USDA-ARS / USWBSI
FY03 Final Performance Report (April 1, 2003 – March 31, 2006)
Includes two one-year No Cost Extensions
July 14, 2006

Cover Page

PI:	**Jeff Andresen**
Institution:	**Michigan State University**
Address:	**Dept. of Geography** **Room 417 Nat. Sci. Bldg.** **East Lansing, MI 48824**
E-mail:	**andresen@msu.edu**
Phone:	**517-355-0231 x107**
Fax:	**517-432-1076**
Year:	**FY2003 (approx. May 03 – April 04)**
FY03 ARS Agreement ID:	**59-0790-1-067**
Agreement Title:	**Determination of Wetness Duration Using Radar-Derived Precipitation Estimates.**
FY03 ARS Award Amount:	**$ 25,902**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
EDM	Determination of Wetness Duration Using Radar-Derived Precipitation Estimates: FY2003.	$ 25,902
	Total Amount Recommended	**$ 25,902**

_____

Principal Investigator Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

Project 1: ***Determination of Wetness Duration Using Radar-Derived Precipitation Estimates: FY2003.***

1. What major problem or issue is being resolved and how are you resolving it?

Fusarium head blight (FHB) of small grains tends to be associated with particular environmental conditions, especially rain-induced wetness periods occurring near anthesis. Attempts to monitor and predict the risk FHB over large areas have been limited by the measurement of precipitation, which is among the most spatially discontinuous of all environmental variables. In this study, 4 km resolution precipitation estimates from National Weather Service weather radar are employed in a Geographic Information System-based model simulation of wetness duration periods for small grains over an area encompassing Michigan's Lower Peninsula using a crop canopy energy balance approach. Weather data for the system were obtained from National Weather Service (NWS), Michigan Automated Weather Network (MAWN), and other non-federal state networks. Risk of FHB was estimated with the two-algorithm methodology of DeWolf et al., 2002. Validations of the system were made with observations from the MAWN network as well as field FHB observations taken by Michigan State University Cooperative Extension Service. Given longer term regional shifts in climate, we also investigated potential temporal changes in the overall risk of FHB (as determined by the method of DeWolf et al.) across major wheat-producing areas of the U.S. Hourly meteorological data from 15 sites in major spring and winter wheat production areas were considered for the period 1948-2004.

2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

Accomplishment: Use of radar-derived precipitation estimates in a Geographic Information System framework shows promise for operational monitoring of leaf wetness for FHB and other foliar plant diseases. The radar-derived estimates were correct in identifying precipitation frequency 89.7% and 89.0% of time on a daily basis for NWS and MAWN networks, respectively, and 95.9% (NWS) and 95.6% (MAWN) of the time on an hourly basis. In terms of differences between estimated and observed precipitation totals, mean differences for daily and hourly periods over the 1999-2002 study period were -0.05mm and 0.13mm and -0.10mm and 0.01mm for NWS and MAWN networks respectively. Validation of the simulated leaf wetness duration in Lower Michigan at head height was also carried out. Overall, simulated leaf wetness duration per event tended to be less than observed leaf wetness, with mean differences and mean absolute differences between the two averaging -4.4 hours and 4.5 hours, respectively. The mean absolute difference for wetness events associated with precipitation events (those of most significance when monitoring for the incidence of FHB) was only 1.0 hour. The results suggest satisfactory performance with wetting events associated with precipitation, but tended to underestimate wetness duration associated with the formation of dew, especially at the onset of the event. Evaluation of the FHB risk scheme was carried out with field disease observations taken during the 2000 and 2004 growing seasons. The results were mixed, largely due to difficulty in estimating the date of wheat anthesis, an essential input variable in the disease scheme. The investigation of temporal patterns of FHB risk resulted in some notable regional

trends. Overall FHB risk was found to decrease over past 50 years across the western and southern Great Plains, and in the middle Mississippi Valley. FHB risk was found to have increased from the Red River and Middle Missouri Valleys eastward into the Great Lakes region. The increases in FHB risk appear to be associated with concurrent increases in precipitation. In many of the locations considered, FHB disease risk was relatively high during the 1970's and 1990's and relatively low during the 1980's.

Impact: This method of estimating wetness duration over large areas should enhance the ability of researchers to correlate specific weather data with the occurrence of plant foliar disease and ultimately allow operational regional monitoring of plant disease risk to assist producers in making disease control decisions. Results from the temporal trend study suggest that FHB risk is changing in certain wheat production regions due to changing climatological conditions.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?

The study confirms the utility and applicability of a technique that combines various layers of spatially-oriented and remotely sensed information to study a ground surface-based, environment-driven biological process over large areas.

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Presentations:

Andresen, J.A..and T.M. Aichele, 2003. Simulation of plant disease risk on a regional basis. Proc. American Society of Agronomy Annual Meeting, 5 Nov 2003, Denver, CO. Am. Soc. Ag., Madison, WI.

Andresen, J.A., T.M. Aichele, and A.Pollyea, 2003. Determination of wetness duration using radar-derived precipitation estimates. 2003 National Fusarium Head Blight Forum, 13-15 December 2003, Bloomington, MN. US Wheat and Barley Scab Initiative, Michigan State University, East Lansing, MI.

Andresen, J.A., T.M. Aichele, and A.Pollyea, 2005. Determination of Wetness Duration for Regional Plant Disease Management Using a Geographic Information System. Am. Meteorological Society 15th Conf. on Applied Climatology. Savannah, GA. 20-24 June 2005. American Meteorological Society, Boston, MA.

Publication:

Andresen, J.A. T.M. Aichele, and A. Pollyea, 2003. Determination of wetness duration using radar-derived precipitation estimates. Proceedings from 2003 National Fusarium Head Blight Forum, 13-15 December 2003, Bloomington, MN, p. 122. US Wheat and Barley Scab Initiative, Michigan State University, East Lansing, MI.

Andresen, J.A. T.M. Aichele, and A. Pollyea, no date. Estimation of Leaf Wetness Duration for Regional Plant Disease Management. Manuscript under development to be submitted to *Agriculture and Forest Meteorology.*