

## PROGRESS REPORT FOR CROP YEAR 2022

**Program:** Virginia Small Grains Board

**Project Title:** Development of Specialty Wheat Varieties with High-Value End-Use Properties

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The small grain breeding program initiated the research which focused on the evaluation and development of specialty wheat in 1998. A primary objective of the program has been to identify and develop hard winter wheat and winter durum varieties adapted to our region. We continue to interact with producers and millers in Virginia and the region in order to identify and incorporate desirable and high value end-use traits into adapted wheat varieties. Grain samples of specialty wheat lines are provided to millers for milling and baking evaluations each year, thereby directly identifying wheat lines having desirable end-use quality for commercial production and/or use as parents in the breeding program.

In fall 2010, seed of the first hard red winter (HRW) wheat cultivars (Vision 30 and Vision 40) developed exclusively at Virginia Tech, were provided to VIPG producers for evaluation and commercial production. The high yielding HRW wheat cultivar Vision 45, developed in our program, was released in spring 2012. The hard wheat cultivars LCS Wizard (VA08HRW-80) and LCS Compass (VA10HRW-13) were released in 2013 and 2015, respectively; and both have performed well in the Great Plains. Vision 50 and CM 1163 (VA09HRW-6) were released in 2016, Hardy 2519 (VA14HRW-25) was released in spring 2019, Phoenix (14VDH-HRW-02-029) was released in spring 2022, and VA18HRW-96 was release in spring 2023. Specialty wheat cultivars developed at Virginia Tech that perform well in other non-competitive marketing areas will provide royalty returns to support our specialty wheat breeding program.

### Summary of Project Activities to Date

#### Bread Wheat Elite Trial

During the 2021-22 growing season, 75 HRW wheat lines and 3 soft wheat checks were evaluated for agronomic performance in Virginia's Bread Wheat Elite Test at Blacksburg, Warsaw, Blackstone and Painter (Table 1). The highest-yielding line was cultivar dH18HRW-138-96, producing grain yield (117 bu/ac) that was 6 bushes higher than soft red winter (SRW) wheat check Hilliard and Shirley (111 bu/ac), and 14 bushes higher than SRW check Liberty 5658 (103 bu/ac). Five other Virginia hard wheat lines also produced grain yield significantly higher than test mean. Milling and baking quality analyses of entries in this trial were performed by Mennel Milling Company and are summarized in Table 4 (part of the test entries). Six lines have acceptable quality based on Mennel Milling (highlighted in Table 4). Line Phoenix 29, VA18HRW-96, VA18HRW-58, VA19HRW-17 performance well both on yield and quality.

#### Preliminary Experimental Bread Wheat Test

Forty-nine new HRW wheat lines selected from 2021 observation yield tests and 13 checks were re-evaluated in replicated yield tests at Blacksburg and Warsaw VA in 2021-22 planting season (Table 2). Out of the 49 new lines, VA21HRW-29 is the highest yield hard wheat line, and its grain yield (101 bu/ac) ranked first in the test, 3 bushes higher than the soft wheat check Shirley (98 bu/ac). Another 2 new lines VA21HRW-102 and

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VA21HRW-87 produced grain yields significantly higher than test mean (89 bu/ac). Total of 30 out of the 49 new lines were selected to retest in 2022-23 bread wheat elite test. The 30 lines were sent to Mennel Milling Company to evaluate milling and baking quality (Table 4).

Only milling analyses of entries in this trial were performed by Mennel Milling Company, seven lines have acceptable quality base on one year's milling data.

#### **USDA-ARS Uniform Bread Wheat Trial**

A total of 47 entries were included in the regional Uniform Bread Wheat Trial. There were 29 testing locations for the 2021-22 UBWT, with 1 in each of Florida, Illinois, Indiana, Kentucky, Minnesota, Nebraska, Ohio, Oklahoma and Kenya; 2 in each of Georgia, Kansas, Virginia, and Washington; 3 in Texas, and 9 in North Carolina (Table 3 with 10 locations). Nineteen Virginia Tech experimental lines and one soft wheat check were included in the UBWT. Seven Virginia lines produced grain yields ranked in top ten. Phoenix 29 is the highest yield HRW line and ranked first in the test.

#### **New Bread Wheat Lines Evaluated in 2020-21 Observation Yield Tests**

Single yield plot tests of 160 new bread wheat lines selected from regular progeny rows and DH lines in 2021 were evaluated for agronomic performance in non-replicated yield tests at Blacksburg and Warsaw, VA (Data were not showed). Total 30 new lines were selected and are currently being tested in replicated yield tests in the 2022-23 Bread Wheat Preliminary Test at two locations.

#### **Bread Wheat Breeding and Population Advancement**

In summer 2022, 364 bread wheat breeding populations, 560 new crosses, 6800 progeny rows were evaluated, selected among, and advanced in the 2022-23 crop year.

During spring 2023, more than 300 single and top-crosses were made among bread wheat lines. The program continues to evaluate new bread wheat lines from other programs (KSU, USDA-ARS), and some of these lines are used as parents in our crossing program.

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Table 1. Summary of performance of entries in the 2021-2022 Virginia Bread Wheat Elite Test (part of lines included)

Line (Highlighted lines have acceptable quality by Mennel)	Yield Rank	Yield		Test Weight	Heading Date		Height		Lodging		Powdery Mildew	FHB Plant Response		
		bu/ac	lb/bu	lb/bu	Julia	inch			0-9					
DH18HRW-138-56	1	104	+	59	117	-	36		0.0		0.5	-	4.5	
VA20HRW-39	2	101	+	60	122	+	41	+	0.1		1		4.12	
VA18HRW-98	3	101	+	59	120		38		0.6	+	3		3.5	
VA18HRW-96	4	99	+	60	122	+	38	+	0.0		1		3.5	
HILLIARD (SRW)	5	99	+	59	118	-	36		0.0		2.5		4.5	
SHIRLEY (SRW)	6	98	+	58	-	121		35	0.0		0	-	4.5	
VA20HRW-80	7	97	+	60	119	-	37		0.1		0	-	5	
VA20HRW-38	8	97	+	59	121		41	+	0.3		2.5		4	
Pheonix 29	9	96		59	120		34	-	0.1		1		6	
VA19HRW-26	10	95		60	121		39	+	0.0		1		3.5	
VA20HRW-73	11	95		59	121		37		0.0		0	-	3.5	
17VDH-HRW12-169	12	94		61	+	120	-	33	-	0.0	0	-	4	
DH16HRW-72-134	13	94		61	+	119	-	34	-	0.0	2		2	
Hardy 2519	14	94		61	+	117	-	36		0.0	3.5		3.5	
VA18HRW-58	16	93		61	+	124	+	37		0.0	2		3	
VA19HRW-47	17	93		60	+	119	-	39	+	0.0	2		5.5	
VA20HRW-43	18	93		58		122		39	+	0.1	1		5	
VA20HRW-50	19	93		60		121		42	+	0.5	+	0.5	-	4.5
VISION 45	27	91		60		123	+	41	+	0.1	0.5	-	3.5	
Liberty 5658 (SRW)	29	91		60		117	-	36		0.0	3.5		6	
VA18HRW-57	39	89		59		124	+	37		0.0	3.5		3.5	
VA19HRW-17	49	87		59		124	+	37		0.0	1		2.5	
5210	63	84		57	-	123	+	32	-	0.0	2		6	
Vision 50	64	83		59		118	-	34	-	0.0	4		5	
Everest	70	81		59		115	-	34	-	0.2	3		7.5	
SOISSONS	75	76	-	57	-	122		33	-	0.0	2.5		5	
JAGGER	78	69	-	58	-	116	-	34	-	0.3	6		4.5	
Mean (N=78)		88		59		121		36		0.1	2.14		4.27	
CV (%)		8		1.41		1		4		464.7	30.61		24.89	
LSD (0.05)		8		0.95		1		2		0.4	1.31		2.12	
No. of test sites		4		4		2		2		1.0	1		1	

Note, plus or minus sign means the value is significantly higher or lower than average.

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Table 3. Performance summary of entries in the 2021-2022 Uniform Bread Wheat Trial (part of lines included)

Name	Yield Rank	Yield		Heading		Height	Lodging	Powdery Mildew		FHB		Protein content	Kernel Hardness
		Bu/a	Yield	Date	Inch			Mildew	response	plant response	%		
Phoenix 29	1	86		117	33	33	0.3	1.5	5.5	5.5	10.4	71.1	
Shirley (SRW)	2	84		117	33	33	0.3	0.0	4.5	4.5	10.9	16.0	
VA20HRW-38	3	82		120	41.5	41.5	0.3	0.5	3.0	3.0	10.9	72.2	
VA18HRW-58	4	79		122	36	36	0.3	2.0	6.0	6.0	11.1	73.0	
VA20HRW-43	5	79		120	39	39	0.3	3.5	6.0	6.0	10.9	67.9	
VA18HRW-57	6	78		122	37	37	0.3	4.5	4.0	4.0	11.0	80.9	
VA18HRW-96	7	77		121	36.5	36.5	0.3	0.5	3.0	3.0	11.3	71.0	
ARS18W0646	8	76		116	32	32	0.3	1.0	4.0	4.0	10.8	69.6	
ARS16W1067	9	76		118	38.5	38.5	0.1	2.5	3.5	3.5	11.1	70.1	
VA19HRW-33	10	75		122	38	38	0.3	3.0	3.0	3.0	11.1	78.9	
VA19HRW-17	11	75		122	35	35	0.3	2.0	3.0	3.0	11.4	63.0	
Vision 45	12	75		122	40	40	0.3	1.0	4.0	4.0	12.0	65.2	
Hardy 2519	13	75		115	38	38	0.3	6.0	4.0	4.0	11.1	72.9	
15VDH-HRW19-018	14	74		119	37.5	37.5	0.3	2.0	3.5	3.5	11.0	72.5	
ARS19W519	16	72		125	34.5	34.5	0.3	0.0	2.0	2.0	9.7	86.4	
VA20HRW-4	17	72		121	38	38	0.3	2.5	4.0	4.0	10.9	84.1	
USG 3120 (SRW)	22	71		113	36	36	0.3	6.0	6.0	6.0	10.8	22.4	
Catawba	30	68		115	37.5	37.5	0.3	1.0	5.5	5.5	11.7	68.9	
NuEast	37	63		117	36	36	0.3	6.0	3.5	3.5	10.9	69.3	
Zenda	39	62		116	36.5	36.5	0.3	5.0	6.0	6.0	11.1	69.0	
Appalachian White	45	55		122	37.5	37.5	0.3	2.5	2.5	2.5	12.4	77.7	
Mean (n=47)				119	36.77	36.77	0.3	2.7	4.4	4.4			
CV (%)				1	3.94	3.94	40.8	27.8	24.3	24.3			
LSD (0.05)				2	2.91	2.91	0.3	1.5	2.2	2.2			
No of test sites		5		2	2	2	2	1	1	1			

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Table 4. Milling and baking quality of entries in the 2021-22 Virginia Bread Wheat Tests with Acceptable Quality by Mennel Milling Co.

Cultivar	WHEAT			MILLING			FLOUR			FARINOGRAPH				BREAD BAKE		
	Protein @12%	Falling No.	Vomitoxin ppm	Flour Yield %	1st Break, % flour	Protein @ 14%	Water Absorption %	Peak min	Stability min	MTI bu	Bake Volume cc	Loaf score	Grain score			
	%	sec		%	%	%	%	min	min	bu	cc	0-6	0-6			
SOISSONS	10.7	412	0.00	78.4	8.3	9.41	52.8	1.4	2.6	72	2408	4.0	4.5			
VISION 45	11.8	458	0.00	76.1	6.6	10.19	53.4	1.7	4.6	63	2467	4.5	5.0			
Phoenix 29	11.3	426	0.00	78.0	7.7	9.38	53.5	1.7	3.5	54	2392	3.5	4.0			
VA18HRW-58	10.5	448	0.00	76.8	5.7	9.21	55.5	1.5	5.9	45	2442	4.0	5.0			
VA18HRW-96	10.9	470	0.10	78.2	6.4	9.31	56.0	1.6	2.3	70	2342	3.0	5.5			
VA19HRW-17	10.5	461	0.50	77.8	7.2	9.40	53.8	2.1	4.9	60	2467	4.5	5.0			
VA20HRW-50	10.7	437	0.00	77.5	6.9	9.48	53.1	3.3	6.8	50	2317	3.0	5.0			
IDO 1906 (white)	10.7	446	0.00	76.9	6.4	10.21	56.9	2.5	6.8	36	2308	3.0	5.5			
VA21HRW-9	11.6	424	0.00	76.3	6.3	10.23	56.5	3.4	6.6	48						
VA21HRW-12	10.0	458	0.00	76.1	4.3	9.21	56.1	1.6	6.8	34						
VA21HRW-20	11.0	462	0.20	76.6	6.7	9.84	55.7	1.6	3.1	69						
VA21HRW-34	9.9	383	1.00	76.4	6.1	8.40	55.2	1.6	2.6	61						
VA21HRW-39	11.1	446	0.10	76.3	6.4	9.60	55.3	1.5	3.2	58						
VA21HRW-50	10.2	435	0.10	79.1	8.1	8.67	55.1	1.4	2.5	67						
VA21HRW-99	10.0	430	0.00	76.0	8.1	8.62	58.5	1.4	2.2	72						
Mean (n=44)	10.6	440	0.14	76.3	6.7	9.21	55.1	1.8	3.5	69						
Maximum	11.8	504	1.00	79.1	9.6	10.25	60.2	3.4	6.8	111						
Minimum	9.0	358	0.00	73.3	4.2	7.88	50.6	1.0	1.4	34						

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