USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
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Cover Page

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Year:	**FY2003 (approx. May 03 – April 04)**
FY03 ARS Agreement ID:	**59-0790-9-031**
FY03 ARS Agreement Title:	**Crop residue management and dryland screening techniques for improved management FHB.**
FY03 ARS Award Amount:	**$ 76,884**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
EDM	Crop residues and the survival, production and control of Fusarium inoculum.	$ 68,293
VDUN	A dryland inoculation screen for spring wheat reaction to Fusarium head blight.	$ 8,591
	Total Amount Recommended	**$76,884**

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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: ***Crop residues and the survival, production and control of Fusarium inoculum.***

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

Fusarium-infested residues left on fields after harvest provide inoculum for the development of subsequent Fusarium head blight (FHB) epidemics. An understanding of the role of crop residues in the survival of *Fusarium* and production of primary inoculum is essential to evaluate management strategies aimed at the reduction of inoculum. Such strategies may include the use of colonization-resistant cultivars and residue treatments to reduce inoculum. In a continuing study, field experiments were conducted to determine the relative ability of the residues of newly released wheat cultivars, with improved levels of FHB resistance, to harbor inoculum of *F. graminearum*; to determine the field-scale movement of inoculum by examining the patterns of spread of *F. graminearum* into burned plot areas from adjacent areas with higher levels of infested residues to aid in our understanding of the effectiveness of burning; and to further examine the effect of severity of burning on the survival of *Fusarium* in wheat residues.

2. What were the most significant accomplishments?

We showed that the incidence of kernel colonization by *F. graminearum* (*Gz*), *F. avenaceum*, *F. sporotrichioides*, and *F. poa* in sixteen wheat and eight barley entries grown at five locations in 2003 was affected by cultivar location and the interaction of cultivar by location. Overall, moderately FHB-resistant wheat cultivars, such as Alsen, had lower levels of *Gz*-colonized kernels than susceptible or moderately susceptible cultivars such as Oxen, Reeder, Mercury, or Norpro. Hanna also had low levels of *Gz*-colonized kernels. Consistent differences were observed in barley entries for the incidence of Fusarium-colonized kernels at the four locations tested. Robust and Conlon barleys having the lowest levels of *Gz*-colonized kernels.

In other field studies, burning was demonstrated to significantly reduce the number of nodes and the *F. graminearum* population of surface soil in comparison with unburned treatments. The recovery of *F. graminearum* following burning was also significantly ($P<0.01$) reduced in residues recovered following a burn, *Gz* being recovered in 1-12% of burned nodes in comparison to 29-37% of unburned nodes. Burning also significantly reduced recovery of *F. culmorum*, *F. poae*, *F. sporotrichioides*, *F. avenaceum*, *F. acuminatum*, *F. moniliforme*, *F. oxysporum*, and *F. equiseti*. There was no a significant detrimental impact of burning on seedlings emergence.

Experiments examining patterns of *F. graminearum* incidence in a burned area surrounded by a non-burned area did not show any distinct pattern of re-colonization. Other experiments aimed to determine the effect of severity of burning and wheat cultivars showed that incidence of *F. graminearum* in plants was significantly ($P = 0.01$) higher in control and lightly burned plots than in severely burn plots. The incidence of *F. graminearum* tended to be highest within the upper portions of the wheat canopy (node 3 to kernels) than in the lower portions of the canopy (crowns to node 2). Again nodes of FHB-susceptible cultivars, such as Wheaton, had higher levels of infection by *F. graminearum* than moderately resistant cultivars such as Alsen.

Project 2: ***A dryland inoculation screen for spring wheat reaction to Fusarium head blight.***

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

Most, if not all, breeding and pathology programs in the Upper Midwest utilize mist-irrigation to provide moisture to establish Fusarium head blight (FHB) infection for germplasm screening purposes. These irrigation systems are expensive and require significant labor resources to assemble and manage. In this project we sought to demonstrate that the establishment and subsequent screening of wheat nurseries for reaction to FHB need not require the use of mist-irrigation. We hypothesize that this is specifically true in environments that are generally conducive enough for the development of the disease without irrigation. However, many researchers are wary of not using mist-irrigation for fear of not being able to discriminate between resistance and susceptible germplasm. In this project we proposed the use of standard FHB inoculation procedures, similar to those used in our irrigated nurseries, to establish disease plots that were not mist-irrigated.

2. What were the most significant accomplishments?

In 2003, at two-locations, we demonstrated that we could adequately differentiate resistant from susceptible reactions among the wheat entries in the Uniform Regional Scab Nursery (URSN). This indicated that breeding programs would be able to establish disease nurseries and conduct successful screening without the use or expense of implementing mist-irrigation systems. The URSN has previously been conducted only at locations with mist-irrigation. Our results suggest that dryland screening provides a less severe disease intensity while still differentiating among FHB resistant and susceptible genotypes. In mist-irrigated nurseries the high intensity of disease may limit the ability of cooperators to identify intermediate levels of scab resistance as high FHB levels can obscure intermediate levels of FHB resistance. Genotypes with intermediate levels of resistance frequently possess desirable agronomic characteristics. Thus dryland screening techniques provide an opportunity to identify genotypes with improved agronomic characteristics and intermediate levels of FHB-resistance. Thus, the use of dryland nurseries may augment the breeders' ability to identify germplasm appropriate for selection and crossing aimed at improving FHB resistance in conjunction with agronomic quality. The dryland screening also has the advantage of requiring fewer resources than traditional FHB resistance screening nurseries.

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 you grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Salas, B., Dill-Macky, R., and Wiersma, J.J. (2003). Incidence of *Fusarium graminearum* in kernels of wheat and barley cultivars at four locations in Minnesota. In: *Proceedings of the 2003 National Fusarium Head Blight Forum*, Bloomington, Minnesota, USA, December 13-15, 2003, p. 170.

Salas, B., Dill-Macky, R., and Wilhelm, K.P. (2003). Previous crop affecting soil populations of Fusarium head blight pathogens in Minnesota. In: *Proceedings of the 2003 National Fusarium Head Blight Forum*, Bloomington, Minnesota, USA, December 13-15, 2003, p. 171.

Evans, C.K. Garvin, D.F., and Dill-Macky, R. (2003). Comparative evaluation of the uniform regional scab nursery for spring wheat parents under dryland and mist-irrigated conditions. In: *Proceedings of the 2003 National Fusarium Head Blight Forum*, Bloomington, Minnesota, USA, December 13-15, 2003, p. 245.

Salas, B., Dill-Macky, R., and Wilhelm, K.P. (2003). Previous crop affecting soil populations of Fusarium head blight pathogens in Minnesota. *Phytopathology*, **93**:S75.

Dill-Macky, R. and Evans, C.K. (2003). Fusarium head blight of wheat and barley: epidemics and control strategies in Minnesota. In: *Proceedings of the 8th International Congress of Plant Pathology, Volume 2 – Offered Papers*, Christchurch, New Zealand, February 2-7, 2003, p. 293, <Abstract no. 22.18>.

Dill-Macky, R. (2003). Fusarium head blight of wheat and barley: epidemics and disease management in the United States. In: *Proceedings of the 9th International Fusarium Workshop*, Sydney, Australia, January 27-30, 2003, p. 21.