

GSCSSA Progress Report October 2006

Title:

Stem rust prediction and decision aid for disease management on grass seed crops.
(Funded for July 2004 - July 2005, at \$15,000, with a no-cost extension to July 2006)

Objectives:

1. Monitor and maintain an automated network of weather stations.
2. Add interactive features to stem rust web site (allow users to input scouting and spray information).
3. Improve model accuracy and test model output.

Investigators:

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Abstract of 2005 progress:

We modified the rust model and decision aid website to include kick-back activity and post-spray persistence of the two major types of fungicides used for rust control. We also added archived weather data from prior years, so that users can do "virtual experiments" on the web site to learn how the fungicides compare when used at various times during the growing season. Using the improved web site as a decision aid for demonstration field plots, we eliminated one spray application from half of the demonstration trials. The economic analysis done by the OSU extension cooperators showed significant economic return from using the model in these cases.

Justification:

Growers apply 2-4 sprays per season for control of stem rust in perennial ryegrass and tall fescue seed crops. Fungicides are often applied unnecessarily, because rust severity varies among years and locations. We are developing an Internet-delivered decision aid to optimize timing of fungicide sprays. On a regional basis, elimination of one scheduled spray on half the perennial ryegrass acreage would reduce grower cost by approximately \$1.8 million. This research aims to bring the decision aid to full function by operating the weather data collection system, adding critical interactive features to the web site, and testing the model in demonstration plots.

Progress:

(GSCSSA support of this project was for the period July 2004-July 2005, with funds expended through July 2006.)

The most significant outcome accomplished with the year of funding was the inclusion of fungicide activity in the predictive rust model available on the stem rust web site. These funds allowed us to incorporate results, from another research effort on

fungicides, into the decision aid. We reprogrammed the model to include postinfection ("kick-back") activity and post-spray persistence of the two major types of fungicides used for rust control. The fungicides differ quantitatively in their activity, especially during the critical stem-elongation phase of plant growth. We modified the web site to allow users to input dates and materials for spray events, and see the effects on estimated rust development for the current year. We also added archived weather data from several prior years and locations, so that users can do "virtual experiments" on the web site with prior years' data and learn how the fungicides compare when used at various times during the growing season. Using this improved web site as a decision aid, we advised our OSU extension cooperators on fungicide sprays for one of the treatments in their large-plot demonstration studies for rust control in growers' fields during the 2005 and 2006 seasons (two locations per year). This "rust model treatment" was compared with other standard fungicide treatment schedules. The results, published in the OSU Seed Research Report, showed that the decision aid eliminated one spray application from the treatments at each of two location-years (from a total of four location-years in 2005 and 2006). The economic analysis done by the OSU extension cooperators showed significant economic return from using the model in these cases.

Several aspects of the effort funded by this grant worked together to produce the improved decision aid described in the previous paragraph. The first component was to allow the continued operation of a system of in-field, automated weather stations that provide the backbone of the data to run the decision aid. In 2005 (the crop year of the funding) there were 15 weather stations, each reporting daily to a base station in Corvallis. Personnel supported by this grant created the protocols for routing the data and for performing the automated calculations necessary to transform the weather data into rust model inputs. This flow of information from automated weather stations in grass fields to web server was required to produce the web site on which a user can click a selected location in the grass seed growing region to load that location's weather into the rust model decision aid.

The next component needed in this effort was to re-write the rust model computer code to incorporate results of research on fungicide activity. Each of the major fungicides (strobilurins and DMI fungicides) has significant kickback activity, i.e. the ability to stop or slow infections that have already started at the time the fungicide is applied. The rust model runs as a day-to-day simulation, so incorporating kickback activity requires substantial computer programming such that a fungicide applied today can "go back in time " to affect infections that occurred as long ago as 10 days. Also, the interface for the web site was remodeled so that user inputs of fungicide type and date could be transferred into the rust model. This has been achieved, so that users can now easily try different fungicides and timings to view the comparative results. Results are displayed on the web site as a graph of rust severity, which can be compared with a critical threshold value shown on the graph. The dates and materials of fungicide use are also printed on the graph for easy reference. The web site was modified also to include two input types of scouting values for rust: pustules per foot of row and average pustules per 10 tillers. Taken together, this web site can now function

not only as a decision aid for the current season, but as a learning tool for fungicide use. By using archived data from prior years, together with the user's own knowledge of the way rust behaved in fields that year, a person can try out many "what if" scenarios for fungicide use to learn optimum strategies.

The third component in this effort was model testing. This was accomplished by personnel collaborating with OSU Extension County Agents, who set up a large demonstration plots for stem rust management in growers' fields. The field experiment design typically consisted of 4-6 treatments, each with three replicate plots which were at least 200 feet long. An automated weather station was established at each study site, and the weather data was handled as one of the 15 regional weather stations described in a previous paragraph. Stem rust ratings were taken in the field periodically. The decision aid web site was used by the PI's to determine the best time(s) for fungicide sprays, which were applied to one of the treatments ("model treatment"). Other treatments were various standard combinations and timings of fungicides, as determined by OSU extension personnel. At the end of the season, a weigh wagon was used to determine seed yield in each plot. Data on seed yield, and economic analysis based on seed price and cost of fungicide applications, were published in the OSU Seed Research Report. Results of the economic analysis as reported in the 2004 and 2005 Seed Production Research reports (Gingrich et al, 2004; Gingrich et al, 2005) are shown in the table below. It can be seen that spray decisions guided by the stem rust model gave an economic return greater than the standard fungicide schedules did at one of the two sites each year, and an equivalent return at the other site.

Table 1. Economic return (increased yield X seed price) per dollar spent on fungicide

	2004		2005	
	Location A	Location B	Location C	Location D
Rust model treatment	\$8.01 *	\$4.48	\$7.16	\$6.32 *
Standard treatments (average)	\$3.47	\$4.63	\$7.97	\$2.46

* Significantly greater than the standard treatment for that location-year.

Progress Report References:

Gingrich, G. A., Mellbye, M. E., Pfender, W. F., and Coop, L. B. 2005. Preliminary evaluation of the effectiveness of the USDA rust model on perennial ryegrass in 2004. *In* 2004 Seed Production Research at Oregon State University, USDA-ARS Cooperating. Department of Crop and Soil Science Ext/CrS. 124. p. 10-12.

Gingrich, G.A., Mellbye, M.E., Pfender, W.F. 2006. Field evaluation of the USDA rust model – year II. *In* 2005 Seed Production Research at Oregon State University, USDA-ARS Cooperating. Department of Crop and Soil Science Ext/CrS. 125. p. 27-30. 2006.

Pfender, W. F. and Coop, L. B. "Grass stem rust estimator" (website).
<http://pnwpest.org/cgi-bin/stemrust1.pl>

Interaction:

Cooperation on this project was primarily between the PI's and several OSU Extension faculty members. We worked with Mark Mellbye, Gale Gingrich, and Tom Silberstein in conducting the field demonstration experiments. We also work informally with Dr. Paul Jepson, Director of OSU Integrated Plant Protection Center, and Drs. George Taylor and Chris Daly of the Oregon Climate Service, in setting up the system for collection, transmittal and processing of weather data.

Timeline:

The weather stations whose operation was supported by this grant were in place by September 2004, and operated through July 2005. (Other funds were used to support the weather stations during the 2006 growing season). Improvements to the user interface of the web site were operational by March 2005. Demonstration plots, and cooperation with OSU extension, were in place for the 2004 and 2005 cropping seasons. Data were published in May of 2005 and 2006.

Publications, reports and presentations for current year:

Gingrich, G.A., Mellbye, M.E., Pfender, W.F. 2006. Field evaluation of the USDA rust model - year II. In 2005 Seed Production Research at Oregon State University, USDA-ARS Cooperating. Department of Crop and Soil Science Ext/CrS. 125. p. 27-30. 2006.

Pfender, W., Coop, L., and Upper, D. 2006. An interactive website to deliver a weather-based stem rust warning system for perennial ryegrass seed crops in NW USA. *Phytopathology* 96:S93.

Pfender, W. F. and Coop, L. B. "Grass stem rust estimator" (website).
<http://pnwpest.org/cgi-bin/stemrust1.pl>