USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY06 Final Performance Report (approx. May 06 – April 07)
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Cover Page

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Fiscal Year:	2006
USDA-ARS Agreement ID:	59-0790-3-079
USDA-ARS Agreement Title:	Aerial and Ground Spray Application Technology for Enhanced Fungicide Efficacy for Control of FHB.
FY06 ARS Award Amount:	$ 52,740

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
CBCC	Aerial Spray Application Techology for Enhanced Fungicide Efficacy for Control of FHB.	$ 24,333
CBCC	Ground Spray Application Technology for Enhanced Fungicide Efficacy for Control of FHB.	$ 28,407
	Total Award Amount	**$ 52,740**

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Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Aerial Spray Application Techology for Enhanced Fungicide Efficacy for Control of FHB.*

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

Aerial application of fungicides has been reported on up to 50 % of the acres treated with fungicide for control of FHB. Almost no studies have been undertaken on barley evaluating application parameters of aerial application equipment with the goal of improving deposition and fungicide efficacy, e.g. what spray volume, and what spray drop size will maximize fungicide deposition on the grain head and maximize efficacy. A second year's study was conducted in a farmer's field in 2006 to evaluate spray volumes of 3 and 7 GPA and 'large' fine and medium drop sizes to determine if any of the parameters provided greater deposition and efficacy.

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: Drop size and spray volume did not affect dye deposition on the barley heads. Increasing spray volume increased coverage on water sensitive cards. The greatest coverage on the cards was attained with the 7 gpa treatment utilizing 400 micron volume median diameter drops. No disease developed at the site so efficacy was not determined.

Impact: Future studies with aerial fungicide application technologies will need to increase the number of replicates and samples to measure statistical differences. Increased risk of success occurs in aerial type studies due to the necessity to use large grower's fields without supplemental additional inoculum sources and microclimate modifications to increase chances of disease development.

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?

Based on 12 aerial fungicide application studies on small grains a publication recommending a set of aerial application parameters is being distributed to applicators in 2007 describing best known methods to maximize fungicide efficacy. A general understanding of the scope, difficulty, and cost associated with evaluating aerial application equipment on field scale bases was developed.

Project 2: *Ground Spray Application Technology for Enhanced Fungicide Efficacy for Control of FHB.*

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

Spray systems with air delivery type units are being utilized more frequently by growers and commercial applicators for applying fungicides for FHB control. Most applicators have not been provided with supporting operating parameters for this type of equipment to maximize fungicide deposition and efficacy. Results have been inconsistent and sometimes disappointing. A preliminary study using a farmer's field scale air-assist sprayer identified operating parameters that affected fungicide deposition.

Adjuvants are recommended added to fungicides solutions for improved fungicide performance. A screening of several adjuvant types in combination with fungicide and a dye were evaluated on barley to measure effects on fungicide efficacy and dye deposition. Awns were separated from the rest of the spike above the glume and deposition of dye on the barley head was determined.

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: Application of fungicide with specific drop sizes has been shown to affect the quantity of fungicide deposition on the grain spike. Air delivery sprayers are utilized by an increasing number of growers. Air delivery sprayers can use different air delivery speeds as one of their operating parameters. The interaction between different air delivery speeds and two different nozzle types was measured using a Hardi-Twin sprayer. No interactions between drop size and air delivery speeds for fungicides to wheat spikes have previously been reported. Greater quantities of dye were recovered from wheat spikes when air delivery speeds were operated at the equipment maximum (2400 rpm or about 50 mph at the exit point of the orifice). Deposition on water sensitive cards by the cooperator's typical operating parameters (company supplied nozzles, 90 psi and 2400 rpm) indicated that using a larger drop size (50 psi) and the equipment maximum air speed (2400 rpm) increased both deposition and coverage area on water sensitive cards.

Approximately 75 % of the deposited fungicide solutions are collected on barley awns leaving about 25% on the glume areas of the head.. Some adjuvant types more effectively increased deposition on the awns and whole head. Deoxynivalenol levels were not statistically different among treatments although some levels were reduced by close to 50% from no adjuvant treatments and an untreated. One wonders if changing the number of replicates or sampling procedures may show differences. No differences among FHB field severities among the adjuvant treatments were measured. Significant correlations were measured between dye coverage on the grain, awns, and whole head and deoxynivalenol levels in the harvest sample.

Impact: This preliminary study indicates that in addition to drop size, air delivery speeds need to be considered as critical operating parameters for air-assist type spray systems. An evaluation of delivery angles relative to the grain spike is warranted to improve deposition and efficacy.

Interest in evaluating adjuvants for improved fungicide efficacy has been generated in the manufacturing community. Some compounds will be further evaluated in 2007 for promise in improving deposition on the parts of the spike. A refinement in the sampling procedure will be made in hopes of measuring differences on deoxynivalenol levels on barley. The research will be expanded to hard red spring wheat in the future.

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 farmer cooperator will be able to increase deposition and fungicide efficacy by increasing the drop size while continuing to utilize maximum air delivery speeds of the equipment. Future evaluations of relative orifice angle may improve the efficiency of air delivery systems.

Additional studies will be undertaken in 2007 to evaluate adjuvants as additives to improve fungicide efficacy on wheat and barley.

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.

R.E. Oliver, X. Cai, T.L. Friesen, S. Halley, R.W. Stack, and S.S. Xu. Evaluation of Fusarium head blight resistance in tetraploid wheat (*Triticum turgidum* L.). Accepted for publication in Crop Science.

Halley S., Van Ee G., Hofman V., Panigrahi, S. and Gu, H. Fungicide Deposition Measurement by Spray Volume, Drop Size, and Sprayer System in Cereal Grains. Accepted for publication in Applied Engineering in Agriculture.

Hofman, V., Halley, S., Van Ee, G., Hollingsworth, C., McMullen, M., and B. Ruden, 2007. Aerial application of fungicide for the suppression of Fusarium head blight in small grains. North Dakota State University Extension Report AE-1327.

Hofman, V., Halley, S., Van Ee, G., Draper, M., McMullen, M., and C. Hollingsworth. 2006. Ground application of fungicide for the suppression of Fusarium head blight in small grains. North Dakota State University Extension Report AE-1314 4 p.

Fritz, B.K., I.W. Kirk, W.C. Hoffman, D.E. Martin, V. Hofman, C.R. Hollingsworth, M. McMullen and S. Halley. 2006. Aerial application methods for increasing spray deposition on wheat heads. Applied Engineering in Agriculture. 22 (3) 357-364.

Halley, S., and Hofman V. 2006. Evaluation of fungicide for control of Fusarium head blight with aerial application technology. May 2007 at <http://www.ag.ndsu.nodak.edu/langdon/06data/barley_aerial_esmond06.pdf>.

Halley, S., Hofman V., and G. Van Ee. 2006. Assessment of air stream speed with two nozzle types as a tool to improve deposition of fungicide for control of FHB in wheat. May 2007 at <http://www.ag.ndsu.nodak.edu/langdon/06data/fungicidedeposition.pdf>.