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report on
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SUDDEN DEATH SYNDROME OF SOYBEANS

Sudden Death Syndrome (SDS) of soybeans, caused by a strain of the fungus known as *Fusarium solani*, is becoming a common problem throughout Illinois, particularly when cool temperatures and rainy conditions occur throughout the early flowering period. Losses commonly do not exceed 10-15% of a crop, but cases have occurred where yields were reduced over 70% due to SDS. Although most cases of SDS occur in the southern half of the state, there have been reports of SDS in most Illinois counties when weather conditions favor disease development.

Figure 1. Healthy plant on right; left plant shows weak stem and discolored leaves.

The name sudden death syndrome is somewhat misleading, since the disease may take up to 14 days to fully develop. However, symptoms may not be readily apparent until the disease is well advanced and plants have actually begun to defoliate. Time from defoliation to death is short and may account for the "suddenness" of this disease.

Figure 2. Early leaf symptoms (flecking) on soybean leaves.

SDS occurs throughout the Mississippi River basin where soybeans are grown. Soybean researchers in other states have reported isolating the pathogen from soybean roots but symptoms were not consistent with those for SDS found in the Midwest. There is no clear indication at this time if the disease will be restricted northward by cold weather or if it will continue to expand into other northern or southeastern states. No environmental studies have been made at this time to fully define the range of conditions that this strain of *Fusarium* can tolerate, although other *Fusarium* species are widely adapted and can tolerate temperatures well below freezing.

Figure 3. Late leaf symptoms.

SDS can vary greatly in appearance and severity from year to year. The disease is favored by cool, rainy weather through the first half of the growing season. Hot and dry conditions limit the development of the disease but will not totally eliminate it from an area.

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Early planted soybeans tend to be more heavily damaged than later planted beans because of the more favorable conditions for infection by the Fusarium fungus early in the season. Thus, delaying planting until after soils warm and dry can help reduce the impact of the disease. Losses can also be reduced by planting full-season or late maturing soybeans. Where possible, the use of several planting periods or different maturities within a group or different maturity groups is also suggested. No pesticides have been found to control the disease. Research has also shown that SDS is far more likely to appear in a field with moderate to high populations of the soybean cyst nematode (SCN). Although there does not appear to be a direct relationship of SDS to SCN, the nematode acts as an additional stress on the plants, making them more subject to infection and colonization. Management of SCN will not eliminate SDS but can significantly reduce the levels of losses. SCN-resistant soybeans are a helpful method of reducing this major stress on the plants.

Current research indicates that soybeans may vary greatly in their response to infection by SDS. Although no varieties are yet labeled as resistant, there are a number of soybeans which yield well even when infected. Research is ongoing to determine factors in these beans which influence SDS levels.

Fusarium fungi can colonize corn and other crops commonly planted in Illinois. In addition, this fungus can exist for many years without a host crop surviving in the soil as mycelium or by colonizing crop debris. However, this survival ability does not directly relate or predict disease appearance or losses. Like many other soilborne diseases, SDS losses are greatly dependent on environment, time of infection, and the general vigor of the soybean crop.

Symptoms

SDS symptoms begin as small yellow spots on the upper leaves of the plants. These may either not be noticed or may be diagnosed as another disease. Spots gradually enlarge and develop a brown necrotic (dead) center. They continue to enlarge until all of the interveinal tissues are killed, leaving a green vein pattern on the leaf. The time involved for this symptom to develop is dependent upon the weather and the variety of soybean in the field.

Defoliation follows the development of interveinal necrosis. Petioles (leaf stems) remain firmly attached to the plant after defoliation. This may occur late in the season and be mistaken for early maturity.

Flower and pod abortion is common with SDS. Infected plants generally set some pods on the lower stem area and abort the majority of their other flowers. Lower pods may or may not fully ripen depending on the time of infection.

A diagnostic feature of SDS is found by splitting the stems lengthwise and examining the pith. The central pith should be white with no discoloration or decay. A slight browning of the vascular system lying just outside of the pith area is often seen.

SDS foliar symptoms can be confused with those of brown stem rot (BSR), another fungal disease of soybeans. Certain varieties of soybeans infected with BSR can exhibit leaf symptoms identical to those of SDS. However, brown stem rot infections produce a dark brown discoloration of the pith. BSR, favored by cool, wet weather, is commonly found in northern Illinois while SDS is more common in the south. Both diseases can be found in the central parts of Illinois. An accurate diagnosis is needed to develop control programs since BSR can be controlled by resistant varieties, not possible with SDS.

Roots may also exhibit some decay and discoloration. Nodulation is often sparse on SDS-infected plants. However, these features are commonly seen with many other root-rot diseases and cannot be considered diagnostic.

Disease Cycle

Fusarium fungi commonly survive in crop debris and as mycelium in the soil. SDS is not known to be transmitted through seed. Since the primary inoculum occurs in the soil, movement of soil or infected plant debris could transfer the disease as well.

The exact time of infection for SDS is not known, although research has shown that the causal fungus can be isolated from plant roots as early as 40 days after planting, even though symptoms do not appear until much later. Fusarium fungi commonly invade plant roots through wounds caused by insects, nematodes or mechanical injuries. Conditions favoring infection by *Fusarium* fungi are saturated soils and temperatures of 55° to 65°F, with maximum infectivity at the lower end of this range.

After colonization, it is believed that this fungus produces a toxin which is translocated to the upper leaves, causing the characteristic spotting, interveinal necrosis, and other symptoms. The fungus survives in root tissues and as mycelium and spores in the soil.

Stresses, especially those affecting root development, may increase losses due to SDS. The soybean cyst nematode, in particular, predisposes plants to infection by producing feeding wounds in the roots as well as affecting plant vigor. Research in Mississippi has also shown that the causal fungus can be isolated both externally and internally from SCN. Thus, fields with moderate to high SCN populations are much more likely to have SDS infections.

Development of SDS depends upon many factors, including planting date, variety of soybean, and presence or absence of additional stresses. Tillage does not seem to have a direct affect on SDS levels. However, since reduced tillage (especially zero-till) produces additional residue levels which may not decay during the winter and causes slower warming and drying of the soil in spring (conditions favorable to the *Fusarium* fungus), growers should be aware that these conditions can influence the level of SDS.

MANAGEMENT OF SDS

SDS is a difficult disease to manage. At present, there are no labeled resistant varieties, although many soybeans do show differences in reaction to SDS. No fungicide or nematicide will adequately reduce SDS levels in a field. Tillage does not appear to directly impact the disease, although environmental conditions favoring wet or cool soils may increase chances of infections.

Follow these guidelines to lessen the impact of SDS:

1. Learn to identify SDS in the field. Symptoms may appear much as those of other, more common, diseases.

2. Select varieties of soybeans that will mature at different times. Use either different maturities within a maturity group or use different maturity groups.

3. Extend planting times so that all beans are not at the same growth stage at the same time. However, do not wait past the suggested time for your area of the state.

4. Where feasible, improve drainage in the field and reduce soil compaction. Tiling or ditching will remove excess water and can help lessen the impact of other soybean diseases.

   Reduction of soil compaction will help drainage and also improve root growth and development, two factors that can affect SDS development.

5. Crop rotation is of limited value. SDS has been found in continuous soybeans, soybeans following one or two years of corn or milo, and in fields that had been out of beans for many years. *Fusarium* fungi can persist for many years in the soil, even without a host crop. However, continuous soybeans is **not recommended** since this can increase other diseases.

6. Control and monitor soybean cyst nematode populations. Although not directly involved with SDS, SCN populations over the suggested threshold will affect plant growth and development. Use soil sampling, resistance, and crop rotation to reduce SCN levels. Nematicides are not recommended due to handling and environmental hazards and unreliable performance.