SeedSCOOP

Managing Soybean Disease

Diseases of soybean can be caused by numerous microorganisms (including fungi, bacteria, viruses, and nematodes) that can damage soybean plants, reducing vigor and yield. Seeds, seedlings, and older plants may all be affected by disease-causing microorganisms. The disease can spread from plant to plant and cause damage over time. Plants under stress, such as from drought, excessive moisture, extreme temperatures, chemical injury, or other physical injuries, are more susceptible to disease. Symptoms of disease vary depending on the associated pathogen, and these symptoms may also be influenced by soybean product, environmental conditions, or physical injuries.

Disease Triangle

The disease triangle is most often comprised of three factors:

- The host: A susceptible cultivar, regardless of crop.
- The pathogen: The pathogen is any organism (bacterial, fungal, viral, or nematode) that can cause disease on the host.
- The environment: Favorable temperature, moisture, and other environmental conditions allow infection by the pathogen to occur and disease development to progress.

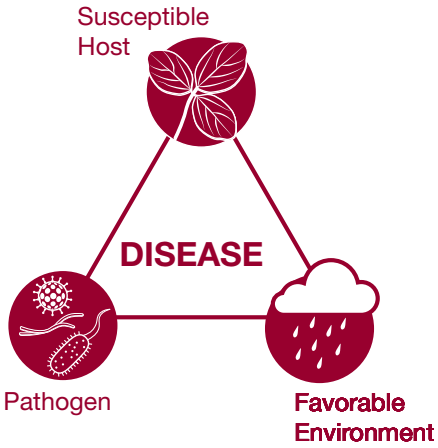

Figure 1. Disease Triangle.

Management

There are several tools that can be used to manage diseases in the field. Determining the most effective approach will depend on the field's disease and crop history, environmental conditions, and accurate diagnosis of the disease(s) present.

Several factors have contributed to an increase in the incidence and severity of soybean diseases in recent years. Soybeans have been increasingly used as a continuous crop in production fields due to support prices, allowing pathogen populations to build up in the field. Systems implementing no-till or reduced tillage practices may leave disease-infested crop debris near the soil surface where pathogens can overwinter and infect plants in the next growing season.

Pathogen populations have been adapting to resistance genes used in several available commercial soybean products, rendering these resistance genes less effective. To properly manage diseases, these factors need to be taken into consideration and a variety of methods should be included in the management program such as crop rotation and specific resistant products.

Scouting

Proper identification of the causal agent requires proper disease scouting, and fields should be scouted regularly to detect problems early. Diseases often occur randomly throughout a field in circular or elliptical patches. Do not simply walk a straight line; scouting is best conducted in an irregular pattern, such as a zig-zag, to increase the likelihood of intercepting an area of diseased plants. If a region within a field is a perennial disease problem, scouting that area first may allow for early action for disease management strategies, such as fungicide applications.

A newer tool for scouting is the drone. Early detection is now much easier with the aerial observation provided by a drone coupled with walking the fields.

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Soybean Product Selection

After receiving an accurate diagnosis of a current disease problem, select soybean products with the appropriate resistance genes. If the appropriate and functional resistance genes are used, little to no disease may develop even when environmental conditions are favorable. However, even high levels of resistance can be overcome by high inoculum levels or extremely favorable conditions. There are two types of resistance incorporated into commercial soybean products, (1) race-specific resistance and (2) partial resistance. These two types will appear different in the field, but both can be effective in limiting losses due to soybean pathogens.

Race-specific resistance is effective against some strains (races) of the pathogen but not others, while other forms of resistance are more general and equally effective against all strains of a particular pathogen. Some forms of resistance provide near immunity to a disease, resulting in little or no symptom development, while other resistance genes convey partial resistance in which disease does develop but at a slower rate or with less severe symptoms, resulting in fewer effects on production when compared to a completely susceptible plant.

Crop Rotation

A good crop rotation program is essential for long-term productivity. Wheat and corn in a crop rotation scheme are beneficial for reducing pathogen populations. Without the presence of soybean plants, many soybean pathogens begin to decline. Soybean cyst nematode (SCN) (Figure 2) populations are reduced by half in the first few years that corn or wheat are grown.

Figure 2. Soybean Cyst Nematode

Seed Treatments

In most of the soybean production areas the weather is highly variable from year to year. Seed treatments can help protect the seed and young seedlings from numerous pathogens that infect soybeans at planting and early emergence, such as Phytophthora (Figure 3) or Rhizoctonia (Figure 4), especially during cool, wet periods when germination and seedling growth are delayed.

Figure 3. Late-season Phytophthora root rot on soybean seedlings

Figure 4. Rhizoctonia root rot

Tillage

Tillage is not essential every year, but should be considered as a management tool when one of the following situations applies:

1. High incidence of residue-borne pathogens.

2. Wet years after losses due to Phytophthora or other root rot organisms.

3. Thick crop debris on the soil surface, causing the soil to retain moisture and stay cooler for longer periods in the spring.

Row Width

Research into row spacing over the last 20 years indicated that narrower row spacing could increase yield. However, recent research indicates that there is little to no difference between row spacings of 7.5, 10, 15, or 20 inches in terms of soybean yield.

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However, farmers should consider disease pressure and weed control options when planting in narrow rows. Diseases are probably the most important thing to consider as there are so many post-emergent herbicide options available for weed control. White mold (Figure 5) is one of the greatest concerns over most of the northern soybean production area. This fungus has spread quickly due to short crop rotations, decreases in tillage practices, and narrow row spacing. The higher humidity levels in the dense canopy of narrow-row soybeans favor infection by the white mold fungus. Once the fungus is present in a field, little can be done to remove the pathogen or lessen the impact of the disease. An important factor determining the potential for white mold is the environmental conditions. Cold and cloudy conditions in combination with high rainfall during flowering are optimal for pathogen infection. In areas with a history of white mold, growers are encouraged to plant on wider row spacing and to use soybean products that are resistant to white mold.

Planting on narrow rows does provide certain advantages because narrow rows decrease the time to canopy closure so plants can intercept more light throughout the season. The time to canopy closure can have a big impact on soil moisture loss, the ability to control emerging weeds, and especially on crop growth rates and crop yield. In addition, many of the current varieties being used are bushy plant types. Controlling population is important for limiting plant heights that will lead to lodging. Narrow row seeding of more than 124,000 seeds/acre is too high for most of today's soybean genetics.

Figure 5. White mold

Planting Date

In recent years, soybean yields have been correlated to planting date. Better genetics and planter systems have allowed earlier and earlier planting dates. The ideal soil temperature for rapid germination and emergence for soybean is 77°F. For most of the Midwest, soil temperatures do not reach these levels at a soil depth of two inches until mid to late May. Soybeans can germinate at soil temperatures as low as 50°F at two inches, but it can take as much as three weeks for emergence at these low temperatures.

Early planting means colder soils and slower emergence. Recommendations by many extension services across the Midwest are to plant soybeans when soil conditions are suitable, which means not to plant into wet/cold soils early in the planting cycle. Plant into a warm, moist but not wet seedbed since little is gained by planting at extreme dates unless conditions are optimal. Planting into a field that is too wet early in the season will often result in reduced yields at the end of the year.

Cold soils slow root development and make the stand more susceptible to root rot pathogens. Use of a fungicide seed treatment is highly recommended if there is a field history of Phytophthora, Pythium, Rhizoctonia, or Fusarium.

Seeding Rates

Because of major improvements in soybean genetics, seeding rates have been coming down from 200,000 plants/acre just a few years ago to less than 140,000 now. Harvest populations of 100,000 plants/acre that are evenly spaced at harvest currently is recommended particularly if the soybean product is a medium to full bush plant type.

Specific reasons for lower seeding rates are:

- The movement away from drills to planters
- The use of seed treatments
- Improvements in seed and seedling vigor
- Growers are no longer depending on a plant population to suppress weeds
- Many of the better varieties today are full bush plant types

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Variable-rate seeding (VRS) allows the farmer to optimize their seed investment. VRS for soybeans is planting higher rates in areas of lower productivity and lower seeding rates in areas of higher productivity. Lower productive areas need more seeds to compensate for the yield loss.

Based upon soil conditions, environment, historical stand establishment, management level, weed control, and disease management, seeding rates should range from 120,000 plants/acre up to 160,000 plants/acre. Consult your local extension service and soybean product supplier for specific seeding rate recommendations for your area.

Field Disease History

For field crop production, not having accessible records can result in not knowing when a disease or insect has occurred, and specifically, how widespread and how severe a disease was in a certain field. There are many apps and systems that make it very easy to record all the information needed to help maximize production in each field. Many universities have free apps for use on your iPhone® or iPad® to easily record and save all aspects of field conditions. No matter which system you use, the recording of all the data is highly important in being prepared to make a decision based on field history.

Soil Testing for Soybean Cyst Nematode

There are several species of plant pathogenic nematodes which feed on soybean, including lance, sting, lesion, root-knot, and SCN. Of these, SCN causes the greatest yield losses in soybean. In plants affected by SCN, water and nutrient uptake by the root will be impaired and the number of nitrogen-producing nodules formed on the roots will be reduced. When above-ground symptoms are visible, plants will look yellow and stunted. SCN may be present in a soybean field without causing any above-ground symptoms but still reduce soybean yields. SCN can go unnoticed for several years. When visible symptoms are present yield loss can be as high as 50%.[1]

Recent SCN surveys indicate that virtually all previous soybean fields have some level of infestation. The best way to diagnose and quantify SCN levels in a field is by collecting soil samples and sending them to a professional diagnostic laboratory. Use a soil probe if available and go down 8 inches with the probe. If soybeans were grown the year of the sample, collect samples within the row, in the root zone. In some cases, some state university extension services are offering free testing. Check with your local extension service for any testing programs, specific sampling methods, and where the closest diagnostic lab is located.

Most soybean seed companies have the specific types of SCN resistance listed in their seed catalogs. Knowing which nematode species you have is important for choosing the correct resistant soybean product. Knowing the HG type (races) present in the fields is also important for selecting the most appropriate forms of resistance.

Sources (web sources verified 8/8/19)

1. Disease and Nematode Management, North Carolina State Extension Publication, http://content.ces.ncsu.edu/north-carolina-soybean-production-guide/soybean-disease-and-nematode-managment

2. Principles of Plant Pathology: The Disease Triangle and Influence of the Environment. https://www.mississippi-crops.com/2012/08/31/the-principles-of-plant-pathology-the-disease-triangle-and influence -of-the-environment/

3. Soybean Seeding Rates. Dan Davidson, January 15, 2019. https://www.ilsoyyadvisor.com/on-farm/ilsoyadvisor/soybean-seeding-rates

Legal Statements