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Figure 1. Soybean field with sudden death syndrome. This field had suddenly and prematurely begun turning yellow within a few days. (NDSU photo)

Sudden Death Syndrome of Soybean

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Sudden death syndrome (SDS) is a soybean disease primarily caused by the fungal pathogen, *Fusarium virguliforme* in the U.S. The disease was first observed in the U.S. in the 1970s but was first reported in North Dakota in 2018. Since the identification of SDS in North Dakota, the disease has been considered a minor concern. However, if this disease establishes itself within the state, the potential yield losses could be significant.

Causal Agent

F. virguliforme is a soil-borne fungus that thrives in cool (below 60 degrees Fahrenheit), wet soils. SDS is commonly thought of as a late-season disease because that is when foliar symptoms become noticeable (Figure 1). However, the pathogen infects the roots early in the growing season, typically during vegetative growth stages. During the middle to late reproductive growth stages (R3-R6), *F. virguliforme* can produce toxic metabolites that cause interveinal chlorosis symptoms. Additionally, there is a strong relationship between the presence of soybean cyst nematode (SCN) and the development of SDS. When *F. virguliforme* is present, the severity of SDS is typically more severe in soybean fields that also have populations of SCN. Due to this association and the high levels of SCN present within the Red River Valley, SDS has the potential to cause even greater yield losses.

Symptoms and Signs

Foliar symptoms typically appear in the reproductive growth stages as interveinal chlorosis (yellowing) with bright green vein tissue. The chlorosis will progress into necrotic (brown) lesions between the veins due to the death of the leaf tissue (Figure 2). Severe disease development will lead to the leaflets dropping prematurely, while the petioles remain attached to the main stems. Another symptom of SDS is the browning or bruising of the cortex tissue. To evaluate this, take a sharp knife and shave away the outer stem tissue near the soil line and look for this bruising discoloration (Figure 3). If splitting the stem, the pith tissue in the center of the stem will be healthy and white. Lastly, if roots are gently dug up and inspected, there can occasionally be the presence of a blue thread-like structure (mycelia) on the outside of the root tissue (Figure 4).

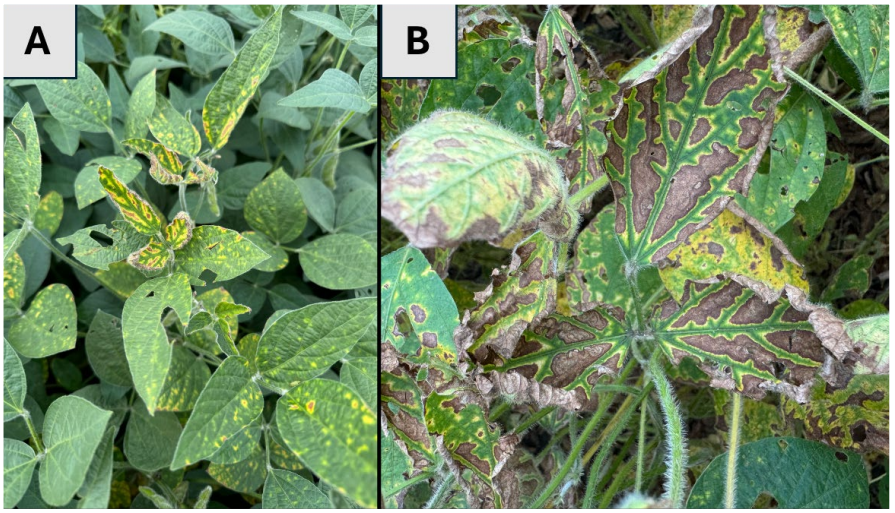

Figure 2. Soybean leaves with A) developing and B) advanced SDS symptoms. Note the presence of interveinal chlorosis with yellowing between deep green leaves. In mature leaves, this yellowing turns necrotic brown and brittle. (NDSU photos)

Figure 3. Bruising symptoms in soybean stem cortex due to SDS. (NDSU photo)

Figure 4. A soybean plant infected with *Fusarium virguliforme* with blue fungal growth on the outside of the taproot. (NDSU photo)

Disease Cycle

The SDS pathogen is primarily spread through the movement of the pathogen either by equipment or the physical movement of contaminated soils by wind or flooding. This pathogen is capable of overwintering in the soil and on soybean and corn residues. When a susceptible soybean variety is planted into those infested soils at optimal environmental conditions such as consistently wet soils, infection occurs during the vegetative growth stages. *F. virguliforme* colonizes and begins to rot the root tissue. Later in the season, the fungus produces toxic metabolites that will move from the roots to the leaves and cause the foliar symptoms described above. In severe cases, this toxin-induced interveinal chlorosis can result in yield loss due to premature defoliation, pod abortion and poor pod fill. This fungus is capable of surviving in the field for many years, especially since it can colonize and overwinter on different types of crop residues.

Management Strategies

1. **Resistant varieties:** Selecting and planting soybean varieties with some level of SDS resistance is the most effective option for managing this disease. This type of resistance will still result in SDS being able to develop, but the severity of infections will be reduced.
2. **Seed treatments for SDS:** Using seed treatment with the active ingredients fluopyram or pydiflumetofen can aid in protecting seedlings from infection by *F. virgiluforme*.
3. **Planting conditions:** Improving soil drainage is critical for reducing the risk of SDS. Fields with poor drainage are more likely to experience severe outbreaks. Practices like installing tile drainage or avoiding soil compaction can help improve soil conditions and reduce disease severity.
4. **Crop Rotation:** While crop rotation alone does not eliminate SDS, rotating soybeans with non-host crops — such as sunflowers, small grains or forages — can help reduce inoculum levels of *F. virguliforme* in the soil. However, *F. virguliforme* is known to be pathogenic on dry beans (less severe than soybeans), and the pathogen is known to overwinter and survive on corn, canola and sugar beet residues, indicating these crops may not be viable options for rotation. This strategy is most effective when combined with other practices like resistant varieties and good soil management.
5. **Management of Soybean Cyst Nematode (SCN):** SCN and SDS often occur together leading to more severe development of SDS. Managing SCN populations with resistant varieties and crop rotation may help reduce the severity of SDS.

For more information on managing Sudden Death Syndrome, visit the Soybean Disease Diagnostic Series on the NDSU Extension website or contact your local Extension agent.

For more information on this and other topics, see www.ndsu.edu/extension