USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
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Cover Page

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Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-035
USDA-ARS Agreement Title:	Improved Malt Barley Production in the Northeast.
FY14 USDA-ARS Award Amount:	$ 14,591

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Enhancing the Capacity of Farmers to Produce Malting Barley in the Northeast.	$ 14,591
	FY14 Total ARS Award Amount	**$ 14,591**

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: *Enhancing the Capacity of Farmers to Produce Malting Barley in the Northeast.*

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

   Public interest in sourcing local foods has extended into beverages. This had led to a rapid expansion of the northeast malting industry and has given farmers new markets. However these farmers are struggling to produce barley that is not infected with Fusarium head blight (FHB) and deoxynivalenol (DON). Hence integrated management strategies are essential for reducing yield and quality losses from FHB. Most of these farmers have experienced significant crop loss from FHB and some farmers have already stopped growing barley. At present few farmers are specifically selecting varieties for resistance to FHB and even fewer are combining host resistance with fungicide applications. First year integrated studies in VT showed that lowest DON levels were achieved when resistant barley varieties were sprayed with fungicide. When fungicide was applied to susceptible barley varieties DON levels were still above 2 ppm. Preliminary data suggests that application of an organic approved copper based fungicide also reduced DON levels but additional years of research need to be conducted to confirm the results. Producers are already adopting project results especially paying attention to variety selection.

   The first step was to develop variety trials that identify varieties suitable for malting and adapted to the Northeast. A variety trial with thirty-four winter barley cultivars was established in September, 2013. In addition a spring barley variety trial, consisting of fifteen different varieties, was established in April, 2014. These varieties were evaluated for disease resistance/tolerance as well as yield and quality.

   Fungicide applications have proven to be relatively effective at controlling FHB in other barley growing regions. No work has been done in this region on the optimum timing for a fungicide application to barley specifically to minimize DON. In addition, there are limited studies evaluating organic approved fungicides or biostimulants for management of this disease. In April of 2014, a spring barley fungicide trial was initiated to determine the efficacy and timing of fungicide application to reduce FHB infection on cultivars with varying degrees of disease susceptibility. The treatments were assessed for FHB infection rates as well as yield and DON levels.

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 2014 variety trials were successfully completed. Harvest yields were calculated and grain quality assessed; harvest moisture, test weight, seed germination, protein, falling number, and DON analysis. Results indicated that spring barley grown in 2014 was minimally impacted by FHB and DON levels were generally below 1ppm. However in the spring barley trial AC Minoa had both the highest yield and lowest DON level (Table 1). Winter barley varieties were more severely impacted by FHB and DON in

2014 (Table 2). All but 3 varieties exceed 1ppm of DON concentration. The varieties Charles and Alba are both commercially available and also had low DON levels so would be recommended to growers in our region. Future testing over multiple years is needed to develop more specific recommendations.

Research reports were written for each of the trials and disseminated via our website, www.uvm.edu/extension/cropsoil and hard copies were distributed at our conferences, workshops and field days. The results from the 2014 field trials were presented to 436 stakeholders at the 2014 Crops and Soils Field Day, Alburgh, VT, 2015 Grain Growers Conference, Essex, VT and at the 2015 Grain Research Tour, Alburgh, VT.

Table 1. Harvest and quality results for the 15 spring barley samples trialed in Alburgh, VT, 2014.

Variety	Yield @13.5% moisture	Harvest moisture	Test weight	Crude protein @ 12% moisture	Falling number @ 14% moisture	DON	Germination
	lbs ac^{-1}	%	lbs bu^{-1}	%	seconds	ppm	%
Robust	1337	8.40	43.1	11.0	305	0.80	94.0
AC Minoa	1587	13.1	46.6	11.5	336	0.33	81.5
Conlon	341	12.9	40.8	9.83	228	1.07	75.0
Full Pint	732	11.1	39.3	11.1	62	0.77	3.00
Hanna	572	14.0	42.8	11.2	285	0.67	87.5
Lacey	1054	10.0	43.0	10.5	291	1.13	86.5
Newdale	1167	11.4	41.1	10.1	134	1.00	40.0
AC Newport	1019	12.7	47.8	10.0	326	0.83	90.0
Quest	1125	9.10	40.0	10.9	288	0.63	85.0
Rasmussen	1569	10.0	43.4	10.4	313	1.65	83.5
Valley Malt 1	658	9.50	35.5	13.1	270	0.87	80.5
Valley Malt 2	813	6.00	31.1	13.5	332	0.97	82.0
Valley Malt 3	404	7.68	27.5	12.4	271	1.97	71.0
Valley Malt 4	919	7.48	32.8	12.5	341	1.17	95.5
Valley Malt 5	973	12.4	44.8	12.7	351	0.30	95.5
LSD (0.10)	541	2.21	3.02	0.67	68.5	0.64	NA
Trial Mean	951	10.4	40.0	11.4	275	0.95	NA

NA - was not statistically tested.

Table 2. Yield and quality data for winter barley variety trial in Alburgh, VT.

Variety	Yield lbs ac^{-1}	Moisture %	Test Weight lbs bu^{-1}	Crude Protein @ 12% moist %	Falling Number seconds	DON ppm
02Ab431	1687	12.5	44.2	7.4	205	0.8
02Ab669	1252	15.4	43.7	8.2	263	1.3
02Ab671	1331	13.1	43.8	7.9	220	1.6

Variety	Yield	Moisture	Test Weight	Crude Protein @ 12% moist	Falling Number	DON
	lbs ac^{-1}	%	lbs bu^{-1}	%	seconds	ppm
06OR-9 (TCFW6-194)	2000	13.1	37.2	9.0	287	1.9
07OR-64 (TCFW6-235)	315	17.8	29.7	8.8	151	3.6
08OR-48 (TCFW6-244)	1024	13.7	37.0	8.9	224	9.0
2011-F5-141-5 (TCFW6193)	1859	14.4	37.3	9.2	219	1.5
2Ab08-X05W061-216	948	18.2	35.7	10.2	191	2.6
2Ab09-X05W018-119	1062	16.1	45.2	7.5	262	1.1
2Ab09-X05W040-125	1916	15.8	42.3	8.3	187	0.8
AC 07/022/2	1215	13.1	41.8	8.5	264	1.7
AC 07/041/33	1000	12.8	40.2	8.9	251	1.3
Alba	1309	12.8	37.3	8.7	315	1.2
Archer	1598	14.2	39.3	8.6	243	2.2
Ariane	1637	12.6	37.2	9.9	271	1.8
Charles	1533	11.4	42.8	8.5	117	1.0
Etincel	1393	12.3	38.2	9.0	241	2.2
Flavia	1559	11.0	43.0	8.8	259	1.6
Hickory	1063	12.9	40.0	8.8	189	2.1
Joy	1065	15.8	41.3	8.9	244	1.9
Liga	1370	14.5	40.7	8.3	236	1.4
Maja	1367	11.7	39.0	9.2	250	2.5
Maltesse	1341	12.2	43.3	9.1	269	2.1
McGregor	1029	13.0	30.0	9.2	237	4.4
Nectaria	936	12.8	42.5	9.7	254	2.3
SC11203	716	14.2	38.8	9.9	275	2.8
SC11213	1079	14.3	41.8	9.8	243	2.0
Saturn	2670	10.8	40.8	8.8	301	1.5
Strider	1782	10.4	40.7	9.0	282	3.9
Thoroughbred	1010	11.8	40.7	9.4	254	3.2
VA10B-43	1459	12.3	39.8	10.0	256	4.9
VA12B-7	1490	11.7	44.5	9.5	321	2.0
VA12B-8	1973	12.2	44.0	9.8	326	1.1
Violetta	1059	13.7	35.8	10.1	233	3.2
Trial Mean	1354	13.4	40.0	9.0	245	2.3
LSD (0.10)	837	3.3	5.2	1.1	59.7	1.8

Impact: Barley growers throughout the Northeast have used our reports to identify varieties that performed well in our trials. Sixty percent of grain growers (n=44) surveyed at the 2015 Grain Research Tour indicated adopting resistant varieties based on information provided by UVM Variety Trials.

Accomplishment: The first year results from the spring barley fungicide trial indicate that the application of a conventional fungicide (Porsaro) at anthesis and post-anthesis reduced DON concentrations (Table 2). Timing of application did not appear to impact efficacy of the fungicide in

controlling DON. Interestingly, Champ WG (copper oxide) when applied at anthesis reduced the concentrations of DON similar to Posaro. The post-anthesis application of Champ WG did not significantly reduce DON concentrations compared to the control. This indicates that copper based fungicides sprayed at flowering may have some efficacy for FHB control. This would provide organic farmers with another management tool for FHB control. The Regalia appeared to have no efficacy for FHB control. Regalia is not labeled for FHB.

This trial found that varietal selection was vital in reducing FHB infection rates and the resulting DON levels (Table 3). In this study Conlon, a moderately resistant variety, had lowest incidence of FHB and DON levels, while Rasmussen, a susceptible variety, had DON levels five times greater (2.52 ppm) than Conlon (0.50 ppm). Even once treated with a fungicide, DON levels in Rasmussen still exceeded the acceptable level of 1 ppm. This indicates the importance of selecting resistant cultivars to manage FHB in our region.

Table 2. The impact application timing and fungicide on barley yield and quality.

Treatment	Timing	Yield @ 13.5% moisture	Harvest moisture	Test weight	DON
		lbs ac^{-1}	%	lbs bu^{-1}	ppm
Control (water)	All	1643	13.6	46.6	1.74
Fusarium	29-Jun	1801	12.8	46.4	1.58
Champ	Anthesis	2310	13.4	46.5	1.30
Champ	Post-Anthesis	2253	12.5	46.2	1.50
Porsaro	Anthesis	2488	14.4	47.0	1.06
Porsaro	Post-Anthesis	2560	14.6	46.8	1.10
Regalia	Anthesis	2085	13.7	46.3	1.83
Regalia	Post-Anthesis	2393	13.1	46.4	1.96
LSD (0.10)		434	0.62	NS	0.41
Trial Mean		2192	13.5	46.5	1.51

Values shown in **bold** are of the highest value or top performing.
NS - None of the varieties were significantly different from one another.

Table 3. The impact of malting barley variety of quality and yield.

Variety	Yield @13.5% moisture	Harvest moisture	Test weight	DON
	lbs ac^{-1}	%	lbs bu^{-1}	ppm
Conlon	1841	13.3	46.8	0.50
Rasmussen	2543	13.7	46.2	2.52
LSD (0.10)	187	0.29	0.33	0.19
Trial Mean	2192	13.5	46.5	1.51

Impact: There are few growers in the region applying fungicides to barley for management of FHB and DON. This data is critical for further grower adoption. There has been much interest expressed by growers throughout the region but more information is needed before they add this practice into their management strategies.

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?** No

   If yes, how many?

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.

Darby, H., E. Cummings, S. Monahan, J. Post, and S. Ziegler. 2015. The Efficacy of Spraying Fungicides to Control Fusarium Head Blight Infection in Spring Malting Barley. University of Vermont Extension Northwest Crops and Soils Program, St. Albans, VT. Available online at: http://www.uvm.edu/extension/cropsoil/wp-content/uploads/2014-Spring-Barley-Fungicide.pdf (accessed 1 Jul. 2015).

Darby, H., E. Cummings, S. Monahan, J. Post, and S. Ziegler. 2015. 2014 Organic Spring Barley Variety Trial. University of Vermont Extension Northwest Crops and Soils Program, St. Albans, VT. Available online at: http://www.uvm.edu/extension/cropsoil/wp-content/uploads/2014-Spring-Barley-Variety-Trial.pdf (accessed 1 Jul. 2015).

Darby, H., K. Blair, E. Cummings, S. Monahan, J. Post, and S. Ziegler. 2015. 2014 Winter Barley Variety Trial. University of Vermont Extension Northwest Crops and Soils Program, St. Albans, VT. Available online at: http://www.uvm.edu/extension/cropsoil/wp-content/uploads/2014-Winter-Barley-Variety-Trial-Report.pdf (accessed 1 Jul. 2015).