

**U.S. Wheat and Barley Scab Initiative
 FY02 Final Performance Report (approx. May 02 – April 03)
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Cover Page

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Project

Program Area	Project Title	USWBSI Recommended Amount
VDUN	Enhanced resistance to Fusarium in two-rowed barley.	\$73,259
GIE	Resistance to FHB in wild barley associated with leaf rust locus <i>Rph15</i> .	\$5,000
	Total Amount Recommended	\$78,259

 Principal Investigator

 Date

Project 1: Enhanced resistance to Fusarium in two-rowed barley.

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

This research is designed to improve resistance to Fusarium head blight (FHB), incited primarily by *Fusarium graminearum*, in two-rowed spring malting barley (*Hordeum vulgare*) cultivars for the Upper Midwest. For malting barley growers, this means cultivars that accumulate little or no deoxynivalenol (DON). Many years are required to achieve this goal; thus, intermediate goals include: 1) identifying good selections from crosses to FHB resistant accessions, 2) improving FHB resistance in locally adapted cultivars by crossing to elite lines, and 3) studying genetic mechanism that retard incorporation of FHB resistance into locally adapted cultivars. Accessions previously identified as partially resistant to FHB were crossed again to elite breeding lines. The F₅ lines from these crosses were evaluated in FHB screening nurseries near Hangzhou, China and Osabrock, North Dakota (ND). Breeding lines were evaluated for FHB response because two-rowed barley cultivars have some resistance to FHB and DON accumulation.

Initial breeding efforts have produced few two-rowed barley lines with improved FHB resistance. The best ones are taller and later than adapted cultivars. Genetic studies of quantitative trait loci (QTL) for FHB resistance have demonstrated that several QTLs are located in chromosome 2H near loci that control spike type, plant height, and photoperiod response. To better define the problem, linkage distances between marker genes in centromeric region of chromosome 2H are being estimated. Plant height and maturity genes in progeny from crosses to Chinese cultivars are being studied because they affect the local adaptation of new lines. Chinese and Japanese barley cultivars are being retested to identify better sources of FHB resistance.

2. What were the most significant accomplishments?

Some ND farmers have found that growing the two-rowed cultivar Conlon does limited DON accumulation. Research results show that Conlon accumulates less DON than other cultivars recommended for ND. Conlon, which was recommended for malting in 2000, was planted on 10.8% of the ND barley area in 2002. Retesting Chinese and Japanese cultivars has identified Shenmai 3, Guan 78-101, and Zhouri 19 as the best ones for FHB resistance. The correlation between FHB response and DON accumulation was low in these studies. Evaluation of single-seed descent lines from crosses between Chinese and ND cultivars showed that some lines have much lower FHB incidence levels than either parent. A similar result was found when the Morex-Harrington doubled haploid lines were tested for FHB response. Yet, few lines were identified that had both improved FHB resistance and acceptable agronomic traits. These results suggest that adverse linkage is only one of several factors that limit success in incorporation of FHB resistance into adapted lines. The range of heading dates was 35 days in China. Photoperiod responses in nurseries in China, New Zealand, and ND nurseries indicate that at least eight genes are involved: *Eam1*, *Eam6*, and *Eam11* for long-day response; *Eam5* and *eam9* for short-day response; and at least three other factors that influence expression of early maturity genes. Besides interacting with each other, the early maturity genes also interact with genes for plant height and vernalization requirement. The results suggest that adapted lines with better FHB resistance can be identified using the genetic resources available in barley.

Project 2: Resistance to FHB in wild barley associated with leaf rust locus Rph15.

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

This research investigated if partial resistance to Fusarium head blight (FHB) has already been transferred from wild barley (*Hordeum vulgare* subsp. *spontaneum*) to Midwest two-rowed barley (*H. vulgare* subsp. *vulgare*). The *Rph15* gene for leaf rust resistance is located in chromosome 2H near *vrs1-Eam6* region, which is associated with FHB resistance (*Rfg* genes) in several mapping populations. Since some wild barley accessions were reported to be partially resistant to FHB, linkage drag with the *Rph15* gene may have transferred FHB resistance to cultivated barley. Leaf rust resistant Bowman backcross-derived lines from 39 different *H. v.* subsp. *spontaneum* accessions were evaluated at three different sites for their reactions to FHB. Partially FHB resistant cultivars and Bowman backcross-derived lines with other *Rph* genes were used as controls. The morphological similarity of Bowman and backcross-derived lines with *Rph* genes was evaluated in tests at other sites. This information will be used to determine the potential value of specific *Rph15* lines in barley breeding programs.

2. What were the most significant accomplishments?

Only minor differences in response to FHB were observed among the Bowman backcross-derived lines having leaf rust resistance genes. The disease incidence was high in all three nurseries in which the Bowman *Rph15* lines were tested. In the nursery at Hangzhou, China, over 50% of the kernels were infected and the only difference detected was a few lines with higher disease readings than Bowman. In the nurseries at Osnabrock and Langdon, ND, the average frequency of FHB infected kernels was about 30%. The *Rph15* lines with PI 355444 and PI 405201 as donor parents appeared to have lower FHB readings. Bowman backcross-derived lines with the *Rph1* and *Rph13* genes from Lechtaler and PI531849, respectively, also had lower readings. The *Rph1* gene maps in chromosome 2HS and the location of *Rph13* is unknown. The six-rowed check cultivar and the *Rph15* line from PI 391024 had higher readings at both ND locations. These results suggest that none of the Bowman backcross-derived with the *Rph15* is much more resistant to FHB than Bowman. The line from PI 355447, which is commonly used as a source of the *Rph15* gene, did not differ from Bowman in reaction to FHB. Some of the *Rph15* lines differed from Bowman in plant height, seed size, and lodging score.

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.

Agrama, H.A., L.S. Dahleen, R.D. Horsley, B.J. Steffenson, P.B. Schwarz, A. Mesfin, and J.D. Franckowiak. 2002. QTL analysis of Fusarium head blight in barley using the Chinese line Zhedar 2. p. 2. *In* S. Canty, J. Lewis, L. Siler and R.W. Ward (eds.) Proc. 2002 National Fusarium Head Blight Forum, Erlanger, KY. 7-9 Dec. 2002. Michigan State University.

Franckowiak, J.D. 2002. Coordinator's report: Chromosome 2H (2). *Barley Genet. Newsl.* 32:144-146.

Franckowiak, J.D. 2002. Coordinator's report: Semidwarf genes. *Barley Genet. Newsl.* 32:168-171.

Franckowiak, J.D. 2002. Variety development and uniform nurseries: FHB resistance in barley. p. 232-233. *In* S. Canty, J. Lewis, L. Siler and R.W. Ward (eds.) Proc. 2002 National Fusarium Head Blight Forum, Erlanger, KY. 7-9 Dec. 2002. Michigan State University.

Franckowiak, J.D., and A. Hang. 2002. Evaluation of Bowman backcross-derived barley genetic stocks. p. 23. *In* Proc. 17th N. Amer. Barley Researchers. Workshop, 22-25 Sept. 2002, Fargo, ND.

Franckowiak, J.D., and U. Lundqvist, L. 2002. Descriptions of barley genetic stocks for 2001. *Barley Genet. Newsl.* 32:49-137. (Fifty-five new and revised Barley Genetic Stock (BGS) descriptions are presented.)

Franckowiak, J.D., G.-T. Yu, and N Krasheninnik. 2003. Genetic control of photoperiod responses in spring barley. p. 98. *In* Proc. 3rd Canadian Barley Symposium, 19 and 20 June, 2003, Red Deer, Alberta, Canada.

Krasheninnik, N., and J.D. Franckowiak. 2002. Spike morphology and FHB reaction in barley. p. 27. *In* Proc. 17th N. Amer. Barley Researchers Workshop, 22-25 Sept. 2002, Fargo, ND.

Urrea, C.A., R.D. Horsley, B.J. Steffenson, and J.D. Franckowiak. 2002. Registration of 6NDRFG-1 six-rowed barley germplasm line with partial Fusarium head blight resistance. *Crop Sci.* 42:675.