

Integrated Management Strategies for Wheat Diseases

Principle Investigators:

Lawrence Osborne, Assistant Professor, Ext. Plant Pathology, SDSU
Kay Ruden, Research Associate I, Ext. Plant Pathology

Collaborators:

Karl Glover, Assoc. Professor, Spring Wheat Breeding, SDSU
Vacant, Winter Wheat Breeding
Jeff Stein, Assoc. Professor, Small Grains Pathology, SDSU
Marie Langham, Professor, Virology, SDSU
Michael Moechnig, Assistant Professor, Extension Weeds, SDSU
Ron Gelderman, Professor, Soil Fertility, SDSU

Plant diseases have always been major constraints on wheat production in South Dakota and throughout the region, however with proper management tools and techniques, diseases can be controlled or tolerated, resulting in significant economic returns for wheat producers. The major economic diseases of wheat in SD include scab, wheat streak mosaic and other virus diseases, cereal rusts, leaf spot complex (primarily tan spot and Septoria diseases), and root rot complex. Through funding from the SDWC and grants from the federal government, the Extension Plant Pathology project at SDSU conducts ongoing research to discover, test, and implement efficient integrated management strategies for several of these important diseases. Our primary emphasis over the last decade has been on chemical and cultural management, and that will continue under the proposed project, however we anticipate the integration of additional factors into our management research. These factors include: host resistance, soil fertility (as it affects disease development), and herbicide/fungicide interactions.

It has also been the role of Extension Plant Pathology to disseminate current research findings. Once management recommendations are developed, it is crucial to deliver the information to where it is needed most – into the hands of growers, crop managers, and other industry stakeholders. The overall objective of this proposed project is to continue development and testing of effective management methods for the major wheat diseases in the state of South Dakota, as well as for the active transfer of those recommendations into common practice within the state.

Chemical Disease Management

Objective:

Chemical fungicide treatments will be tested with the objective of measuring efficacy in managing endemic and epidemic fungal diseases of spring and winter wheat crops.

Justification:

Fungicide management remains the primary response to epidemics (outbreaks) of fungal diseases such as scab, cereal rusts, and leaf diseases when varietal resistance or other cultural methods do not provide satisfactory control. For some diseases such as scab, genetic resistance is generally considered to be inadequate in adapted varieties to manage epidemic levels of the disease. Other diseases such as stem rust, particularly the virulent 'Ug99' race may be virulent on some or all of

the adapted varieties in SD due to low frequency of host resistance, leaving producers and crop managers to rely on timely application of efficacious fungicides. Furthermore, endemic (routinely encountered) pathogens such as *Fusarium spp.* and *Bipolaris spp.*, present in many of our SD soils, threaten to infect the wheat crop before it even emerges from the soil. Protectant seed treatments are often relied on to provide protection to seed and seedlings when they are most vulnerable to attack by such opportunistic pathogens.

Progress:

For at least the past nine years, the SDSU Extension Plant Pathology project has tested the latest available fungicide formulations as well as many experimental products and formulations for the management of the major fungal diseases of wheat in South Dakota. Each year, recommendations have been created and distributed to South Dakota growers and crop managers to aid in their decision making relative to disease management. SDSU CES Publication FS917, 'Managing Crop Diseases With Fungicides' is an example of the information made available through this activity. Results of the 2007 studies as well as results from prior years can be found at: <http://plantsci.sdstate.edu/plantheath/publications.cfm>.

Proposed research priorities:

- 1.) Evaluation of fungicide seed treatment for managing soilborne pathogens causing root rot complex, seedling diseases of wheat, and smuts and bunts;
- 2.) Evaluation of foliar fungicide treatments for managing leaf diseases including tan spot, Septoria complex, and cereal rusts; and
- 3.) Evaluation of foliar fungicide treatments and timings for managing *Fusarium* head blight (scab).

Seed treatment. Winter wheat sites have already been planted, and are located at Brookings, SD and at Northeast Research Farm (NE Farm), near South Shore, SD. Spring wheat sites will be planted at the NE Farm and at Brookings. Treatments will include commercially available seed treatment formulations as well as several industry-supplied experimental treatments. All treatments will be applied to one or more wheat lines. Data collected will include emergence and stand counts as well as disease notes (subcrown internode ratings and crown evaluation) and harvest data (yield, test weight, protein).

Foliar fungicide for leaf diseases. A winter wheat site has already been planted, and is located at the NE Farm. Three spring wheat sites will be planted: NE Farm, Brookings, and near Groton, SD. Treatments will include most commercially available fungicides labeled for use on wheat, as well as several industry-supplied experimentals. Additional treatments of several of the formulations will also be incorporated to evaluate timing of application as a factor. All treatments will be applied to two or more adapted varieties with differential susceptibility to leaf diseases, in general. Data collected will include disease incidence and severity for fungal leaf spots, leaf rust, and stripe rust. For rusts, disease reaction type will also be noted if differences exist among treatments. Harvest data collected will include yield, test weight, and protein content.

Foliar fungicide for *Fusarium* head blight (scab). Study sites will be the same as for #2, above. The Brookings location will be mist-irrigated to create more favorable conditions for disease

development, and will be inoculated with *Fusarium*-colonized corn kernels, which will develop and release airborne spores of the fungus. Treatments will include commercially available products labeled for application to flowering wheat (growth stage Feekes 10.51) as well as industry-supplied experimentals and additional treatment combinations. Data collected will include scab incidence and severity, deoxynivalenol (DON) content in grain, and harvest data (yield, test weight, and protein).

Integrated Systems Research
(in collaboration with SDSU Soil Fertility and Extension Weeds)

Objective:

The objective of the proposed research is to examine the interaction of several crop management/cultural practices (herbicides, chloride fertilization, foliar-applied nitrogen, and variety selection) alone or in combination with other management strategies (fungicide sprays, seed treatments, tank-mixes) on the foliar diseases as well as scab.

Justification:

Fungicides used in plant disease management are only a part of the plant health management activity in wheat production. In fact, most wheat grown in the state receives some sort of fertility treatment as well as herbicide weed management. Occasionally, producers may also utilize foliar-applied nutrients, either as a fertility treatment or as a way to increase final grain nitrogen levels (used for protein estimates) to maintain full price or even achieve premium pricing for grain. These integrated treatment plans may have both positive and negative effects on disease in the wheat crop.

For example, based on a number of 'samples from the 2006 growing season, Extension weed specialist and plant pathologists concluded that herbicide/fungicide interactions may have led to environmentally-influenced injury symptoms. Supporting the conclusion is data from North Dakota State University suggesting that tank mixing fungicides, such as pyraclostrobin, with an herbicide containing bromoxynil (e.g. Bronate) increased incidences of wheat leaf burn over bromoxynil alone (19% vs. 4% leaf area affected, respectively) (K. Howatt et al. 2004). Further supporting data from Minnesota suggested that the pyraclostrobin+bromoxynil reduced wheat yield and increased *Fusarium* head blight severity compared to sequential applications (R. Severson and C. Hollingsworth, U of MN, Crookston, 2004). Environment also appeared to interact with treatments in both cited studies.

Chloride fertilization is an example of soil fertility treatments impacting plant health and disease. Fixen, 1993, details some of the interactions observed when chloride fertilizer was applied to wheat in South Dakota. The available information on this subject suggests that foliar and root diseases may be significantly impacted by chloride fertilization at planting. One drawback is that the effects have rarely been quantified in terms overall influence on disease suppression and economic impact. Also, foliar applied nitrogen has been shown to affect protein estimates in grain, but the effect on foliar or head diseases is not well understood. Furthermore, if disease management is not negatively influenced, nitrogen treatments may be tank-mixed with fungicide applied at proper timing for scab control (Feekes 10.51, flowering). Because of the increased

margins available to producers for some aspects of wheat production, it is thought that cultural or integrated methods of plant disease management such as those proposed for this study, might be attractive alternatives or additions to chemical disease management.

Progress:

The fertility components are new additions to the proposed research. In 2007, the herbicide/fungicide interaction study showed no effects on Harding winter wheat in Highmore, SD (Table 1). The treatments were applied during very cold conditions to induce injury, however snowy conditions were ultimately experienced, likely mitigating any effects by diluting the treatments.

Table 1: Herbicide/Fungicide Interactions, Highmore, SD (courtesy of Dr. Mike Moechnig)

<u>Treatment</u>	<u>Rate/A</u>	<u>% VCRR 7/10/07</u>
Untreated Check	----	0
<u>POSTEMERGENCE</u>		
Bronate Advanced+Headline	19.2 oz+3 oz	0
Bronate Advanced+Headline	38.4 oz+6 oz	0
Bronate Advanced	38.4 oz	0
Silverado+Bronate Advanced+Headline+MSO	1.78 oz+12.8 oz+3 oz+1.5 pt	0
WideMatch+Headline	16 oz+3 oz	0
WideMatch+Headline	32 oz+6 oz	0
WideMatch	32 oz	0
WideMatch+MCPA ester+Headline	16 oz+12 oz+3 oz	0
Silverado+WideMatch+MCPA ester+ Headline+MSO	1.78 oz+16 oz+12 oz+ 3 oz+1.5 pt	0
Weedmaster+Headline	12 oz+3 oz	0
Weedmaster+Headline	24 oz+6 oz	0
Weedmaster	24 oz	0

Proposed Research Priorities:

Under this focus area, we intend to establish studies aimed at investigating the interaction of fungicide management with herbicides, foliar-applied nitrogen and soil-applied chloride fertilizer. Data from all studies will include disease incidence and severity from any disease found to be significantly affecting the study areas. Harvest data (yield, test weight, and protein) will also be collected from the studies. When scab is found to be present, vomitoxin levels will also be assessed in grain after harvest. No funding is requested specifically for this focus area. However Extension Plant Pathology personnel will manage the data collection and processing from the integrated studies.

Applied Epidemiology

Objective:

The objective of this focus area is to apply epidemiological principles and current research to the integrated management of several important wheat diseases including scab, wheat viruses, and the rusts.

Justification:

Applied plant disease management of most diseases is achieved more easily once the etiology and epidemiology (disease development within plants and upon populations of plants) is fully understood. Diseases such as scab and the cereal rusts have specific environmental and biological conditions that must be met for disease to occur, or to reach high levels. Tools such as the wheat scab risk advisory tools developed at SDSU and elsewhere utilize environmental and biological signals to trigger applied management (such as fungicide applications). Beginning in 2008, the Extension Plant Pathology project will assume responsibility for the development and delivery of the SDSU Wheat and Barley Scab Risk Advisory.

Our program will also work cooperatively with the wheat breeding programs, small grain pathologist, and virologist to better understand the genetic frequencies associated with disease resistance in the respective programs. We hope to gain a strong understanding of the levels of resistance in adapted or developing lines, as well as within the genetic pool utilized by the breeders. That information allows our program to develop educational tools for growers to increase the adoption of multiple-disease resistant cultivars. The information also allows the program to observe any changes or shifts in geographical prevalence of certain diseases. That information becomes very useful, epidemiologically, if certain diseases significantly change in frequency or intensity.

Proposed research priorities:

Under this focus area, we intend to work closely with the breeders and pathologists to document and develop educational materials about the frequency of resistance sources, and phenotypic resistance observed in wheat to the major pathogens in SD. We also will use field monitoring to document and verify the effectiveness of integrated management, such as the use of our scab advisory to trigger fungicide decisions. The documentation of the economics of crop loss due to disease is made even more important by the changes in production and increase in prices as well as input costs.