USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
July 15, 2015

Cover Page

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Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-006
USDA-ARS Agreement Title:	FHB Management Research in New York.
FY14 USDA-ARS Award Amount:	$ 20,753

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Integrated Management Strategies to Reduce FHB and DON in New York.	$ 11,655
MGMT	Uniform Fungicide and Biological Trials in New York.	$ 9,098
	FY14 Total ARS Award Amount	**$ 20,753**

Gary C. Bergstrom July 15, 2015
Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
WES-CP – Western Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Integrated Management Strategies to Reduce FHB and DON in New York.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

In response to the USWBSI goal to validate integrated management strategies for FHB and DON, the Disease Management RAC of USWBSI initiated a multi-state, multi-year, coordinated field study. In New York during 2014, we observed the disease and yield impact of cultivar susceptibility, inoculation with *Fusarium graminearum*, and treatment with Prosaro® fungicide at two timings. The trial was conducted at the Musgrave Research Farm in Aurora, NY in a Lima silt loam soil planted with four soft red winter wheat varieties, 'Pioneer Brand 25R40' (susceptible to Fusarium head blight (FHB), 'Emmit' (moderately susceptible to FHB), 'Otsego' (moderately susceptible to FHB), and 'Pioneer Brand 25R46' (moderately resistant to FHB), following soybean harvest on 25 Sep 2013. The experiment was set up as a completely randomized block design with a split-plot arrangement, with cultivar as the main plot and the treatments as subplots, randomized in six replicated blocks. Main plots were sown with wheat at 118.8 lb/A with a 10 ft wide commercial grain drill. Subplots were 20 x 10 ft including 15 rows with 7-in. row spacing. The plots were fertilized at planting (200 lb/A of 10-20-20) and topdressed on 10 Apr (170 lb/A of a 50/50 mix of ammonium sulfate and urea, providing ca. 57 lb/A of nitrogen) and again on 21 Apr (30 lb/A of urea, providing an additional 13.8 lb/A of nitrogen). The first Prosaro application was at anthesis (Feekes growth stage, FGS 10.51) on 2 Jun including the surfactant Induce at 0.125% V/V, and inoculated with a conidial suspension of *F. graminearum* (40,000 conidia/ml) after the fungicide had dried to augment the development of FHB. The second Prosaro application occurred seven days after anthesis on 9 Jun including the surfactant Induce at 0.125% V/V, and inoculated with a conidial suspension of *F. graminearum* (40,000 conidia/ml) after the fungicide had dried. Fungicide and *F. graminearum* treatments were applied with a tractor-mounted sprayer with paired TJ-60 8003vs nozzles mounted at an angle (30^o from horizontal) forward and backward, 20-in. apart, pressurized at 30 psi, and calibrated to deliver 20 gal/A. Incidence and severity (percent of symptomatic spikelets on symptomatic heads) of FHB in each plot were rated on 23 Jun and used to calculate FHB Index, where FHB index = (FHB severity * FHB incidence)/100. Foliar diseases were rated on 23 Jun as percent severity on flag leaves (average rating for whole plot). Grain was harvested from a 20 x 4 ft area in each subplot using an Almaco plot combine on 25 Jul. Grain moistures, plot yields, and test weights were recorded. Yields and test weights were adjusted to bu/A at 13.5% moisture. Fusarium damaged kernels (FDK) were evaluated post-harvest as a percentage of kernels visibly affected by FHB out of a 100 kernel subsample from each plot. Analysis of deoxynivalenol (DON) content in grain was conducted in the US Wheat and Barley Scab Initiative-supported mycotoxin analysis laboratory at the University of Minnesota, St. Paul, MN. Treatment means were calculated, subjected to analysis of variance, and separated by Fisher's protected LSD test (P = 0.05).

The incidence of FHB over all plots ranged from 0.7 to 16%. The impact of supplemental inoculation with *F. graminearum* was determined by comparing the non-inoculated and inoculum only treatment. Overall, inoculation resulted in significantly reduced yield and increased FHB and DON as compared with the non-inoculated plots. FHB and DON development in 2014 were attributed primarily to supplemental rather than background inoculum. Significant cultivar responses to inoculation were observed for yield, FHB and DON for the susceptible variety Pioneer 25R40, but only for FHB and DON, for the moderately susceptible varieties Emmit and Otsego and for the moderately resistant variety Pioneer 25R46.

2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:

Accomplishment:

Under moderately low disease pressure, significant differences were detected in yield among the varieties. Prosaro fungicide application at either FGS 10.51 or 7 days later reduced DON risk in the susceptible variety by more than 50%. When results of all the cultivars were combined, the overall impact of each of the two Prosaro application timings was to significantly decrease FHB incidence, index, DON, and foliar diseases, as compared with the inoculum only treatment. The Prosaro application at 7 days after the initiation of flowering resulted in the lowest FHB and DON, i.e., the fungicide applied later did the best job of suppressing FHB and DON resulting from fungal spores that arrived at the later timing. FHB and DON applied at 7 days after FGS 10.51 were significantly lower than for the Prosaro application at FGS 10.51, and did not differ from the non-inoculated, no-fungicide control treatment.

Impact:

These data support the current qualitative designations of varieties as susceptible (Pioneer 25R40), moderately susceptible (Emmit and Otsego), and moderately resistant (Pioneer 25R46). With excellent choice of high yielding varieties in the moderately susceptible and moderately resistant categories, we counsel New York growers to no longer plant susceptible soft red winter wheats. Sufficient fungicide remained on spikes from the FGS 10.51 application to give significant suppression of FHB and DON resulting from fungal spores deposited on plants at 7 days after 10.51. Therefore we can recommend to producers with confidence that triazole application up to a week after initiation of anthesis can result in satisfactory suppression of FHB and DON.

Project 2: *Uniform Fungicide and Biological Trials in New York.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

Improved chemical and/or biological control strategies are necessary for reducing yield and quality losses from FHB. In New York, we have observed that timely and efficacious fungicide application is a key factor in reducing DON levels down to the 2 ppm required by the local milling industry. This coordinated project validates that chemical and biological control strategies contribute to reducing FHB and DON and to increasing yield and quality. The fungicide trial was conducted at the Musgrave Research Farm in Aurora, NY in a Lima silt loam soil planted with the soft red winter wheat variety 'Pioneer 25R34' sown at 118.8 lb/A following soybean harvest on 25 Sep 2013. Twenty foliar treatments (combinations of products, amounts, and timings of fungicides and of the *Bacillus*-based biological control product, Taegro) were arranged in a randomized complete block design with four replicates. Subplots were 20 x 10 ft including 15 rows with 7 in.-row spaces. The plots were fertilized at planting (200 lb/A of 10-20-20) and topdressed on 10 Apr (170 lb/A of a 50/50 mix of ammonium sulfate and urea, providing ca. 57 lb/A of nitrogen) and again on 21 Apr (30 lb/A of urea, providing an additional 13.8 lb/A of nitrogen). Fungicides were applied on 21 Apr at Feekes growth stage (FGS) 5 (tillering), 25 May at FGS 9 (ligule of flag leaf just visible), 2 Jun at FGS 10.51 (begin anthesis), and 9 Jun (7 days after flower initiation) depending on the treatment. All plots were inoculated with a conidial suspension of *Fusarium graminearum* (40,000 conidia/ml) on 2 Jun and 9 Jun, after fungicide applications were completely dried, to augment natural inoculum for initiation of Fusarium head blight (FHB). Treatments were applied with a backpack sprayer with 8002DG flat fan nozzles, 18.5-in. apart, pressurized at 34 psi, and calibrated to deliver 20 gal/A. The *F. graminearum* was applied by a tractor-mounted sprayer with TJ-60 8003vs nozzles, 20-in. apart, pressurized at 30 psi, and calibrated to deliver 20 gal/A. Incidence and severity of FHB were rated for each plot on 23 Jun. Foliar diseases were rated on 23 Jun as percent disease severity on flag leaves (average rating for whole plot). Grain was harvested on 25 Jul from a 20 x 4 ft area in each subplot using an Almaco plot combine. Grain moisture, grain yield, and test weight for individual plots were recorded and yield and test weights were recalculated to bu/A at 13.5% moisture. Analysis of deoxynivalenol (DON) content in grain was conducted in the US Wheat and Barley Scab Initiative-supported mycotoxin analysis laboratory at the University of Minnesota, St. Paul, MN. Treatment means were calculated, subjected to analysis of variance, and separated by Fisher's protected LSD test ($P = 0.05$).

FHB symptom reduction resulting from Prosaro (6.5 fl oz or 8.2 fl. oz.) application at flowering was not significantly greater than that resulting from flag leaf applications of Prosaro at either the 5.0 or 6.5 fl oz rates. Yet, Prosaro application at either rate at flag leaf did not result in significant reduction in DON, whereas Prosaro application at flowering did. DON levels were not reduced further by addition of any other material to a Prosaro or Caramba® application at flowering, thus providing further evidence that these are the materials and timing of choice for DON suppression. Treatments that did not include Prosaro or Caramba at flowering failed to reduce DON more than in the non-treated control.

2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:

Accomplishment:

All treatments resulted in significantly lower severity of fungal leaf blotches on flag leaves and FHB index than the non-treated control, though overall disease pressure was fairly low. All treatments except the late application of the biological control product Taegro significantly reduced *Fusarium* damaged kernels (FDK) compared to the non-treated control. Early applications of Tilt, Quilt, A15457, Quadris, Priaxor, Aproach, or Twinline did not enhance the control of FHB or leaf spot as compared to treatment with Prosaro or Caramba alone. Caramba applied at the higher rate (17 fl oz) at flowering did not result in greater reduction in FHB or DON than Caramba at the lower rate. Following the flowering application of Prosaro with Taegro seven days after flowering did not improve FHB control or significantly reduce DON.

Impact:

Single applications with Caramba or Prosaro within the first seven days of the start of anthesis remains the most efficacious treatment for suppression of FHB and DON, and therefore will continue to be recommended as the treatment of choice for New York producers.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 award period. The term “support” below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student’s stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY14 award period?** No

   If yes, how many?

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?** Yes

   If yes, how many? One (now a post doc at University of Wisconsin)

3. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?** None

   If yes, how many?

4. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?** None

   If yes, how many?

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. *If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.*

N/A

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 FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Publications (peer-reviewed journals):

Crane, J.M., and G.C. Bergstrom. 2014. Spatial distribution and antifungal interactions of a *Bacillus* biological control agent on wheat surfaces. *Biological Control* 78: 23-32.

Publications (non-peer reviewed):

Bergstrom, Gary C. and Pierri Spolti. 2014. Triazole sensitivity in populations of Fusarium graminearum: Preliminary findings, needed research, and implications for management. Page 2 in S. Canty, A. Clark, N. Turcott, and D. Van Sanford (Eds.) Proc. 2014 National Fusarium Head Blight Forum, East Lansing MI/Lexington, KY: U.S. Wheat and Barley Scab Research Initiative.

Cummings, J.A., and G.C. Bergstrom. 2014. Evaluation of integrated methods for managing FHB and DON in winter wheat in New York in 2014. Pages 7-10 in S. Canty, A. Clark, N. Turcott, and D. Van Sanford (Eds.) Proc. 2014 National Fusarium Head Blight Forum, East Lansing MI/Lexington, KY: U.S. Wheat and Barley Scab Research Initiative.

Salgado, J.D, K. Ames, G. Bergstrom, C. Bradley, E. Byamukama, J. Cummings, R. Dill-Mackey, A. Friskop, P. Gautam, N. Kleeczewski, L. Madden, E. Milus, M. Nagelkirk, J. Ransom, K. Ruden, K. Wise, and P.A. Paul. 2014. Best FHB management practices: A 2014 multi-state project update. Pages 31-36 in S. Canty, A. Clark, N. Turcott, and D. Van Sanford (Eds.) Proc. 2014 National Fusarium Head Blight Forum, East Lansing MI/Lexington, KY: U.S. Wheat and Barley Scab Research Initiative.

Smith, M.E., J. Wiersma, A. Friskop, B Schatz, P. Gautam, G.C. Bergstrom, J.A. Cummings, E. Byamukama, K. Ruden, B. Bleakley, N. Murthy, C.A. Bradley, K. Ames, J. Pike, R. Bellm, and G. Milus.. 2014. Uniform fungicide trail results for management of FHB and DON, 2014. Page 43 in S. Canty, A. Clark, N. Turcott, and D. Van Sanford (Eds.) Proc. 2014 National Fusarium Head Blight Forum, East Lansing MI/Lexington, KY: U.S. Wheat and Barley Scab Research Initiative.

Cummings, J.A., G.C. Bergstrom, R.J. Richtmyer III, and R.R. Hahn. 2015. Evaluation of integrated methods for management of Fusarium head blight and foliar diseases of winter wheat in New York, 2014. Plant Disease Management Reports 9: CF027.

Cummings, J.A., G.C. Bergstrom, R.J. Richtmyer III, and R.R. Hahn. 2015. Evaluation of foliar fungicides and a biological control product for control of Fusarium head blight and foliar diseases of winter wheat in New York, 2014. Plant Disease Management Reports 9: CF026.

Invited research presentation by Gary C. Bergstrom:

Cornell University, Plant Pathology and Plant-Microbe Biology Section Seminar. Close encounters with a cereal killer: The biology and management of *Fusarium graminearum*. Geneva, NY. February 10, 2015.

Farmer/Brewer Conference, Amherst College, Amherst, MA. Small grain diseases 101. January 17-18, 2015.

National Fusarium Head Blight Forum, St. Louis, MO. Triazole sensitivity in populations of *Fusarium graminearum*: Preliminary findings, needed research and implications for management. December 8, 2014.

Cornell University, Grass Research Discussion Group, Grass Diseases of Consequence for Agriculture: What's on Our Current Radar Screen in New York State? Ithaca, NY. May 2, 2014.

Extension presentations by Gary C. Bergstrom in 2014-15 that included updates on Fusarium head blight research:

Springwater Ag Products Meeting, Wayland, NY. (3/25/15)

Madison County Field Crops Meeting, Cazenovia Tractor, Cazenovia, NY. (3/17/15)

Pennsylvania Corn and Soybean Winter Congress, Grantville, PA. (2/19/15)

Finger Lakes Soybean and Small Grains Congress, Waterloo, NY. (2/5/15)

Western New York Soybean and Small Grains Congress, Batavia, NY. (2/4/15)

Central New York Small Grains Workshop, West Winfield, NY. (2/3/15)

Agriculture In-Service Conference, Ithaca, NY (11/18/14)

Field Crop Dealer Meeting, Syracuse, NY (11/12/14)

Malting Barley Field Day, Canajoharie, NY (7/2/14)

NOFA-NY Small Grain Field Day, Knox, NY (8/5/14)

Northeast Certified Crop Advisors Conference, Syracuse, NY. (12/4/14)

Organic Grains Field Day, Freeville, NY (7/1/14)

Seed Growers Field Day, Ithaca, NY (6/24/14)

Hudson Valley Grains Day, Red Hook and Hurley, NY (6/23/14)

Small Grains Management Field Day, Aurora, NY (6/5/14)