How Do Fungicides Help to Reduce Disease Pressure in Corn?

The Disease Triangle

An understanding of what a fungicide is, how it protects plants from diseases, and when to consider an application is important prior to using a fungicide.

There are three factors that contribute to disease development, which is commonly known as the disease triangle (Figure 1). These three factors are the pathogen (fungal, bacterial, or viral), a susceptible host plant, and favorable environmental conditions. High moisture situations such as rain, fog, prolonged dew, or overhead irrigation can provide a favorable environment for fungal spore generation and infection. Temperatures also play a role, as some pathogens favor cooler temperatures, while others thrive in warm temperatures. For example, southern rust is favored by humidity and higher temperatures, while northern corn leaf blight favors cool and wet conditions.

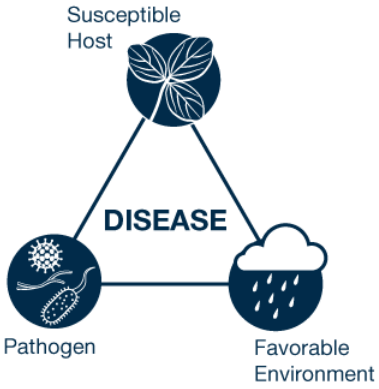

Figure 1. Disease triangle.

How Fungicides Protect the Corn Plant

Fungicides are products that may prevent or reduce the impact of diseases caused by fungi. While corn can be infected by fungal, bacterial or viral diseases, fungicides are only active on fungal diseases. Some fungicides interfere with disease growth and reproduction while others provide a barrier that inhibits spore germination. In addition, there are fungicides that can induce changes in the plant to reduce susceptibility to fungal infections but are not specifically toxic to the pathogen.

Corn Fields that are Considered High Risk for Fungal Infections

Continuous corn fields, fields with a previous history of fungal disease(s), and cultural practices like no-till or conservation tillage that leave high amounts of residue on the soil surface may increase the risk of infection. Planting susceptible seed products or products with a history of stalk health issues can influence the likelihood of disease development. Portions of a field that border tree lines, creeks or ponds may also be a factor. A proactive fungicide application may be warranted to help decrease the potential for diseases to limit yield potential.

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Benefits of Protecting the Upper Canopy

During the grain fill period of corn growth, the developing kernels are the primary sink for the photosynthate produced by the plant. The demand of the developing kernels for photosynthate takes priority and as a result, a corn plant does what it can to produce grain, sometimes at the expense of the health of other plant parts including the roots and lower stalk.[1]

A low stress grain fill period can help maximize the yield potential of a crop, while high stress during grain fill may cause kernel abortion or lightweight grain and encourage the development of stalk rot. The health of the upper leaf canopy is particularly important for achieving maximum grain filling capacity. Some research indicates that the upper leaf canopy, from the ear leaf to the uppermost leaf, is responsible for no less than 60% of the photosynthate necessary for filling the grain.[1]

Those involved in corn production have historically reported "increased standability" and a "greening effect" from fungicide applications. These observations have been supported by university research through fungicide trials. A research team from Iowa State University conducted a series of experiments in 2016 and 2017 looking in part at the effect of fungicide applications on stalk lodging in corn. Their results confirmed those observations, with an average reduction in stalk lodging of 9.3% and an increase in corn yield of 4.1 bu/acre when fungicide was applied at the R1 growth stage. The "greening effect" was also observed, although the researchers caution that this effect could lead to higher grain moisture content at harvest. Concern was expressed that fungicides used to achieve greening could lead to a higher risk of resistance of the pathogen to the fungicide.[2,3]

Classifying Fungicides

Fungicides are classified in several of ways including mode of action, contact or systemic, and preventative or curative.

Mode of Action

The mode of action (MOA) describes what process is impacted in the fungi and is denoted with a letter code. There are eleven fungicide MOA classes, with the most common corn fungicides being respiration inhibitors (C) and sterol biosynthesis inhibitors (G). The eleven MOA classes are further divided into groups which describes the target, or specific site, of the fungicidal activity. Groups 7 and 11 are the most commonly used respiration inhibitors in corn, and Group 3 is the most common of the sterol biosynthesis inhibitors.[4]

Preventative and Curative Modes of Action

For a fungicide to be considered curative, it is necessary for the active ingredient to be systemically translocated within the plant, allowing it to inhibit (cure) existing pathogens within the leaf. Curative fungicides may be applied shortly after infection occurs. They are systemic and can be absorbed into the leaf and translocated through the xylem within the leaf (locally systemic) or the plant (acropetal systemic). Besides controlling pathogens which have already entered the plant, curative fungicides have longer residual activity as they are protected from wash-off and weathering. Due to their systemic nature, curative fungicides have the potential to reach plant tissues that could otherwise be difficult to reach using spray equipment.[5]

In contrast, preventative (protectant) fungicides are described as having a contact action (but may exhibit some systemic activity), remaining on the surface of the leaf where they can protect the plant against the germination of newly-landed fungal spores. Protective fungicides require application before infection by the pathogen takes place. Translaminar fungicides (locally systemic), such as strobilurin fungicides, redistribute the fungicide from the upper, sprayed leaf surface to the lower, unsprayed surface. Some triazole (protective and early-curative) fungicides may also have translaminar activity.[5]

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The three primary groups of foliar treatments for corn are as follows:

1. Triazoles (Group 3) inhibit any enzyme that is necessary for sterol production, which is essential for the development of fungal cell membranes. Inhibition results in abnormal fungal growth and eventual death. These are generally considered to be curative compounds, but have some exceptions, like prothioconazole, an active ingredient in Delaro® 325 SC fungicide and Delaro® Complete fungicide, which has both preventative and curative activity.
2. Strobilurins (Group 11) inhibit mitochondrial respiration at complex III, which stops energy production, causing fungal death. These are generally considered to be curative compounds and often have a "plant health" effect.
3. SDHI's (Group 7) are also respiration inhibitors, blocking electron transport at complex II. They work primarily by stopping spore germination.

Combining Modes of Action

To help slow the development of fungicide resistance in a fungal population, it is important to blend effective modes of action whenever possible with each application.

Because different modes of action respond to diseases and growing conditions differently, combining modes of action may help improve performance consistency while reducing the likelihood of resistance. A product with two or more modes of action may offer protection even if a fungus is resistant to one of the chemistries. However, to do so, it is critical that multiple modes of action have activity against each of the important diseases.

Scouting and Thresholds For Disease Infections

Timely and regular field scouting for disease development can be an early warning system. If disease lesions are identified, then other factors can be evaluated to determine if a foliar fungicide should be applied immediately, after a waiting period, or not at all. Considerations include the product planted, current weather conditions, forecasted weather conditions, and stage of plant development.

One accepted threshold is if the field is planted to a susceptible or moderately susceptible seed product, a foliar fungicide may be warranted if lesions appear on the third leaf below the ear or higher on 50% of the plants at tasseling.[6]

Applying Fungicide Proactively May be Beneficial

Applying fungicides proactively may be beneficial for several reasons:

- A proactive application may help protect the plant from disease development before usual symptoms appear. Symptoms take several days to appear after initial infection. The time between initial infection and symptom appearance give a disease such as gray leaf spot (GLS) time to get a foothold and in the process invade plant cells that increase or maintain yield potential. Gray leaf spot has a two-week latent period from infection to visible lesions.
- Fungicides can help reduce the impact of stress events such as disease, hail, drought, and heat. Plants under stress produce the ripening gas hormone ethylene. When ethylene is produced prematurely, plant growth slows, leaf senescence begins, and kernel abortion can occur, which ultimately and negatively impacts yield potential. Fungicides that contain a strobilurin component inhibit the production of ethylene, which along with other effects, helps keep the plant growing in times of stress, such as drought.
- During periods of rapid growth, the waxy layers on the leaf surface may become thinner, allowing disease an easier entry into leaf tissue.

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Disease Resistance/Tolerance of Corn Products

Each corn product has its own level of resistance to various diseases. One can be highly susceptible to a disease such as southern rust or tar spot, and another highly resistant. If growing conditions are favorable for disease development and a susceptible product is planted, a properly applied foliar fungicide can help reduce the potential impact on yield. If the seed product is highly resistant, a foliar application for the explicit protection against the disease may not be warranted. However, the diseases to which the seed product is vulnerable may have the potential to develop and a well-timed fungicide application can help provide protection against diseases and maintain overall plant health. Fungicide resistance management procedures should be followed.

Fungicide Products

Apply Delaro® 325 SC fungicide at 8 to 12 fl oz/acre, with 2 gallons per acre (GPA) when applied aerially, or 10 GPA when applied by ground at VT to R1 growth stages. Delaro® 325 SC fungicide contains prothioconzazole (Group 3) and trifloxystrobin (Group 11) and is labelled for control of key fungal diseases including gray leaf spot, northern corn leaf blight, southern corn leaf blight, rust, eyespot, anthracnose leaf blight, and tar spot. Consult the label for more instructions, and to determine if it is labeled in your state.

Delaro® Complete fungicide is labelled for control of the same diseases listed above and includes an additional mode of action, fluopyram, a Group 7 product. Delaro® Complete fungicide should be applied at 8 to 12 fl oz/acre at a minimum of 2 GPA aerially or 10 GPA with ground applicators.

To learn more about Delaro® 325 SC Fungicide, please visit https://www.cropscience.bayer.us/products/fungicides/delaro or contact your retailer.

For more information on Delaro® Complete Fungicide, please go to https://www.cropscience.bayer.us/products/fungicides/delaro-complete or contact your retailer. Delaro® 325 SC Fungicide and Delaro® Complete Fungicide are not registered for use in all states and may be subject to use restrictions.

The use of adjuvants depends on the fungicide and the timing of application. Fungicide labels should be read to determine if and when adjuvants can be used.

Sources:

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[6]Collins, A., and Esker, P.D. July 2022. Fungicide considerations for corn and soybean. PennState Extension. https://extension.psu.edu/fungicide-considerations-for-corn-and-soybean.

Web sources verified 4/13/2023.

Legal Statements