U.S. Wheat and Barley Scab Initiative
FY01 Final Performance Report (approx. May 01 – April 02)
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Cover Page

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Year:	**FY2001 (approx. May 01 – April 02)**
Grant Number:	**59-0790-9-065**
Grant Title:	**Fusarium Head Blight Research**
FY01 ARS Award Amount:	**$ 81,641**

Project

Program Area	Project Title	Requested Amount
Chem/Bio	Uniform Fungicide Trials to Identify Safe Products That Are Effective Against Fusarium Head Blight	$ 5,000
Epid/Dis. Mgt.	Forecasting Wheat Scab Based on Weather and Pathogen Monitoring	$ 35,867
Germplasm	New Sources of Resistance to Fusarium Head Blight of Wheat	$ 42,934
	Total Amount Requested	**$ 83,801**

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Principal Investigator Date

(Form – FPR01)

Project 1: Uniform Fungicide Trials to Identify Safe Products That Are Effective Against Fusarium Head Blight

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

Scab has become a serious disease of wheat and barley in many areas of the US. Although resistance will be an important component of a disease management strategy, fungicides may be required to augment resistance under conditions highly favorable for scab, and may be required for cultivars that lack effective resistance.

2. What were the most significant accomplishments?

Trials were located at 2 locations in Indiana (ARC in Tippecanoe Co. and SEPAC in Jennings Co.). Several fungicides and 2 biological materials were applied at the flowering stage of wheat to test their efficacy against scab. Some of the fungicides were also applied at early flag leaf emergence to investigate the effect of timing on control of foliar diseases. Scab developed only at SEPAC. Disease incidence was low, but there were significant differences among treatments. No treatment had less head blight or fewer scabby kernels in harvested grain than seen in the untreated control. Two treatments applied at flowering (Folicur and AMS 21619) did reduce DON contamination compared to the untreated control. There was a highly significant correlation between incidence of head blight in the field and number of scabby kernels (R=0.87) and DON level (R=0.87), and between number of scabby kernels and DON level (R=0.90). Yield was not correlated with any of the disease measurements.

Stagonospora leaf blotch was the only foliar disease that developed at ARC and was confined mainly to leaf flag-2 or below. All fungicides reduced severity of leaf blotch compared to the untreated control, but the biological materials were ineffective. No treatment yielded more or less than the untreated control, and none had a test weight greater or less than that of the untreated control. Leaf blotch was more severe at SEPAC than at ARC. By the time of the final assessment, most of the flag leaf area was blighted in the untreated control and some treatments. At SEPAC also, the biological materials were ineffective against leaf blight. Several fungicide treatments kept the flag leaf green. Folicur, AMS 21619, and a tank mix of Headline and Folicur, all applied at Feekes 10.51, gave the best control of leaf blotch as well as of *Fusarium* head blight. Treatments that were ineffective toward leaf blotch were also ineffective against *Stagonospora* glume blotch.

Project 2: Forecasting Wheat Scab Based on Weather and Pathogen Monitoring

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

Effective management of scab requires a thorough understanding of the relation between weather and inoculum production, inoculum dispersal, and disease development. This information is necessary to develop disease forecasts, which can be used to assess risks of scab in various regions, for making decisions about whether and when to use fungicides, and for decisions about marketing and utilizing grain. Understanding these relations will permit creation of conditions that permit effective selection for resistance in the field, or for evaluation of experimental fungicides or other control measures.

2. What were the most significant accomplishments?

We sampled airborne spores of *Gibberella zeae* with 2 Burkard volumetric samplers during the spring. One sampler was in a wheat field that had corn residue covering 47% the soil surface; the other was about 100 m to the north on sod. We also quantified colony-forming units (cfu), i.e., spores, by washing 5 wheat heads each day in 50 ml of water and plating samples of the washing on Komada's medium. By either sampling method, we recovered very few cfu per day during the time wheat was flowering (11 to 17 May). During the last week of May, when wheat was in the milk stage of development, cfu were somewhat higher (50 to 300 cfu per head) or 3 to 7 $cfu \cdot m^{-3}$ of $air \cdot day^{-1}$. There was a strong correlation between cfu recovered by the 2 Burkard samplers (r=0.86), but the sampler placed in the field with corn residue collected on average 10% more propagules than the sampler placed 100 m from residue. There was a poor correlation between propagules recovered by the Burkard sampler in the residue field and propagules recovered from wheat heads in the same area (r=0.225, NS). The low number of propagules recovered by either method may account for this low correlation. During the 2 weeks prior to flowering, rain fell on only 3 days, for only 1 or 2 hours per day. Number of cfu recovered did not surge until after a 2-day period of rain, with durations of 8 and 4 hours. This was at the end of anthesis. As expected from the low number of airborne propagules during anthesis, scab incidence was nil in the wheat plots. We evaluated risk models, developed by DeWolf et al. from data collected from this multi-state project. Model I uses weather data before anthesis and predicts the production of inoculum. Model II uses both pre- and post-anthesis data to predict both inoculum production and infection. Both models indicated low probabilities of severe scab (in these models, severe scab is taken to be an incidence of greater than 10%), and this was consistent with observed disease incidence.

Project 3: New Sources of Resistance to Fusarium Head Blight of Wheat

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

Scab has become a serious disease of wheat and barley in many areas of the US. Resistant cultivars will be an important component of an integrated disease management strategy. In wheat, most disease resistance breeding programs are utilizing resistance from Sumai 3, a resistant spring wheat cultivar from China, or Ning 7840, a closely related cultivar. While this resistance appears to be the best available, and reasonably effective, it does not totally prevent disease development. There is also concern when wheat breeding programs over a wide area all rely on the same source of resistance. If any of the *Fusarium* species capable of causing scab were to adapt to this resistance, millions of hectares of wheat could become vulnerable to infection. This project is designed to find other sources of resistance to scab, with two objectives: to provide genetic diversity for resistance and to enhance the degree of resistance conferred by the Sumai 3 source of resistance.

2. What were the most significant accomplishments?

From a large number of wheat accessions, we have selected lines that have Type II resistance to *F. graminearum*. When we compared 49 of these lines to both single-floret inoculation and whole spike inoculation (spraying the spike with a spore suspension), the effects of line, inoculation method, and line x inoculation were all highly significant. Overall, the spray inoculation resulted in the greater severity, but a few lines showed the opposite pattern. Four lines reacted entirely different to the 2 inoculation methods. They were highly resistant when a single floret was inoculated, but fully susceptible when the entire head was inoculated. This suggests that they have a high degree of Type II resistance but little or no Type I resistance.

We evaluated F3 progeny (usually 10 plants/family) from tested F2 plants for scab resistance following single-floret inoculation. Reaction to infection was expressed as the number of blighted spikelets 20 days after inoculation. Based on 243 families from a diverse set of resistant parents crossed to susceptible cultivars, there was a poor correlation between the mean reaction of the progeny and the parent plant ($r=0.115$). Some progeny of susceptible F2s were resistant; some progeny of resistant F2s were susceptible. None of the progeny families were fully susceptible (i.e. all or most spikelets of every plant blighted). There are at least 2 possible reasons to account for the poor relation between F2 parent reaction and F3 progeny mean reaction. One is the error associated with the single-floret inoculation. Inoculation may fail in some cases. Of the more than 2200 heads inoculated, 48% developed no blight symptoms. Given that many of these were progeny of apparently resistant plants, this is not surprising, but some of these symptomless plants may have been escapes. Another reason that could account for the lack of close correlation is that resistance may be partially recessive. In this case, it would be expected that susceptible F2 plants would give rise to progeny that included resistant plants.

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.

Day, K. M., Lorton, W. P., Buechley, G. C., and Shaner, G. E. 2001. Performance of public and private small grains in Indiana, 2001. Indiana Agricultural Research Programs Purdue University Station Bulletin No. B 805 (www.agry.purdue.edu/ext/variety.htm).

Guo, P., Bai, G., Shaner, G. E. 2001. A STS marker for scab resistance QTL in wheat derived from PSt I-AFLP. p. 15. *In* 2001 National Fusarium Head Blight Forum Proceedings, Canty, S. M., Lewis, J., Siler, Ward, R. W. *eds*.

Shaner, G., Buechley, G. 2001. Estimation of Type II resistance – a dilemma in need of a solution. p. 156-160. *In* 2001 National Fusarium Head Blight Forum Proceedings, Canty, S. M., Lewis, J., Siler, Ward, R. W. *eds.*

Shaner, G., Buechley, G. 2001. New sources of resistance to Fusarium head blight of wheat. p. 203-206. *In* 2001 National Fusarium Head Blight Forum Proceedings, Canty, S. M., Lewis, J., Siler, Ward, R. W. *eds*.

Shaner, G., Buechley, G. 2002. Control of wheat diseases in Indiana with foliar fungicides, 2001. Report no. 57:CF04. Fungicide and Nematicide Tests, http://www.scisoc.org/online/FNTests/vol57/top. htm.