USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report
Due date: July 31, 2018

Cover Page

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Fiscal Year:	2017
USDA-ARS Agreement ID:	59-0206-4-032
USDA-ARS Agreement Title:	Mapping and Accelerated Introgression of FHB Resistance into Superior Wheat and Barley Varieties.
FY17 USDA-ARS Award Amount:	$ 161,885
Recipient Organization:	Virginia Polytechnic Institute and State University 1880 Pratt Drive, Suite 2006 Blacksburg, VA 24060
DUNS Number:	003137015
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Recipient Identifying Number or Account Number:	422419
Project/Grant Reporting Period:	6/17/17 - 6/16/18
Reporting Period End Date:	06/16/18

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Variety Development and Mapping Resistance to FHB and DON in Winter Barley.	$ 48,449
VDHR-SWW	Improving FHB Resistance in SRWW via Breeding, MAS and Mapping in Native Sources.	$ 99,806
VDHR-SWW	Developing Double Haploids to Expedite Variety Development in SRWW.	$ 10,480
	FY17 Total ARS Award Amount	$ 161,885

Carl A. Griffey

7/19/2018

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
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
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: *Variety Development and Mapping Resistance to FHB and DON in Winter Barley.*

1. What are the major goals and objectives of the project?

The primary goal of the project is to evaluate and enhance FHB resistance in commercially viable winter barley cultivars by identifying, mapping, and incorporating unique and/or complementary FHB resistance QTL from different sources using MAS and conventional breeding methods.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) major activities

The program continues to develop and advance populations and pure lines derived from crosses between superior winter barley cultivars and lines with FHB resistant varieties from our program and spring barley lines. The program is conducting research to characterize and validate QTL and to identify diagnostic markers for FHB resistance in our barley cultivars Eve and Nomini. Current diagnostic markers for FHB resistance (ten SSR markers each for QTL on chromosomes 2H and 6H) from spring barley along with markers for other diseases (three SNP markers for leaf rust, three SNP markers for powdery mildew, eleven markers for net blotch, three SSR markers for spot blotch), yield (one SNP marker) and quality (one SNP marker) are being used to characterize parents and for MAS in the Virginia Tech barley program.

Breeding populations derived from crosses made with FHB resistance sources (Island, Gen129, AC Alberte, Atahulpa, Quest, MN Brite, FEG-4-98, and Fredrickson) are in advanced generations. This season (2017-18), we evaluated and selected pure lines from nearly 600 hulled and hulless FHB headrows at the Eastern Virginia AREC in Warsaw, VA. We also evaluated 104 FHB resistant lines in an observation yield trial, and 58 populations were evaluated for FHB resistance in our scab nursery and advanced in the program.

2) specific objectives

The specific objectives of this project are to: 1) evaluate and characterize FHB resistance in winter barley lines and commercial varieties; 2) identify and validate FHB resistance QTL from native sources Eve and Nomini and; 3) deploy MAS to incorporate and pyramid unique and complimentary FHB resistance QTL into adapted lines and varieties

3) significant results

Linkage analysis identified a gene region on chromosome 6H associated with FHB resistance for lower FHB severity, FDK, and reduced DON accumulation in ‘Eve’ barley (Figure 1). Genes associated with heading date and plant height were also located in the same gene region as those for FHB resistance. Through further analysis, it was determined that the FHB resistance identified in Eve likely is similar to that previously reported on chromosome 6H.

A Thoroughbred/Nomini mapping population is currently being used to characterize FHB resistance in hulled barley cultivar Nomini. During 2017-18, a set of 180 RIL were planted in scab nurseries at three locations in VA, KY and NC where FHB data was collected at all three locations. A second doubled haploid population between Nomini and the elite 2-row winter malt barley cultivar Violetta was evaluated in a VA scab nursery. Also in 2017, the Thoroughbred/Nomini mapping population was genotyped with a 50K SNP chip in collaboration with USDA-ARS Genotyping Center at Fargo, ND.

4) key outcomes or other achievements

Pure lines derived from crosses between known FHB resistant spring barley lines and adapted winter barley lines are being developed and evaluated for FHB resistance and agronomic performance. Elite barley line VA11B-141LA is a potential new variety release and had three year average DON values that were 3 to 6 ppm lower than those of current cultivars Atlantic, Secretariat, and Thoroughbred. New SNP markers tightly linked to the FHB resistance QTL on 6H were identified and can be used to incorporate and pyramid FHB resistance genes into adapted cultivars via MAS breeding.

3. What opportunities for training and professional development has the project provided?

This project has provided training to employees at the Eastern VA AREC including current and new research specialists, undergraduate students as well as professional development by allowing a post-doc research associate to attend the annual USWBSI meeting and participate in poster presentation sessions.

4. How have the results been disseminated to communities of interest?

Data on FHB incidence, FHB severity, FHB index, and DON accumulation along with standard agronomic traits obtained from Virginia's state hulled and hulless variety trials are reported online (http://www.pubs.ext.vt.edu/CSES/CSES-97/CSES-97.html) and in the extension bulletin CSES-97NP "Small Grains in 2017" to promote selection and production of FHB resistant cultivars. The results on FHB resistant QTL mapping were disseminated through USWBSI annual meetings.

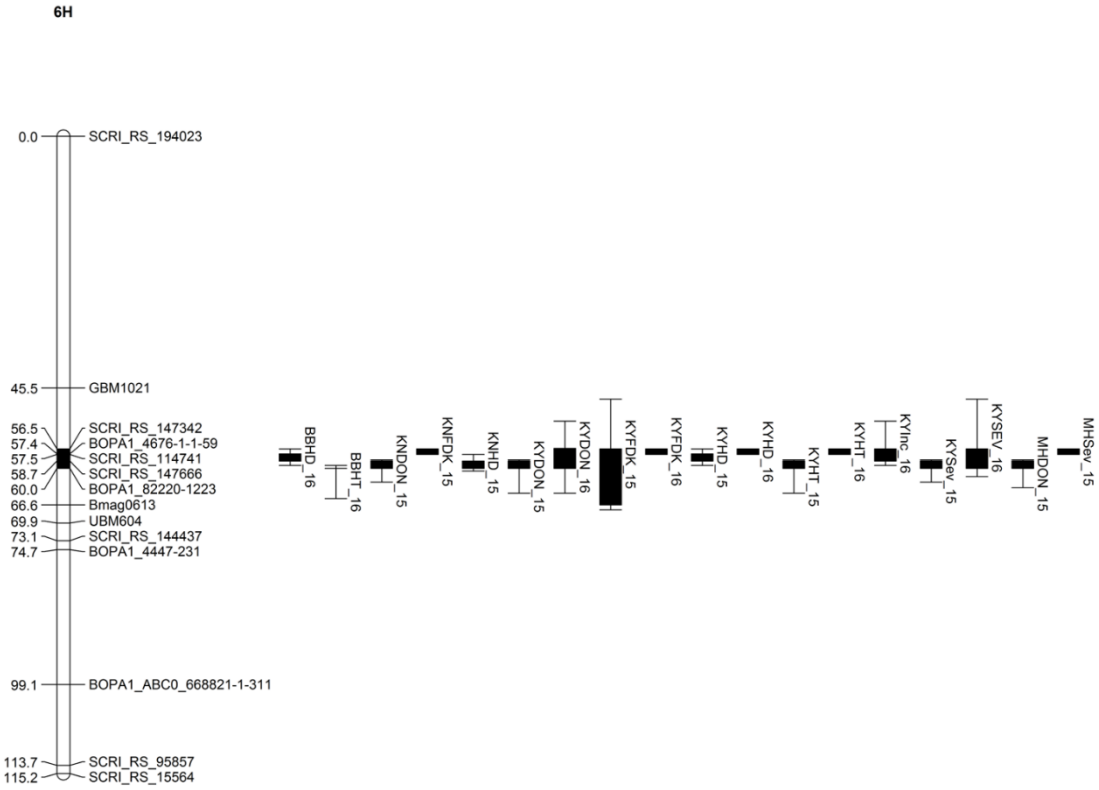

Figure 1. Chromosome map of 6H, derived from the moderately resistant parent Eve, identifying the gene region associated with FHB resistance.

Project 2: *Improving FHB Resistance in SRWW via Breeding, MAS and Mapping in Native Sources.*

1. What are the major goals and objectives of the project?

The ultimate goal of the proposed research is to incorporate unique FHB resistance QTL from complementary types and sources of resistance into commercially viable cultivars using Marker Assisted Selection (MAS) and Doubled Haploid (DH) technologies in conjunction with conventional breeding methods. One objective focuses on the phenotypic and genotypic characterization of FHB resistance derived from native and exotic germplasm and selection and pyramiding of such resistance into adapted lines. A second objective focused on the identification, mapping, validation, and deployment of unique FHB resistance QTL and diagnostic markers in MAS breeding that is critical for accelerating progress and improving selection efficiency in enhancing FHB resistance via gene pyramiding in wheat cultivars.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) major activities

Molecular markers linked to 15 scab resistance genes located on wheat chromosomes 2D, 3B (Fhb1), and 5A of Ning 7840, 1B and 6A of Jamestown, 1A and 2A of Tribute, 3B and 4B of Ernie, 2B and 3B of Bess, 3B of Massey, and 1A, 4A, and 6A of Neuse are being used to screen parental lines of crosses and in marker-assisted selection to pyramid different FHB resistance genes. MAS enrichment was applied in 12 SRW-FHB populations in 2015 (Table 1) and 13 SRW-FHB populations in 2016 (Table 2). During 2017-18, FHB breeding materials evaluated in scab nursery and/or field tests included: 176 populations, 4,400 headrows, and more than 800 pure lines.

2) specific objectives

The specific objectives were: 1) to screen, characterize, and identify adapted wheat varieties having resistance to FHB and other prevalent diseases; 2) to identify and deploy unique FHB-QTL and diagnostic markers in MAS and DH breeding that is critical for accelerating progress and improving selection efficiency in enhancing FHB resistance via gene pyramiding in wheat cultivars.

3) significant results

A major FHB-QTL on chromosomes 1B of Jamestown identified in our program is currently being used routinely by the USDA-ARS Genotyping Lab and in other breeding programs. The SRW wheat cultivars Hilliard and L11550 having the FHB resistance QTL on 1B were released in 2015 and 2016, respectively.

Three QTL conferring resistance to FHB in Tribute were mapped to chromosomes 1A, 2A, and 3BSc. Diagnostic markers (1A: IWB62117, IWB65763; 2A: IWB39170; 3BSc: IWB7909, IWB29048) are being used in MAS breeding in the Virginia Tech wheat breeding program.

4) key outcomes or other achievements
Data on FHB and DON is collected each year on all wheat cultivars and experimental lines included in Virginia's Official Variety Trial and provided to growers and stakeholders in the annual Small Grains bulletin and online. The SRW wheat cultivars Hilliard and L11550, having the FHB resistance QTL on 1B, provide growers with widely adapted and high yielding varieties that also have resistance to other prevalent diseases in the eastern U.S. Identification and validation of QTL in native sources such as Jamestown (1B and 6A), and Tribute (1A, 2A, and 3BSc) has potential to enhance both breeding effectiveness and level of FHB resistance in SRW wheat. These QTL are being used for MAS to enhance scab resistance in wheat breeding programs.

3. What opportunities for training and professional development have the project provided?

This project has provided training to employees at the Eastern VA AREC including current and new research specialists, undergraduate students as well as professional development by allowing a post-doc research associate to attend the annual USWBSI meeting and participate in poster presentation sessions.

4. How have the results been disseminated to communities of interest?

Data on FHB incidence, severity, and index obtained from the Virginia's state wheat variety trial are reported online (http://www.pubs.ext.vt.edu/CSES/CSES-97/CSES-97.html) and in the extension bulletin CSES-97NP "Small Grains in 2017" to promote selection and production of FHB resistant cultivars. Information on FHB resistance of cultivars and the FHB disease forecasting website are also shared with producers at annual field days. Data on seedling resistance to leaf rust, resistance to FHB and other prevalent diseases as well as agronomic traits (e.g. heading date, height, lodging tolerance, yield, and test weight) and quality (samples provided to Soft Wheat Quality Lab) are collected and provided to cooperators in three uniform scab nurseries (SUWWSN, NUWWSN, and PNUWWSN). The results on QTL for FHB resistance mapped in Jamestown and Tribute were disseminated through USWBSI annual meetings and directly implemented by the Genotyping Center.

Table 1. Soft red winter wheat scab top cross populations enriched via MAS in 2015 and evaluated in F_3 headrows in 2017 and in F_4 headrows in 2018 at Warsaw, VA.

Pop no.	Short Pedigree	Traits for MAS	F_4 Rows Tested in 2018
1	MD08-26-H2-7-12-9/USG3555//VA12W-150	Fhb1-het,Fhb_2DL het,Fhb_3BL het,Sr24/Lr24,Sbm1,TaSus-2B het,Ppd-A1a.1 het,Ppd-D1a	52
2	MD08-26-H2-7-12-9/Jamestown//VA09W-73	Fhb1-het,Fhb_2DL het,Yr17/Lr37/Sr38 het,Sr24/Lr24,Lr9,Sbm1 het,vrn-A1,Rht2,Ppd-A1a.1 het,Ppd-D1a het	60
3	MD08-26-H2-7-12-9/Jamestown//VA12W-54	Fhb1-het,Fhb_5A het,Yr17/Lr37/Sr38 het,Sbm1,vrn-A1 het,Rht2,Ppd-A1a.1 het,Ppd-D1a	12
4	MD08-26-H2-7-12-9/12V51//VA11W-95	Fhb1-het, Fhb_2DL het,Fhb_5A het,Fhb_3BL het?,Lr9,Sbm1,Rht2,Ppd-A1a.1,Ppd-D1a	68
5	MD08-26-H2-7-12-9/12V51//VA12W-150	Fhb1-het,Fhb_2DL het,Fhb_5A het,Sr36 het,Sr24/Lr24,Sbm1,Rht2,Ppd-A1a.1 het,Ppd-D1a	68
6	MD08-26-H2-7-12-9/VA09W-73//Hilliard	Fhb1-het, Fhb_2DL het,Fhb_5A het,Sbm1,Rht2,Ppd-A1a.1,Ppd-D1a	28
7	MD08-26-H2-7-12-9/VA09W-73//VA12W-150	Fhb1-het,Fhb_2DL het,Fhb_5A het,Sbm1,Rht2,Ppd-A1a.1,Ppd-D1a	16
8	MD08-26-H2-7-12-9/VA11W-278//Hilliard	Fhb1-het,Fhb_2DL het,Fhb_5A het,Yr17/Lr37/Sr38 het,Sr24/Lr24,Sbm1,Rht2,Ppd-A1a.1,Ppd-D1a	24
9	MD08-26-H2-7-12-9/VA11W-278//VA12W-150	Fhb1-het,Fhb_2DL het,Fhb_5A het,Yr17/Lr37/Sr38 het,Sr24/Lr24,Sbm1,Rht2,Ppd-A1a.1 het,Ppd-B1a_S64,Ppd-D1a	56
10	MDC07027-12-24/Hilliard//VA09W-73	Fhb1-het,Fhb_2DL het,Fhb_5A het,Yr17/Lr37/Sr38 het,Lr9,Sbm1 het,Rht2,Ppd-A1a.1,Ppd-D1a het	80
11	MDC07027-12-24/Hilliard//SS8412	Fhb1-het,Fhb_2DL het,Fhb_5A het,Yr17/Lr37/Sr38 het,Sr24/Lr24,Sbm1,Rht2,Ppd-A1a.1 het,Ppd-D1a het	84
12	MDC07027-12-24/Hilliard//VA11W-278	Fhb1-het,Yr17/Lr37/Sr38 het,Sbm1,Rht2,Ppd-A1a.1 het,Ppd-B1a_S64,Ppd-D1a	12

Table 2. Soft red winter wheat scab top cross populations enriched via MAS in 2016 and grown out in 2017 for evaluation in F2 headrows in 2018 in Warsaw, VA.

Pop No.	Cross Pedigree	Max# FHB QTLs	Marker Traits	No. F_2 Plants
1	NC8248-14 / Jamestown // MDC07026-F2-19-13-1	6	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB1A_Nse, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36	105
2	NC8248-14 / Featherstone 73 // MDC07026-F2-19-13-1	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr9, Lr/Sr24, Sr36	52
3	NC8248-14 / Hilliard // MDC07026-F2-19-13-1	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB1A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36	106
4	NC8248-14 / GA03564-12E6 // MDC07026-F2-19-13-4	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36, 1A.1R	77
5	NC8248-14 / VA12W-54 // MDC07026-F2-19-13-1	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36, Lr46, H13	89
6	NC8248-14 / VA12W-72 // MDC07026-F2-19-13-4	6	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB3B_Msy, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36	72
7	NC8248-14 / MDC07026-F2-19-13-4 // VA11W-108PA	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36	20
8	NC8248-14 / MDC07026-F2-19-13-4 // VA11W-279	6	Fhb1, FHB1B_Jtw, FHB3B_Msy, FHB4A_Nse, FHB1A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36, H13	21
9	NC8248-14 / MDC07026-F2-19-13-4 // VA12W-72	5	Fhb1 or FHB3B_Bes, FHB1B_Jtw, FHB3B_Msy, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36, Lr46, H13	20
10	NC8248-14 / MDC07026-F2-19-13-4 // TXGA06343-17-3-5-EL2	4	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1, Lr37, Lr/Sr24, Sr36	15
11	NC8248-14 / MDC07026-F2-19-13-4 // VA14FHB-28	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1_het, Lr37, Lr/Sr24, Sr36	14
12	NC8248-14 / MDC07026-F2-19-13-4 // VA07MAS3-7304-3-2-4-3	5	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1_het, Lr37, Lr/Sr24, Sr36	16
13	NC8248-14 / MDC07026-F2-19-13-4 // VA09MAS6-122-7-1	4	Fhb1, FHB1B_Jtw, FHB3B_Bes, FHB4A_Nse, FHB6A_Nse, Sbm1_het, Lr37, Lr/Sr24, Sr36	11

Project 3: *Developing Double Haploids to Expedite Variety Development in SRWW.*

1. What are the major goals and objectives of the project?

One of the main objectives of the VDHR research area is to increase the efficiency of coordinated project breeding programs in developing and releasing FHB-resistant varieties. Doubled haploids (DH) shorten variety development time in fall-sown small grains by approximately three years.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) major activities

Research is focused on shortening breeding cycles through the development of doubled haploid populations and enhancing FHB resistance via MAS breeding efforts in selection of parents, designing crosses, gene introgression and pyramiding, population enrichment, and selection of pure lines. Marker haplotypes of parents for validated FHB resistance QTL and other traits of importance such as dwarfing genes, disease and insect resistance, rye translocations, and quality are being assessed and utilized to enhance breeding efficiency. Molecular markers linked to 15 scab resistance genes located on wheat chromosomes 2D, 3B (Fhb1), and 5A of Ning 7840, 1B and 6A of Jamestown, 1A and 2A of Tribute, 3B and 4B of Ernie, 2B and 3B of Bess, 3B of Massey, and 1A, 4A, and 6A of Neuse are being used to screen parental lines of crosses and in marker-assisted selection to pyramid different FHB resistance genes. Marker assisted selection (MAS) was applied in 13 SRW-FHB top cross populations in 2016 and 2017 (See Tables 1 and 2 above). In 2016 and 2017, individual plants having multiple FHB resistance QTL and other traits of interest were delivered to Heartland Plant Innovations to develop DH lines for breeding programs in VA, AR, GA, LA, NC and KY. Other MAS plants were grown out in the greenhouse and are being advance in our breeding program using the Pedigree method. Lines selected from DH populations also have be shared with and evaluated in the aforementioned breeding programs.

2) specific objectives

The specific objective is to shorten variety development time and enhance FHB resistance and other critical traits in SRW wheat cultivars by deploying a combination of MAS and DH breeding methods.

3) significant results

The VT program has developed 10 or more top cross populations (~100 seed / cross) over the past three years, from which individual seedlings have been screened via MAS to identify genotypes having multiple genes/QTL for FHB resistance. This data and selected DH lines have been shared with southern breeders who cooperate in the DH project. During the past two years, breeders in AR, GA, LA, NC, and KY have selected plants from which DH lines were developed by Heartland for their programs. Selected

plants have been vernalized and physically transported either from Gina's lab (2015) or my lab (2016 and 2017) directly to Heartland.

4) key outcomes or other achievements
Concurrent deployment of MAS and DH breeding methods has greatly accelerated the rate at which superior wheat lines having multiple QTL for FHB resistance, including gene *Fhb1*, are being developed and tested in the southern region. The proportion of wheat lines having enhanced FHB resistance has increased significant as a result of this regional project (See results in Table 3).

3. What opportunities for training and professional development has the project provided?

This project has greatly enhanced collaborative breeding efforts between breeding programs in the southern and mid-Atlantic regions. It also has provided novel training to small grains employees located on campus and at the Eastern VA AREC including research associates, research specialists, graduate and undergraduate students.

4. How have the results been disseminated to communities of interest?

Genotypic and phenotypic data, MAS selected top-cross progeny, and selected DH lines have been shared with southern breeders who cooperate in the DH project. Information and progress garnered from the project also has been showcased and shared with producers at field days and annual grower meetings.

Table 3. Top Performing Lines in the 2018 VT-Preliminary SRW Wheat Test

VARIETY	Yield % of Mean	Grain Yield Bu/A		Test Weight Lb/Bu		Head Date Jan1+		Plant Height (Inch)		Plant Lodge (0-9)		Powdery Mildew (0-9)		S.nod glume (0-9)		S.nod leaf (0-9)		FHB Index (0-9)	
Locations:	3	3		3		2		2		2		4		1		1		1	
15VDH-FHB-MAS22-15	113	85	+	57.9	+	121	=	34		2.7		0.6		6.7	++	3.7		53	
15VDH-FHB-MAS41-13	111	83	+	60.0	++	121	=	38	++	2.3		0.6		1.0		2.3		52	
14VDH-SRW20-348	110	83	+	57.1		121	=	37	+	1.7		0.6		1.3		3.7		49	
15VDH-FHB-MAS25-08	108	81	+	56.4		121	=	33	-	1.8		1.0		4.0	+	3.7		36	
15VDH-FHB-MAS41-18	107	80		58.4	+	120	=	35		4.3		0.4		1.3		4.0		39	
15VDH-FHB-MAS33-30	105	79		58.4	+	122	=	35		1.0	-	0.2	-	1.3		3.0		20	-
VA17W-176	122	91	++	57.2		124		35		2.2		1.4		1.3		2.3		50	
VA17W-79	113	85	+	56.7		123	-	37	+	1.2		1.2		1.7		4.0		51	
VA17W-74	113	85	+	57.6		123	-	37	+	2.2		0.2	-	1.3		1.3		35	
VA17W-126	113	85	+	57.3		124		37	+	4.0		0.8		2.7		1.3		35	
15VDH-FHB-MAS22-14	106	79		60.5	++	124		35		0.7	-	1.4		0.7	-	1.0		31	
13VTK59-55	116	87	+	58.7	++	125	+	35		2.7		1.8		1.0		1.0		36	
SHIRLEY	114	85	+	54.8	=	125	+	34		1.0	-	0.4		1.0		1.3		60	
HILLIARD	107	80		56.6		125		37	+	1.2		0.6		2.0		1.3		39	
14VDH-SRW17-102	106	79		57.8	+	126	+	33	-	0.5	-	0.6		6.3	++	1.3		33	
15VDH-FHB-MAS10-25	106	79		58.3	+	125	+	37	+	1.8		1.2		1.0		1.3		39	
VA17W-208	105	79		57.2		125		36		1.8		0.4		1.0		2.3		30	
15VDH-SRW02-075	118	89	++	57.7		126	++	37	+	3.2		1.0		0.7	-	1.0		47	
VA17W-167	115	86	+	56.4		127	++	36	+	4.2		0.4		1.0		3.0		52	
14VDH-SRW06-001	114	85	+	59.2	++	126	++	35		2.2		3.4	++	1.0		1.3		52	
VA17W-163	111	83	+	56.7		126	++	36		2.7		0.8		1.0		2.0		47	
14VDH-SRW06-207	108	81		56.7		128	++	36		3.7		0.8		1.0		3.7		50	
VA17W-145	107	80		59.0	++	126	++	36		3.8		0.4		3.3		2.3		42	
13MAS2-269-5-4	106	80		60.1	++	126	++	37	+	2.3		1.4		4.7	++	4.0		41	
PIONEER 25R32 (Fhb1)	107	80		56.5		125	+	36		2.8		1.2		5.3	++	2.7		31	
COKER 9835 (S-FHB)	84	63	-	54.6	=	125	+	32	=	2.5		1.8		1.0		1.3		76	+
PIONEER 26R46 (S-FHB)	87	65	-	55.2	-	124		37	+	1.2		1.0		5.0	++	2.3		91	+
Mean (N=132)		75.1		56.9		124		35		2.7		1.2		2.1		2.7		50.2	
CV		8.2		1.6		0.5		4.0		52.5		64.6		36.4		41.9		31.7	
LSD		6.0		0.9		0.7		1.6		1.6		0.9		1.3		1.8		22.1	

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17 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 FY17 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 FY17 award period?**

   If yes, how many?

   No.

3. **Have any post docs who worked for you during the FY17 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   If yes, how many?

   No.

4. **Have any post docs who worked for you during the FY17 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

   If yes, how many?

   No.

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY17 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar Evaluated in 2017 and 2018 VT-OVT	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**2-Year FHB Rating** (0-9)	**Year Released**
Dyna-Gro 9811	SRW	MR	2.9	2017
USG 3118	SRW	MR	3.1	2017
PGX 16-7	SRW	MR	3.0	2017
Hilliard (Local MR Check)	SRW	MR	2.1	Check
USG 3228 (Most Resistant Variety)	SRW	R	0.6	Check
Croplan 8415 (Most Susceptible Variety)	SRW	S	4.6	Check

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17 grant. Only include citations for publications submitted or presentations given during your award period (6/17/17 - 6/16/18). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation.

Journal publications.

Nothing to Report

Books or other non-periodical, one-time publications.

Nothing to Report

Other publications, conference papers and presentations.

Fitzgerald, J., N. Carpenter, C.A. Griffey, W. Brooks, D. Van Sanford, P. Murphy, N. McMaster, and D. Schmale III. 2017. Evaluation of Winter Barley Cultivar Nomini for Quantitative Resistance to Fusarium Head Blight. *In:* Proceedings of the 2017 National Fusarium Head Blight Forum (p.84) Milwaukee, WI: U.S. Wheat & Barley Scab Initiative.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), YES (abstract)

Thomason, W., C. Griffey, H. Behl, E. Hokanson, B. Khim Chim. 2017. Small grains in 2017. Ext. Publ. No. CSES-198NP. 117 pp. URL: www.ext.vt.edu.
Status: Extension Publication
Acknowledgement of Federal Support: NO