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Frogeye Leaf Spot Resistance in Soybean

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Abstract
Isolates of *Cercospora sojina* showing reduced sensitivity to quinone outside inhibitor (QoI, strobilurin) fungicides were recently recovered from soybean in Iowa. This pathogen causes frogeye leaf spot, an important foliar soybean disease that can be managed with fungicides. With the confirmation of fungicide-resistant isolates, it becomes especially important to understand when to spray and what products to use for long-term control of this disease.

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Agricultural Science | Agriculture

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Frogeye leaf spot symptoms on a soybean leaf. Image: Daren Mueller

Disease cycle

Cercospora sojina survives in infected soybean seed and plant residue. Spores are produced on infested residue in spring and carried short distances by wind or rain splashes. Warm, humid conditions that are overcast and heavy dews are required for spores to germinate. This pathogen commonly infects newer leaves towards the top of the soybean plant.

Fungicide mode of action and site of action

Like herbicides, fungicides have a specific mode of action (MOA) that interferes with or inhibits specific cellular processes of fungi. Each MOA has a specific site of action (target site). These are usually specific enzymes required for a cellular process that a fungicide binds to. As with herbicides, the continued use of a single MOA places selection pressure on a pathogen, which can result in a population less sensitive or resistant to the chemical being used. Common active ingredients (AIs) farmers across the Midwest use include the QoI (FRAC group 11), DMI (FRAC group 3), and the SDHI fungicide (FRAC group 7).

Qols are considered a "high risk" class of fungicide for resistance development because resistant development is often the result of a single gene/single site mutation, most commonly the G143A mutation that occurs at the fungal cytochrome b gene. The Qo (Quinone outside) inhibiter fungicides act on the outer (Qo) binding site of the cytochrome bc1 complex. By blocking complex III in the electron transport chain, the pathogen is unable to produce energy

DMI fungicides are considered a "medium risk" class of fungicides for resistance development because they typically have polygenic resistance. This means for resistance to occur, several mutations at the target site are required. Each mutation leads to a small reduction in fungal sensitivity. Consequently, multiple mutations usually need to accumulate in a fungal isolate before the reduced sensitivity is large enough to impact the efficacy of a DMI fungicide under field conditions (a slow step-wise erosion of efficacy).

SDHI fungicides are considered a "medium to high risk" class of fungicides for resistance development and a single mutation in the fungus confers resistance. Similar to the group 11 QoI fungicides, the group 7 SDHI fungicides inhibit respiration in fungi. SDHI fungicides target the enzyme succinate dehydrogenase, the so-called complex II, which is a part of the tricarboxylic cycle and linked to the mitochondrial transport chain. Although both groups (QoI's and SDHI's) of fungicides inhibit respiration, they target different sites with no cross resistance between the two fungicides shown. This means that if a pathogen develops reduced sensitivity/resistance to a QoI fungicide, it will not automatically have resistance to a SDHI.

Generic fungicides

Some fungicide AIs are now off patent, allowing generic versions of these fungicides to be sold for use on corn and soybean. Some generic fungicides contain only one active ingredient, such as QoIs (FRAC group 11). It is important to know what active ingredients/or FRAC groups are in the fungicide you choose to spray. Spraying a fungicide with only one site of action comes at a risk.

Knowing the pathogen

Pathogen isolates with reduced sensitivity to fungicides may be present in a population due to natural mutations and are not necessarily the result of fungicide application. Applying a fungicide will select for these mutants and they will proportionally increase as part of the population that is still sensitive to the fungicide. This will consequently lead to a pathogen population that has reduced sensitivity or is resistant to the fungicide.

Understanding the lifecycle of the pathogen of concern is as important as knowing the MOA and/or the site of action of the fungicide being used. Pathogens may be monocyclic (one lifecycle per season) or polycyclic (multiple lifecycles per season). They can produce millions of spores within a single growing season. This can affect the chances of a pathogen becoming resistant to a particular fungicide. The more life cycles in a season, and/or the more spores produced, the greater the genetic variation within the pathogen, and the higher the chance of a genetic mutation that could lead to reduced sensitivity to a fungicide.

Other management strategies

The QoI-resistant strains can still be managed effectively with other fungicides groups. Alternative disease management practices such as planting frogeye leaf spot-resistant cultivars, crop rotation with non-host crops are recommended for the successful management of the disease.

Category: Plant Diseases

Crop:

Soybean

Tags: cercospora fungicide-resistance foliar disease fungicide spray QoI

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Before returning to pursue my PhD I worked at a local cooperative for almost 10 years where I was an agronomist for 7 years. During my time as an agronomist at the coop I did field research/on-farm trials, managed the seed warehouse, operated the seed treater, and did general agronomy sales. As I...

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