Progress in Development and MAS of FHB Resistant Wheat Cultivars and Germplasm at Virginia Tech

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Objectives

- Incorporate, characterize, and combine scab resistance genes from newly-developed scab resistant and/or scab tolerant SRW wheat lines in development and deployment of commercially viable wheat cultivars via haplotype selection and breeding.

- Accelerate release of scab resistant cultivars and/or germplam using molecular marker assisted breeding in the characterization and selection for FHB resistance.

Summary of Progress

- High yielding, FHB resistant SRW wheat cultivars/germplasm have been developed using a combination of top-cross, doubled haploid, backcross and marker assisted breeding methods (Table 1 – 8).
- Potential cultivar/germplasm release in 2007 and 2008 (Table 1).
- Marker-assisted evaluation of three FHB QTL located on wheat chromosomes 3BS, 5AS, and 3AS conducted in 56 parental lines, 120 three-way F1 progeny, 83 BC1F1 progeny, and 145 wheat lines in the 2006 VT FHB Advance and Preliminary Tests.
- High throughput genotyping conducted at VT MAS lab and in collaboration with USDA-ARS Genotyping Centers.
- Promising varieties and germplasm and valuable information on QTL and markers have resulted from support obtained from the U.S. Wheat and Barley Scab Initiative.

Table 1. Potential Cultivar/Germplasm Release at VT Wheat Breeding and Genetics Program

Line	Breeding Method	Type I Incidence (Field %)	Type III DON (Field)	Type II Severity (GH)	QTL - Markers
VA00W-370	Top-cross	58	1.1	8.0	3BS-Barc133, STS3B-142
VA02W-713	Top-cross	70	1.1	8.0	5AS-Barc056
VA04W-389	Top-cross	47	1.7	13.4	3AS-wmc264; 3BS-Barc133, STS3B-142; 5AS-Barc117, Barc056
VA04W-433	Top-cross	57	0.5	8.0	3BS-Barc133, STS3B-142; 5AS-Barc056
VA01W-476	Doubled haploid	20-30	-	-	3AS-wmc264; 3BS-Barc133, STS3B-142
VA04W-474	Doubled haploid	37	0.2	9.8	5AS-Barc117, Barc056
VA04W-515	Backcross	48	0.9	27.8	3AS-Wmc264; 3BS-Gwm533
VA04W-592	Backcross	65	1.3	12.1	3BS-Barc133

Table 2. Performance of VA02W-370 and VA02W-713 in 2006 Uniform Southern Soft Red Winter Wheat Nursery: 13 Sites

Genotype	Grain Yield		Test Weight		PM	LR	YR	SEPT	HF %
	Bu/A	Rank	Lb/Bu	Rank	0-9	%	%	0-9	0-9
B02-8486	81.3	1	59.1	7	1.0	6	0	5.8	3.0
VA02W-370	80.8	2	59.7	2	2.0	11	5	5.0	2.3
GA951231-4E26	80.1	3	58.2	17	2.0	4	0	3.8	2.3
GA951231-4E25	79.5	4	58.1	20	3.0	17	1	4.0	1.3
AGS 2000	79.1	5	58.6	11	1.0	5	36	3.8	2.5
GA96693-4E16	78.7	6	58.4	14	1.0	11	5	4.5	2.3
VA02W-555	78.0	8	57.5	27	0.0	9	0	5.8	4.5
B011260	77.2	9	57.5	26	1.0	17	5	4.5	4.3
USG 3209	75.6	10	57.8	24	2.0	11	5	5.3	3.0
VA02W-713	74.9	12	59.0	9	1.0	3	46	4.8	1.8
MEAN	71.3		57.5		1.8	14	12	4.5	3.6

Table 3. FHB Resistance Breeding Stocks Developed and Evaluated by the Virginia Tech Wheat Breeding Program in 2006.

Breeding Stocks	2005	2006
Populations	100	180
Headrows	3,600	3,000
Observation	359	320
Preliminary	64	85
Germplasm	14	65

Table 4. Molecular Markers Used in the Current Study

3BS	5AS	3AS
gwm533	barc117	gwm002
barc133	barc186	gwm674
STS3B142	barc100	barc045
STS3B256	gwm156	wmc428
gwm493	barc186	wmc264
cfd079		
Liu et al., 2006; Chen et al., 2006	Buerstmayr et al., 2004; Chen et al., 2006	Shen et al., 2003; Somers, et al., 2005; Chen et al., 2006

Table 5. Haplotypes of the Three QTL in Known FHB Resistance Sources.

Line	QTL-3AS	QTL - 3BS				QTL – 5AS	
	Wmc264	Gwm533	Barc133	STS3B-142	Gwm493	Barc117	Barc056
Sumai 3	+	+	+	+	+	+	+
W14	+	+	+	+	+	+	+
Futai8944	+	+	+	+	+	+	+
Ning7840	+	+	+	+	+	+	+
Ning9016	+	+	+	+	+	+	+
Nobeoka Bozu	+	+	-	+	+	+	+
Wngshuibai	+	+	-	+	-	+	+
Frontana	+	-	-	-	-	-	-

Table 6. FHB Resistant Lines Developed by Different Breeding Methods, Two Year Performance

Line	Grain Yield		Test Weight		FHB Index		LR	
	(05)	(06)	(05)	(06)	(05)	(06)	(05)	(06)
Coker9835	84	111	61	59	22	62	3	1
Pion26R46	85	107	61	61	24	57	1	2
Tribute	88	110	64	62	15	14	6	1
VA00W-38	92	115	62	60	10	25	1	2
VA02W-713	80	109	63	61	10	16	2	6
VA04W-360	87	101	64	62	14	10	2	4
VA04W-389	82	99	62	59	4	9	6	4
VA04W-433	85	98	63	61	8	8	1	2
VA04W-439	100	112	64	62	15	16	3	7
VA04W-465	88	111	63	60	9	19	4	7
Grand Mean	80	102	63	61	13	19	2	3

Table 7. Marker-Assisted Evaluation for Newly-Developed FHB Resistant Line

Line	QTL-3AS	QTL-3BS				QTL-5AS	
	Wmc264	Gwm533	Barc133	STS3B-142	Gwm493	Barc117	Barc056
Coker 9835	-	-	-	-	-	-	-
Pion26R46	-	-	-	-	-	-	-
Tribute	-	-	-	-	+	-	-
VA00W-38	-	-	-	-	+	+	+
VA02W-370	-	-	+	+	-	-	-
VA02W-713	-	-	-	-	+	-	+
VA04W-360	-	-	+	-	+	-	-
VA04W-389	+	-	+	+	-	+	+
VA04W-433	-	-	+	+	+	-	+
VA04W-439	-	-	-	-	-	-	-
VA04W-465	-	+	-	-	-	-	-

Table 8. FHB Resistant Lines Developed by Different Breeding Methods, Two Year Performance.

Line	Grain Yield		Test Weight		FHB Index		LR	
	(05)	(06)	(05)	(06)	(05)	(06)	(05)	(06)
VA04W-474	**79**	**101**	**62**	**61**	**6**	**9**	**2**	**4**
Renwood3260	77	97	63	61	10	12	1	1
VA04W-515	**84**	103	**63**	61	**7**	8	**1**	1
Pion2684	85	98	64	61	19	33	1	2
VA04W-547	86	103	63	61	18	25	4	4
VA04W-557	**82**	103	**63**	61	**12**	30	**1**	2
Roane	78	108	63	63	27	22	2	1
VA04W-563	91	107	63	63	14	16	2	5
VA04W-571	86	105	63	62	23	15	2	2
VA04W-592	**88**	114	**62**	61	**12**	17	**1**	0
Grand Mean	80	102	63	61		19	2	3

Table 9. Marker-Assisted Evaluation for Newly-Developed FHB Resistant Line.

Line	QTL-3AS	QTL-3BS				QTL-5AS	
	Wmc264	Gwm533	Barc133	STS3B-142	Gwm493	Barc117	Barc056
VA04W-474	-	-	-	-	+	+	+
Renwood3260	+	+	-	-	-	-	-
VA04W-515	+	+	-	-	-	-	-
Pion2684	-	-	-	-	-	-	-
VA04W-547	-	+	+	-	+	-	-
VA04W-557	-	-	-	-	+	-	-
Roane	-	-	-	-	+	-	-
VA04W-563	-	+	+	+	+	-	-
VA04W-571	-	-	-	-	+	-	-
VA04W-592	-	-	+	-	+	-	-

Table 10-1. FHB Resistant Lines Developed by Different Breeding Methods, 2006 Performance, Warsaw Location

LINE	Grain Yield (Bu/A)	Test Weight (Lb/Bu)	LR 0-9	PM 0-9	Index	Field Incidence %	Field Severity %	Field DON ppm	GH Severity
Coker9835	103.8	58.5	1.0	1.0	29.4	97	30.2	0.9	18
Pion26R46	103.6	59.4	1.3	1.0	42.2	90	44.6	3.0	18
Tribute	106.6	61.8	0.3	1.0	9.7	57	17.4	0.5	13
VA05W-448	108.5	60.1	0.7	1.0	20.0	87	22.3	0.4	5
VA05W-523	100.1	60.6	5.0	1.0	8.2	50	13.6	0.3	5
VA05W-425	97.6	59.6	3.0	1.3	4.3	47	8.3	0.3	8
VA05W-517	107.7	62.5	3.7	1.0	9.7	77	12.2	0.2	6
OH552	-	-	-	-	17.5	80	19.1	0.6	19
VA05W-436	110.1	59.8	0.7	1.3	15.3	87	16.5	1.4	9
VA05W-500	98.3	60.1	1.0	1.0	9.4	53	17.4	0.5	14
VA96W-234	108.3	59.4	2.3	1.0	19.6	93	20.9	0.9	7
VA05W-581	104.4	58.5	2.3	1.0	12.0	63	18.3	0.1	6
Grand Mean	100.7	60.2	2.4	1.3	12.2	65	16.4	0.6	9

Table 10-2. FHB Resistant Lines Developed by Different Breeding Methods, 2006 Performance, Warsaw Location

LINE	Grain Yield (Bu/A)	Test Weight (Lb/Bu)	LR %	PM 0-9	Index	Field Incidence %	Field Severity %	Field DON ppm	GH Severity
Renwood3260	99.3	60.8	0.3	1.0	9.1	60	14.0	0.2	11
VA05W-641	105.2	60.2	1.7	1.0	7.1	53	13.3	0.3	8
Roane	101.1	61.1	1.3	2.3	12.4	73	14.9	0.2	6
VA05W-668	108.3	61.4	2.0	1.7	17.2	97	17.7	0.4	6
VA05W-669	101.7	61.1	2.3	1.7	17.4	83	18.7	0.5	6
VA05W-673	108.1	60.9	2.7	3.0	12.0	87	14.0	0.3	11
VA05W-775	106.0	60.8	3.0	3.0	6.5	60	9.6	0.1	9
Ernie	96.4	58.5	4.0	1.3	9.1	50	18.7	0.2	6
VA05W-690	92.2	58.8	2.3	1.0	5.3	53	12.5	1.0	6
VA05W-693	100.7	59.1	4.3	1.0	4.1	23	13.2	0.1	6
Pion2684	102.1	60.3	1.0	1.0	11.4	57	16.9	0.3	16
VA05W-714	93.5	59.8	2.0	1.0	7.3	43	15.3	0.3	6
VA05W-732	95.6	60.2	1.3	1.0	19.1	87	22.0	1.7	9
Grand Mean	100.7	60.2	2.4	1.3	12.2	65	16.4	0.6	9

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