture. Frequently stem canker is most severe in low areas of fields, much like white mold, which would make less sense if plant mortality has occurred because of low soil moisture.

Yield losses have been reported to be as high as 50 to 80% in naturally infested fields. The incidence of stem canker in 2003 and 2005 was highest observed in decades and likely resulted in significant yield loss. It is difficult to assess yield loss precisely, but observations in 2005 suggest a significant inverse relationship between retention of dead leaves at harvest maturity and soybean yield (Fig. 1). Caution is advised not to attribute all retention of dead leaves at harvest to stem canker. This symptom is also associated with Phytophthora root rot, brown stem rot and white mold. Differences in stem symptoms and signs are characteristic and can aid in accurate diagnosis. Accurate diagnosis of the cause of leaf retention at harvest maturity is important because management of each of the previous diseases can be different.

Management

Stem canker is effectively managed by the combination of planting resistant cultivars and reducing infested residue on the soil surface. Deep plowing can reduce crop residue prior to planting a soybean crop. Seed for planting should not be harvested from fields with a history of stem canker. The benefits of crop rotation to reduce stem canker have not been demonstrated in production fields. Delayed planting can reduce the incidence and severity of stem canker; however, loss of yield potential that accompanies delayed planting makes this a questionable control strategy.

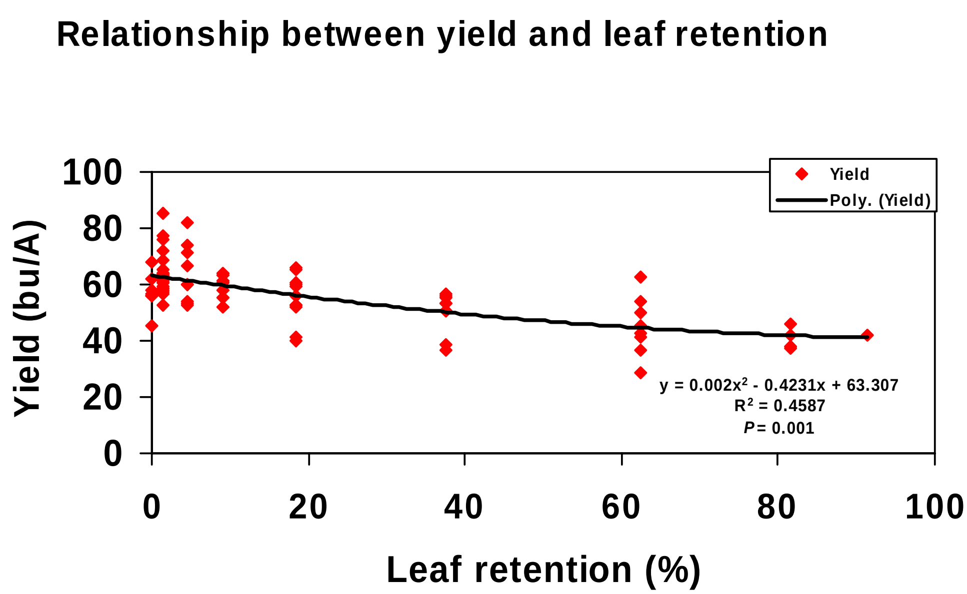

Figure 1. The incidence of retention of dead leaves at harvest maturity predicted a decline in yield in research plots located at the West Madison Agricultural Research Station in 2005. Stem canker is believed to be the cause of leaf retention.

Studies at the West Madison Agricultural Research Station in 2005 provide evidence that soybean varieties differ in reaction to stem canker. The incidence of plants with classic stem canker stem lesions was low, but leaf retention at harvest maturity was used to differentiate among a set of commercial varieties and experimental breeding lines. Less leaf retention was associated with higher yields among the soybean varieties and breeding lines (Table 1). Leaf retention at harvest maturity generally indicates that the plant dyed prematurely and suddenly at a previous growth stage. However, many companies report a reaction to southern stem canker but not northern stem canker. Northern stem canker is believed to be the predominate form of stem canker in Wisconsin. Studies are planned for 2006 to further study stem canker and how to evaluate soybean varieties for stem canker resistance in field trials.

Table 1. Performance of soybean varieties for yield and leaf retention at harvest in the presence of stem canker at the West Madison Agricultural Research Station in 2005.

Variety	Yield	Leaf Retention
	bu/a	%
Dwight	54.0	31
IA2021	60.4	8
O'SOY 211RR	56.5	18
IA 2068	54.1	21
W01-1164	57.4	10
W01-1167	58.5	6
AG2403	62.2	11
H2494	67.2	30
W02 586	51.3	16
W02 589	45.1	56
LSD p = 0.10	6.0	

Fungicides applied to seed are reported to reduce stem canker but will not completely eliminate the incidence of this disease. Foliar fungicides can be effective when applied during vegetative stages, however, results are inconsistent. The current interest in fungicides to improve soybean health and yield has focused on leaf diseases. However, there are indications that fungicides may have direct and indirect effects on stem infecting pathogens. Stem canker is a candidate for experimentation on the role of fungicides to improve soybean stem health. Although not specifically labeled for stem canker, most fungicide products registered for soybean rust and other leaf diseases would be active against stem canker. Stem canker control may be a non-target benefit from fungicides applied with the intent of improving soybean leaf health.

References

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