

U.S. Wheat and Barley Scab Initiative
FY02 Final Performance Report
 (approx. May 00 – September 30, 2002)
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Cover Page

PI:	Suranjan Panagrahi
Institution:	North Dakota State University
Address:	Agriculture & Biosystem Engineer Depart. 1221 Albrecht Blvd. Fargo, ND 58105
Email:	Suranjan_Panigrahi@ndsu.nodak.edu
Phone:	701-231-7270
Fax:	701-231-1008
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2000 ARS Award Amount:	\$9,756

Project

Program Area	Project Title	Requested Amount
Chemical & Biological Control	Improved spray application and objective evaluation system for control of FHB.	\$19,854.00
	Requested Total	\$19,854.00¹

Suranjan Panigrahi *March 15 '03*
 Principal Investigator Date

¹ Note: The Requested Total and the Award Amount are not equal.

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Project 1: Improved spray application and objective evaluation system for control of FHB.

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

The overall goal of this project is the further improvement of the fungicide application system and fungicide coverage evaluation system against FHB (Scab).

A fungicide coverage evaluation system is based on computer-based fluorescence imaging technology. A fluorescence dye is mixed with spray chemical (fungicide) and the image of the sprayed grain head is acquired with a computer imaging system. One important aspect of this computer imaging system is the development of image processing and analysis techniques for quantifying the coverage on grain (barley/wheat) heads. A hybrid optimum algorithm (based on two different histogram based automatic segmentation techniques) has been developed and it provided a maximum error of 2% as compared to visual evaluation (test on 530 sprayed images). Software was also developed to determine droplet size diameters and their distribution.

Investigation was also conducted to evaluate the possibility of using GFP (Green Fluorescence Protein) to replace fluorescence dye. The images of sprayed heads acquired by the computer imaging system provide information of spatial distribution of droplets on grain heads. The visual observation of those raw and segmented images (only showing the droplets) can be very informative regarding the performance of a given spray application system and its associated parameters. Thus, a technique based on wavelet transformation was developed to store images grain heads in computer in an efficient manner while containing significant information. Wavelets transforms (such as Haar, db6, db4 and Sym4) showed satisfactory performance for compressing grain head images.

To determine the optimum dye (Day-glow blaze orange) concentration, studies were conducted on comparing spray coverage using different dye concentrations on grain heads. Additional studies were conducted using spectrofluorometer and our developed fluorescence imaging system. Based on the obtained result, a volumetric dye concentration of 1.75% was selected. Study of dye concentration on wheat heads also showed a dye concentration of 1.6-2.0% to give optimal average spray coverage.

The fluorescence decay characteristics of the spray mixture (a. dye with water and surfactant; & b. dye with fungicide and surfactant) on wheat heads during a fixed period of time were studied. In both cases, adjuvant Induce at 0.06% (by volume) was added and in both cases, Day-glow Blaze Orange at 1.75% volumetric concentration was used. The fungicide used was Folicur at 0.17% (by volume). In both the cases, it was found that during the 3-hour time period, no significant differences could be detected. That indicated that the fluorescence decay did not occur significantly during 3-hour period after spray.

A high-speed computer vision system along with a particle imaging velocimetry (PIV) system were used to further understand the effect of different parameters on sprayed chemical after they leave the nozzle. Spray parameters evaluated in this objective were different spray nozzles, spray

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pressures, spray heights, and wind speeds. Statistical analysis showed that spray angles and spray droplet size distributions were affected by the single main factor, spray nozzle. Wind speed had minor effect.

An air-assist sprayer prototype was designed and developed for applying fungicide (Folicur) for scab control. A Proptec rotary atomizer was integrated in the design. A field test was done to compare Proptec sprayer against conventional and "Spray-air" and the water sensitive paper study showed that the card on the front side of Proptec showed excessive coverage. It was also tested in greenhouse and spray coverage on barley plants, as determined by the developed fluorescence imaging system, showed a steady increase with increasing application rates.

2. What were the most significant accomplishments?

Algorithms/software have been developed for objective quantification of spray coverage of wheat/barley heads and for determination of drop size distribution. Study was conducted to determine optimum dye concentration (for Day-Glow Blaze orange). Study using high speed imaging and PIV (Particle Imaging Velocimetry) was conducted to determine effect of different spray parameters on sprayed chemicals after they leave the nozzle. A prototype of air-assist sprayer was designed and tested. The associate research activities have been presented in several conferences. One M.S. student used most of the research activities as part of his thesis.

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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.

Panigrahi, S., H. Gu, V. Hofman, M. McMullen, and S. Halley. 2000. 'SCES' An objective fungicide coverage evaluation system for control of Fusarium head blight. ASAE Paper No. 00-1115. St. Joseph, MI.

Gu, H., S. Panigrahi, V. Hofman, S. Haley, and M. McMullen. 2001. Effect of dye concentration on spray coverage in wheat/barley Heads. ASAE Paper No. 01-1118. ASAE, St. Joseph, MI.

Venugopal, M., S. Panigrahi, and H. Gu. 2001. Fluorescence decay characteristics of sprayed fungicide (with dye) on wheat heads. ASAE paper No. SD01-128. St. Joseph, MI.

Panigrahi, S., H. Gu, S. Halley, and M. McMullen. 2001. Dye rate determination in spray coverage evaluation system for wheat/barley heads. ASAE paper No. 01-1118. St. Joseph, MI.