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Weather Variability and Disease Management Strategies

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Introduction

This year's title of 'weather variability and disease management strategies' was chosen because we need to remember how weather conditions this year have impacted crop productivity and disease development. This will enable us to look forward and develop better management decisions for future growing seasons. Agricultural production is dependent on many climatic factors such as rain, humidity, temperature, and sunlight. These climate conditions have direct effects on yield as well as other indirect effects. One specific indirect effect of extreme weather events is increased pressure from pathogens and pests. Plant pathogens are commonly favored by very specific, and sometimes extreme, weather conditions. Pathogens take advantage of these conditions to infect, reproduce, and cause disease in crops that can lead to economic losses, ultimately in the loss of yield quality or quantity. Scientific projections indicate that climate change will continue to have major impacts on crops across the country and the world. It is therefore not surprising that this year, the United Nations Summit in New York on September 23, focused on climate change in agriculture with discussions on Global Alliance for Climate-Smart Agriculture. Nebraska is known for its leadership in agricultural production and one germane concern is how we will be able to utilize the available climate data in a timely fashion to our advantage in protecting our crops from the negative impacts of climate change and pathogens. We need to act in a way that can leverage climate change to our advantage, where possible. It is important to monitor soil moisture and irrigation. Late planting and dryer than normal conditions in 2014 resulted in irrigation late into the season in some locations, which will unfortunately result in reduced profits for such farms.

Temperature is also an important factor. When conditions are warmer, crops tend to grow faster and the time for seed maturity reduces. However, warmer conditions have the potential to reduce yield and in addition, can promote certain diseases. The dry and hot weather conditions of 2014, for example, supported charcoal rot infections that were seen in both corn and soybean in many locations this year. Weed control and timely applications of herbicide will be crucial preparation steps in mitigating the impacts of climate change in 2015. Weeds not only act as alternate hosts for many pathogens but also deplete soil moisture. Below we present information on the influence of weather variability on development of diseases in Nebraska field crops. In 2015, crop production practices should be well planned to be climate-ready and climate-compliant.

Seedling Diseases in Corn and Use of In-Furrow Fungicides

The cool, wet, and often severe weather events during the 2014 cropping season led to numerous disease challenges in Nebraska's corn crop. Seedling disease pathogens especially took advantage of the cool and frequently rain in the spring of 2014. Some of the most common seedling diseases observed were those caused by *Pythium* species. *Pythium* species are in a group of fungus-like organisms called the Oomycetes. This group of organisms produces specialized long-lived and thick-walled reproductive and survival structures in the soil (called oospores). A common characteristic of *Pythium* species is that they require wet conditions (also giving them the name "water molds") for their specialized swimming "zoospores" to move through the soil seeking out plant roots. *Pythium* species (and the closely related *Phytophthora* species in soybean) can cause serious seedling disease and stand loss in corn (and soybean and many other crops). They can cause pre- and post-emergence damping off, root rot, seed decay and similar symptoms that can seriously affect stand establishment under adverse conditions killing a significant percentage of plants. Fortunately, all commercial field corn seed is treated with a seed treatment fungicide (except in very specialized cropping situations, such as organic production, etc.), or a cocktail of several products varying in their modes of action and efficacy on varying types of fungal pathogens. Specifically, products containing active ingredients like metalaxyl and mefenoxam, have been successful at controlling *Pythium* (and *Phytophthora*) species. Unfortunately, harsh weather, such as prolonged periods of wet and cool conditions like much of Nebraska experienced during the spring of 2014, can be especially favorable for long-term pathogen reproduction and plant infection. This sometimes exceeds the protection capabilities that some products are known to provide. Unfortunately, in commercial corn production where seed treatment products are pre-determined and applied at the seed company level prior to distribution, there are little to no opportunities to change or supplement seed treatment packages to gain added benefits in especially difficult planting environments. Altering the planting date is one way of manipulating the environment to favor a healthy stand establishment. Sometimes delaying planting date (by as little as a few days for certain high-risk fields with a history of seedling disease and stand establishment problems) can provide some reduction in disease pressure caused by certain pathogens. Doing so can sometimes allow time for field conditions to change, becoming more favorable for seed germination and emergence avoiding some disease pressure. Other practices, such as improving drainage in chronically wet fields or low areas (by tiling) can help to avoid wet conditions that can favor diseases caused by *Pythium* species. In addition, the increase in fungicide use and number of registered products available during recent years has increased dramatically in row crops, especially corn, providing another management option for several diseases. More recently, there has been an interest in expanding the ways that foliar fungicides are used in row crops, specifically the application timing and method. The use of the products in-furrow at planting has begun to increase and may provide additional benefits for seedling disease management in some crops. More extensive research trials have been conducted on the use of in-furrow fungicides in cotton, peanut, potato, and sugar beet. Testing conditions varied by year, location, crop, and disease pressure. However, during some crop years and testing conditions, improvements were reported in stand counts and height. These results indicate that under some growing conditions, in-furrow fungicides may provide benefits in stand establishment.

Soybean Seedling Diseases

Just like in corn, the wet cool soils resulted in mostly *Pythium* seedling diseases in soybean early in the season and *Phytophthora* as the soils warmed up. The high corn yields in 2013 and extreme cold over the winter resulted in large amounts of residue in many fields which kept soil temperatures cooler with the added blanket of corn residue in our no-till fields. The variable soil moisture and temperature resulted in very uneven soybean stands in many fields. In addition to the cool wet soils, hail in many areas stressed and/or killed seedlings resulting in a need for replant. Management of seedling diseases is reviewed in the "Soybean Disease Update" section.

Sclerotinia Stem Rot (White Mold)

The weather cycle over the last two years has provided conditions for more severe disease outbreaks with different profiles in soybean than the previous years. Sclerotinia stem rot, also referred to as white mold, is caused by a fungal pathogen that can reside in soybean fields for an indefinite amount of time. The fungus survives from year to year as hard dark structures called sclerotia. Sclerotia are variously shaped bodies of tightly packed white mycelium covered with a dark, melanized protective coat. These survival structures persist in soybean residue and soil waiting for optimum environmental conditions to occur. Saturated soils and a full canopy favor the emergence of apothecia from the sclerotia, which are mushroom-like bodies that produce millions of airborne spores almost daily over a 7- to 10-day period. These spores are released during favorable weather conditions and can travel to other fields in air currents. Disease development and spread will occur from flowering until pod formation. As the flower is directly related to disease development, this disease will only develop if we have wet, humid conditions at flowering with moderate temperatures (<85° F). This is why stem rot is not a consistent problem in most of the Nebraska soybean crop acres. This is also why the disease was more severe in 2013 and 2014 as we had cool, wet conditions during flowering. Spores infect plants like soybean primarily through colonized blossoms that are senescing but they can also infect through injured plant tissue. Free moisture must be present on the plant surface for infection to occur. Flowers on the tips of small pods provide a common entrance for the fungus. Invasion of the pod and eventually the stem may lead to lesions covered with sclerotia. During harvest these survival structures are scattered back onto the soil. Thus, inoculum for the next three or more seasons has been distributed. More information on symptoms and management are provided in the "Soybean Disease Update" section.

The white mold pathogen also causes a similar disease on dry beans, sunflowers, and potatoes. The incidence and severity on these crops is sporadic like that on soybeans described above due to these very specific environmental conditions that are needed for infections and disease progress. More information on this disease in dry beans is included in the "Specialty Crops Update" section.

Sugar Beet Fungicide Applications for Managing Rhizoctonia Root and Crown Rot

Rhizoctonia root and crown rot caused by the soilborne pathogen, *Rhizoctonia solani* is a common soilborne pathogen, and the most widespread, consistently damaging disease of sugar beets in Nebraska. As a soilborne resident, once the pathogen becomes established, it is very difficult, if not impossible to eradicate. Thus managing it effectively before severe damage occurs is also very challenging.

For those producers who determine that they need to treat for Rhizoctonia root rot, one of the options is to use fungicide sprays. Over the last 10 years this procedure has been widely adopted by growers and the product of choice has been almost exclusively azoxystrobin (Quadris). Due to the concern that the pathogen may potentially develop resistance to Quadris, we have additionally been evaluating the use of several newer labeled products with different modes of action for their ability to suppress the disease. Those additional fungicides tested included Headline (pyraclostrobin), Proline (prothioconazole), and Priaxor. Priaxor is a new fungicide that combines a carboxamide fungicide with a strobilurin (active ingredient in both Quadris and Headline).

We have additionally compared different treatments involving the four fungicides utilizing in-furrow applications shortly after planting alone and in combination with foliar treatments that were employed when soil temperatures averaged 65° F for three sequential days. Previous work the last 4 years has indicated that this is the best time for application to the canopies, rather than applications made at particular crop growth stages.

The results show that the combination treatments (furrow + foliar) consistently provided better yields and lower levels of disease incidence and severity compared to the controls and the treatments individually. More importantly, no differences were observed with those combination treatments utilizing Quadris, Priaxor, and Proline. Each equally reduced disease and improved yields. This is very good news as they have different modes of action and could easily be rotated without loss of effectiveness.

Common Bunt of Wheat

Another disease whose development is influenced by weather conditions is common bunt of wheat. In 2014, there were major outbreaks of common bunt in parts of western Nebraska and northeastern Colorado. These outbreaks can be attributed to wet, cool conditions during or following planting in the fall of 2013. The common bunt fungi infect wheat during germination. Spores of the fungi survive on the seed surface and in soil. The spores germinate and form mycelium in response to moisture. The mycelium penetrates and infects the coleoptile (sheath of tissue protecting the plumule or portion of the young shoot above the cotyledons) before the seedling emerges.

This process of infection is favored by cool temperatures (41 to 51° F). Therefore, in the presence of moisture and cool temperatures, the probability of infection of the seedling is significantly increased if the seed or soil is contaminated with common bunt spores. This explains the sporadic nature of common bunt. In years when these conditions (excessive moisture and cool temperatures) do not exist during planting in the fall, infection is not favored and therefore there may be no outbreaks of common bunt even in the presence of inoculum (spores) on the seed or in soil.

Once infection occurs, the mycelium systemically infects the plant and progresses to and inhabits the flower primordia of the head. The mycelium displaces all the seed tissues and eventually forms spores, resulting in bunt balls (seeds filled with common bunt spores). The bunt balls give off a pungent, fishy smell. During harvest, the bunt balls break and release the spores which contaminate the grain and soil.

The most effective strategies for managing common bunt are to plant clean seed and to treat seed with a systemic fungicide before planting. It is recommended that seed be treated by a professional seed treater. If seed is to be treated on-farm, ensure that it is cleaned thoroughly before treating and that there is thorough coverage with the fungicide. Avoid using farm-saved seed for the next wheat crop. Some wheat cultivars have partial resistance to the disease; however, most cultivars are susceptible.