KEYNOTE PRESENTATION

FUSARIUM HEAD BLIGHT OUTBREAK FREQUENCY UNDER A CHANGING CLIMATE ENVIRONMENT.

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EXECUTIVE SUMMARY

Fusarium Head Blight (FHB) is a re-emerging disease of increasing concern to wheat and other small grains with devastating impacts worldwide (Goswami & Kistler, 2004). In Brazil, FHB epidemics have become more frequent and often resulting in significant yield losses (Panisson et al., 2003). FHB constitutes a disease complex in which several fungal species may cause largely indistinguishable symptoms, although the predominant causal agent worldwide is the fungus *Gibberella zeae* (*Fusarium graminearum sensu stricto*, anamorph) (Goswami & Kistler, 2004). Previous reports in Brazil showed that *G. zeae* was the principal causal agent of FHB in wheat (Angelotti et al., 2006).

FHB is best known as a disease of flowering stage but evidences suggest that wheat may be susceptible at later stages of kernel development. In temperate climates, it has been reported that monoculture, reduced tillage, and maize-wheat rotations have greatly increased inoculum levels in soil (McMullen et al., 1997). In southern Brazil, inoculum is available the year round because of the abundant crop residues from other hosts, widespread no-till and the absence of freezing temperatures or dry seasons impairing fungal development (Fernandes, 1997).

Even though progresses have been made over time, disease control is still challenging. Most of cultivars in use do not possess desirable levels of resistance that could lead to a good genetic control. Breeding for wheat scab resistance is a difficult task but some progress has been achieved in the recent years (Mesterhazy et al. 2005). Although a range of fungicides have been identified with good activity against FHB pathogens, their efficacy is influenced by dose rate, application timing and spray quality for adequate spike coverage (Cromey et al., 2001). The strong dependence on environmental conditions and the relative narrow window of vulnerability to infection by the fungus makes FHB a suitable system for modeling and forecasting, which could lead to a rational and more effective disease control.

In the last few decades, modeling of plant diseases, especially computer modeling, has expanded very quickly and played an important role in integrated disease management. The recent advances in computer hardware and information technologies have assisted in this development, bringing operational advantages to speed up development and application of computer models representing complex processes. Modularity and generic are terms that describe the new and widely accepted methodology to surpass the complexities in the development and re-use of models. Our group has been applying novel software engineering techniques towards the development of linked crop-disease generic simulation models. These techniques revealed to be appropriate and robust to guide in the development of plant disease simulation models. In addition, combining a suite of technologies proved to be possible to use existing knowledge legacy.

Critical epidemiological knowledge of a plant disease is of fundamental importance for developing disease models. Epidemiological aspects of FHB have been studied in southern Brazil since early 1980's in both field and controlled environment. Climatic conditions are most suitable for the disease in that region and moderate to severe FHB epidemics show a periodical occurrence. Studies for developing an FHB model initiated by our group since late 1990s and the result-

ing models has improved along the years. It has been built based on existing knowledge on disease cycle components and a series of local studies to empirically model host development and inoculum availability. The FHB model has been validated against observed epidemic data from Brazil and well explained the variation in FHB severity under distinct conditions (Del Ponte et al., 2005). The model was further coupled onto a wheat growth and development simulation model. The wheat-disease model has been validated with regards to prediction of wheat phenological stages and FHB severity observed in Passo Fundo location, Brazil.

In this presentation, two applications of the model using an integrated systems approach for the development of a web-based information technology platform will be illustrated. First, the potential effect of climate changing/variability in a selected location in the main wheat regions of the Argentinean, Brazilian and Uruguayan Pampas was studied using the wheat-disease model**.** Using daily weather data from a 50-year period and assuming non-limiting inoculum conditions as input into the wheat-FHB model, our results showed that climate at Passo Fundo, Brazil, for example, was very favorable for FHB outbreaks after 1990 following a period of less favorableness for epidemics in the 1970s and 1980s, when outbreaks were very sporadic. Outbreaks were more frequent in El Niño than in La Niña years, especially for later planting dates in a crop year. These results suggest that, considering a fixed amount of inoculum, a changing climate (especially wetter) was associated with a higher frequency of outbreaks especially for the later plantings after the 1990s. Earlier sowing and use of early maturing varieties with a shorter reproductive period would be good strategies for Brazilian growers to avoid more favorable environment later in a season.

Second, the web-based platform has also the capability to forecast infection risks of FHB near real-time during the season. The system integrates hourly weather data collected in a network of weather stations and 5-days hourly forecast weather data generated by computer models. The user interacts with the system by selecting the nearest location and the crop heading date. The model then calculates risk of infections and warns the user whenever a risk level of concern is achieved, based on both actual and forecast weather. A user-friendly mapping interface is under development and weather data from other locations are being integrated into the system in order to generate regional risk maps, besides the site-specific predictions already available.

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