Pathogen Pressure Panels

How did we arrive at thresholds in the pressure panel?

We use a 2-part series of tests to ensure your results are sensitive and reliable. First we ensure our test is sensitive to a range of agronomically relevant egg concentrations in laboratory tests. Our lab adds eggs of relevant species into soil and known concentrations and repeatedly tests our assays to ensure our detection meets the standards we promise to our growers. The second set of tests are from commercial and R&D fields, where we collect soil samples and verify the pressure through secondary lab tests and feeding damage in commercial crops. We track the performance of our tests in commercial fields over multiple growing seasons and ensure our test links to existing thresholds and recommendations so you can make your rotation and seed treatment decisions in alignment with best practices.

Corn Rootworm

Diabrotica virgifera and Diabrotica barberi

Western and Northern Corn Rootworm is a major threat in most corn growing regions, costing >$1B per year across the Midwest in crop damage and insect control. In heavily impacted fields yield loss can reach 50% or greater. Corn rootworm larvae feed on corn roots, and for every node of roots pruned by larvae, expect a 15% yield loss on average (Tinsley et al. 2013). Both corn rootworm larvae and adults may cause damage during pollination, as they feed on corn silks, leading to a reduction in viable kernel formation. Newly hatched larvae feed primarily on root hairs and outer root tissue. As larvae grow and their food requirements increase, they burrow into the roots to feed. Larval damage is usually most severe after the secondary root system is well established and brace roots are developing. Root tips will appear brown and are often tunneled into and chewed back to the base of the plant. Larvae may be found tunneling into larger roots and occasionally in the plant crown.

Western and Northern Corn Rootworms overwinter as eggs in the soil. Emergence is driven by accumulated soil temperatures at a 4-inch depth. Soils that are drier and warm more quickly in the spring stand the greatest risk of early Rootworm pressure. Soil texture is an important factor in larval survival. Sandy, coarse, and abrasive soils may scratch the cuticle of the larvae, resulting in death by desiccation. As a result, rootworms may be less of a problem in sandy soils. However, the effect of sandy soils can be modified by soil moisture. An irrigated or otherwise moist sandy soil will not affect rootworm populations as will the same soil under dry conditions. In addition, muck soils have shown a lower incidence of rootworm larval feeding damage and may provide some protection. Rotation out of corn can reduce pressure, but Western Corn Rootworm has been known to lay eggs in Soybean fields, increasing the risk of Rootworm pressure in first year corn.

(Source: https://extension.entm.purdue.edu/fieldcropsipm/insects/corn-rootworms.php)

If Your Pressure Is:	We Recommend:
Low	No recommeded action.
Moderate	Maximize protection with a Bt trait package, & consider insecticide in furrow. Likely, 0.75-2.5 node injury average without protection.
High	Maximize protection with a Bt trait package, & apply insecticide in furrow. Likely 0.75-2.5 node injury average without protection.

Soybean Cyst Nematode

Heterodera glycines

SCN is one of the largest sources of yield loss in soybeans, causing in excess of one billion dollars in losses per year. Much of the damage may even continue to go unnoticed, as symptoms don't appear until >10-15% yield loss is occurring. In heavily affected areas of a field yield losses can exceed 50%, and the nematode feeding opens woulds that are ideal places for infection of other soil pathogens.

SCN can have up to 6 generations in a growing season, depending on a number of factors (planting date, soil temp, growing season length, host suitability, location, soybean maturity group). SCN prefers warmer, dryer soils. Optimal temperatures are ~75°F for egg hatch, 82°F for root penetration, and 82-89°F for juvenile and adult development. Very little development happens <59°F or >95°F.

If Your Pressure Is:	We Recommend:
Low	Plant resistant soybean cultivars, rotating between PI88788 and Peking resistant cultivars; potentially include a susceptible cultivar every 5th year.
Moderate	Plant resistant variety, and protect with nematicide seed treatment. Elevated SCN reproduction typically associated with 5-10 bushels of yield loss when planting susceptible varieties without protection.
High	Plant resistant variety, and protect with nematicide seed treatment. Elevated SCN reproduction typically associated with 5-10 bushels of yield loss when planting susceptible varieties without protection.

How did we arrive at thresholds in the Decision Dashboard?

Every year we collect thousands of samples across hundreds of commercial fields and compare inoculum loads across regions. We determine low pressure (up to the 50th percentile of inoculum loads), moderate pressure (50th to 70th percentile) and high pressure (>70th percentile inoculum loads) zones and fields by comparing local (climate division), regional (state) and midwest-wide inoculum loads. The difference in inoculum loads can be as much as 5-7x between low and high pressure fields for any given pathogen in any given region. We update these relative pressure level benchmarks every growing season so that you can decide where to invest your marginal seed treatment spend.

Sudden Death Syndrome

Fusarium virguliforme and Fusarium brasiliense

SDS is responsible for hundreds of millions in yield loss every year across the Midwest. In heavily affected fields yield loss can exceed 50%, and there is very little that can be done to protect the crop by the time symptoms start showing. The disease tends to be most severe on well-managed soybeans with a high yield potential. The appearance of SDS symptoms at early pod fill is reportedly more damaging than its appearance at a later stage of plant development. Yield reduction is caused by the reduced photosynthetic area, defoliation, flower and pod abortion, and reduced seed size. To confirm disease pressure in season, it is important to inspect plants closely, dig and inspect roots, and split soybean stems open. After splitting stems, brown to gray discolored areas developin the vascular tissue of the lower stem, and the pith of a plant infected with SDS will be white even if roots are severely rotted, which is a feature that distinguishes SDS from other fungal diseases.

New research suggests that the critical stage for the SDS pathogen to infect soybean plants is before emergence of the germinated seed. Soybeans planted early in cool soil are susceptible to SDS infection when slow germination and emergence prolongs the contact period between pathogen and soybean. Although infection may have occurred, no symptoms are generally seen until the early reproductive stages.

If Your Pressure Is:	We Recommend:
Low	Scout and monitor fields for evolving conditions.
Moderate	Plant resistant variety and protect with seed treatment that has known efficacy against SDS.
High	Plant resistant variety and protect with seed treatment that has known efficacy against SDS.

Fusarium

Fusarium oxysporum, Fusarium solani, Fusarium equiseti, and Fusarium graminearum

Seedling and root rots are responsible for upwards of half a billion dollars in losses every year across the Midwest. Fusarium is one of the most common soil borne diseases.

Infection is favored by cool (less than 60°F), wet soils. It is more common in low-lying or poorly drained areas, or in fields planted too early in spring. Delaying planting dates can help reduce seedling and root rot by giving the soil time to warm up and dry out.

If Your Pressure Is:	We Recommend:
Low	Apply standard rate and type of seed treatments.
Moderate	Let soil dry and warm before planting and apply an increased rate of seed treatment.
High	Let soil dry and warm before planting and apply an increased rate of seed treatment.

Phytophthora

Phytophthora sojae

Seedlings can be attacked and killed in the ground or soon after emergence. At seedling and later vegetative stages, infected stems appear bruised and are soft, secondary roots are rotted, the leaves turn yellow, and brown and plants can wilt and die. It is important to recognize that Pythium is a related pathogen that causes similar damage and symptoms on seeds and seedlings. Plants may die throughout the season. On infected plants, brown lesions form on the roots, the roots rot and degrade, and a dark chocolate-brown discoloration of the stem often extends from below the soil line upward into lower parts of the plant. Leaves turn yellow, wilt, and typically stay attached after plant death. Plants are often killed in patches or in sections of rows. In tolerant varieties, plants may be stunted but not killed.

This disease is favored by wet and warm soil conditions, especially saturated conditions early in the growing season. Clay and compacted soils favor this disease. Spore germination begins when soil temperatures reach 60°F with high soil moisture. Optimal soil temperatures are between 77°F to 86°F.

If Your Pressure Is:	We Recommend:
Low	Apply standard rate and type of seed treatments.
Moderate	Plant resistant variety, and apply an increased rate of seed treatment.
High	Plant resistant variety, and apply an increased rate of seed treatment.

Pythium

Pythium irregulare, Pythium heterothallicum, and Pythium ultimum

Seedling and root rots are responsible for upwards of half a billion dollars in losses every year across the Midwest. Pythium is one of the most common soil borne diseases, and within this genus we are tracking several species known to impact soybeans. Pythium seedling blight symptoms include rotten, mushy seeds or seedlings with poorly developed roots. Water-soaked lesions may be present on the hypocotyl or cotyledons. Infection is favored by cool (less than 60°F), wet soils. It is more common in low-lying or poorly drained areas, or in fields planted too early in spring. It is very difficult to control, but delayed planting, higher planting populations (increase viable seeds), and tillage (warm the soils) can help to reduce pressure.

If Your Pressure Is:	We Recommend:
Low	Apply standard rate and type of seed treatments.
Moderate	Let soil dry and warm before planting and apply an increased rate of seed treatment.
High	Let soil dry and warm before planting and apply an increased rate of seed treatment.

Rhizoctonia

Rhizoctonia solani AGIIB, Rhizoctonia solani AG4, and Rhizoctonia solani AG5

Rhizoctonia disease can cause both pre-emergence and post-emergence death of soybean plants. Seed decay from Rhizoctonia infection occurs pre-emergence and often is not visually detected in a field until damage has already occurred. Post-emergence symptoms on soybean seedlings appear as brown or reddish-brown lesions on stems and roots just below the soil line. This decay is a dry, firm rot unlike the soft, watery rot caused by Pythium or Phytophthora. If lesions become sunken and stems become girdled, the plants can die. With high levels of Rhizoctonia infection in soils, pre- and post-emergence damping-off can reduce stands by 50 percent or more, according to North Dakota State University.

The most severe Rhizoctonia damage generally occurs in fields that are poorly drained, especially after the onset of wet, warm weather. This pathogen generally prefers warm and wet conditions; however, Rhizoctonia solani can infect soybeans across a wide temperature range (60 - 95°F) and wide range of soil moisture (25% to fully saturated conditions).

If Your Pressure Is:	We Recommend:
Low	Apply standard rate and type of seed treatments.
Moderate	Plant resistant variety, and apply an increased rate of seed treatment.
High	Plant resistant variety, and apply an increased rate of seed treatment.

Soybean Stem Canker

Diaporthe aspalanthi, D. caulivora, D. longicolla, and D. sojae

Yield loss from stem canker, formerly known as Phomopsis seed decay, can approach 50% on susceptible cultivars under favorable conditions. Stem canker can cause premature death of soybeans in large areas of the field and may be misidentified as SDS or Brown Stem Rot. Early infection may go unobserved, and sunken, reddish-brown lesions below leaf or stem nodes may appear during reproductive growth phases. These plants often have fewer and smaller seeds. The cankers can grow to girdle the main stem, causing the complete death of the plant. The cankers can grow at the soil surface, making it easy to confuse with Phytophthora, although Stem Canker does not cause root rot. Toxins may transport from cankers to the leaves, giving an appearance much like SDS. One key differentiator of Stem Canker is that the stem above and below the canker will generally appear green and healthy.

The fungus produces spores during rainy weather, which then splash onto plant tissue. Infection occurs during the early vegetative stages of soybean growth, although cankers are not visible until the plant enters reproductive stages. Secondary spore production on infected plant tissue can occur, but later infections will not have as great an impact on disease development. Infection can occur over a wide range of temperatures, but the fungus requires extended moist periods to infect. Disease can develop to epidemic levels when rainy weather persists during the early vegetative stages of soybean growth.

If Your Pressure Is:	We Recommend:
Low	Scout and monitor field for evolving conditions.
Moderate	Plant resistant variety, and scouting in season to assess disease pressure and the benefit of a fungicide application.
High	Plant resistant variety, and scouting in season to assess disease pressure and the benefit of a fungicide application.

Soybean Brown Stem Rot

Cadophora gregata

Yield losses of 10-30% are common for susceptible soybean varieties grown in management systems conducive for brown stem rot development. Recognition of the disease is a major problem. Browning of the internal stem and root systems of infected plants are present as early as the V4 (fourth trifoliate) growth stage, and intensify as the plant progresses into reproductive stages. However, there is no external evidence of BSR at this time and signs of early infection will go unnoticed unless the stems are cut open and examined. Brown Stem Rot may be mistaken for SDS when the leaves prematurely senesce after developing yellow between leaf veins.

Brown Stem Rot was observed first in 1944 in central Illinois and now is prevalent in the North Central states and Canada. Brown stem rot is most severe when conditions are optimal for soybean growth. Stem and foliar symptoms are most severe when air temperatures range between 60° and 80° F during growth stages R4 (full pod) to R6 (full seed). Air temperatures in the 90° F range will suppress foliar symptom development. Brown stem rot is most severe when optimal soil moisture is present at R1 (first flower) to R2 (full flower) followed by dry soil conditions at R5 (begin seed) to R6 (full seed). The severity of brown stem rot is greater if soils are low in phosphorus and potassium and soil pH is below 6.5.

If Your Pressure Is:	We Recommend:
Low	Scout and monitor field for evolving conditions.
Moderate	Plant resistant variety, and scouting in season to assess disease pressure and the benefit of a fungicide application.
High	Plant resistant variety, and scouting in season to assess disease pressure and the benefit of a fungicide application.

White Mold

Sclerontinia sclerotiorum

White Mold is one of the most damaging diseases of soybeans. It is estimated to be responsible for several hundred million dollars in losses every year across the Midwest. It tends to affect high performing fields, as canopy closure

contributes to disease development and progression. In heavily impacted fields, yield losses can exceed 50%. Once symptoms of white mold are evident, fungicides will have no effect on reducing the disease.

When the soil is moist and shaded from canopy closure or cloudy or foggy weather and temperatures are 40 to 60℉ inside the canopy, the sclerotia (a hardened mass of fungal cells) located within the top 2 inches of soil germinate into small cup-shaped mushrooms called apothecia. These tiny mushrooms produce millions of spores called ascospores, and when these spores land on senescing flowers under favorable weather conditions, White Mold infection is initiated. Spores can be blown by wind more than 160 feet. Often by the time you see white mold symptoms in soybeans it is too late to implement control measures. High potential fields and varieties tend to create these shaded, humid, and moist conditions under the canopy. For this reason planting at a density or row width that facilitates air movement under the canopy is a common cultural control proactive for white mold.

If Your Pressure Is:	We Recommend:
Low	Scout and monitor field for evolving conditions.
Moderate	Reduce planting density and/or plant into wider row widths, plant resistant variety, monitor weather conditions and crop progress and scout early in season to identify fields that could benefit from a fungicide application.
High	Reduce planting density and/or plant into wider row widths, plant resistant variety, monitor weather conditions and crop progress and scout early in season to identify fields that could benefit from a fungicide application.

Gibberella & Fusarium Stalk Rot

Fusarium verticillioides & Fusarium graminearum

Gibberella is one of the major stalk rots of corn. It is responsible for hundreds of millions in losses every year across the Midwest. Yield can be impacted due to the plant's inability to move nutrients during grain fill, but the more serious risk comes from increased lodging due to weakened stalk strength. Infection occurs primarily through wounds caused by insect feeding, hail, mechanical damage, or other mechanisms. Infection is favored by warm moist conditions.

If Your Pressure Is:	We Recommend:
Low	Scout and monitor field for evolving conditions.
Moderate	Plant a resistant hybrid, and reduce plant stress and insect feeding through use of crop protection and optimal fertility strategies.
High	Plant a resistant hybrid, and reduce plant stress and insect feeding through use of crop protection and optimal fertility strategies.

Anthracnose of Corn

Colletorichum graminicola

Anthracnose is one of the major stalk rots of corn. It is responsible for hundreds of millions in losses every year across the Midwest. Yield can be impacted due to the plant's inability to move nutrients during grain fill, but the more serious risk comes from increased lodging due to weakened stalk strength.

Infection occurs primarily through wounds caused by insect feeding, hail, mechanical damage, or other mechanisms. Infection is favored by cloudy, warm, and humid weather (75-85F, and wet) after silking. The fungus can infect roots, or rain and wind can disperse fungal spores from plant residues to corn stalks.

If Your Pressure Is:	We Recommend:
Low	Scout and monitor field for evolving conditions.
Moderate	Plant a resistant hybrid, and reduce plant stress and insect feeding through use of crop protection and optimal fertility strategies.
High	Plant a resistant hybrid, and reduce plant stress and insect feeding through use of crop protection and optimal fertility strategies.

For more information, call 800-933-8644 or contact your Pattern Ag Regional Sales Manager