

Characterization and Development of FHB Resistant Soft Winter Wheat Cultivars in the Eastern U.S.A.



U.S. Wheat & Barley
Scab Initiative



**Carl A. Griffey, Gina Brown-Guedira,
Paul Murphy, and Clay Sneller**

FHB Resistance Sources of Entries in the Uniform Soft Wheat FHB Nurseries

	2000 - 2009 SUWWSN	1999 - 2009 NUWWSN	2005 - 2009 PNUWWSN
Total No. Entries	395	547	223
Avg. No. Entries	40	50	45
Max. No. Entries	57	60	60
Avg.% Entries: Non-Exotic FHB Sources	70%	76%	75%
Avg.% Entries: Exotic FHB Sources	30%	24%	25%
Max.% Entries: Exotic FHB Sources	42% (2004)	36% (2002)	35% (2009)
2009 %Entries: Exotic FHB Sources	25%	22%	35%
Avg.% Asian FHB Parents	74%	74%	63%
Avg.% European FHB Sources	9%	5%	20%
Avg.% CIMMYT FHB Sources	15%	1%	0%
Avg.% So.American FHB Sources	0%	8%	4%
No. Varieties: Non-Exotic FHB Sources	9	19	3
No. Varieties with Exotic FHB Sources	0	2	0



Exotic FHB Resistance Sources

1999 - 2009 Uniform Winter Wheat FHB Nurseries

Origin	FHB Resistance Source	No. of Lines
China	Ning 7840 Ning 7840 - Derivatives	61 31%
China	Sumai 3 / Su Mei 25R18 - Sumai 3 Derivative	23 61%
Romania	Fundulea 201R	18
China	Yang Mai 6	16
China	Shanghai 4 Shanghai 4 - Derivatives	15 73%
China	Xing 117	13
China	W14 W14 - Derivatives	14 17%
China	Futai 8944	12
Brazil	Frontana	10
CIMMYT	Catbird	8
France	VR95B717	8
China	Shaan 85-15	5
China	ZM8725 & ZM10782	4
NDSU	Glenn	4
CIMMYT	CIM1-FHB#5	3
China	Ning 8026	3
China	Shanghai 3	3
CIMMYT?	Super Zlatna	3
China	Wuhan 1	3
Italy	Mentana	3
China	Huapei 32-2 and 57-2	2
China	Ning 9016	2



Lines Evaluated in Uniform FHB and Uniform Soft Winter Wheat Yield Nurseries

1999 - 2009	SUWWSN	NUWWSN	PNUWWSN	SUWWSN NUWWSN	SUWWSN PNUWWSN	NUWWSN PNUWWSN	SUWWSN NUWWSN PNUWWSN
USN Yield Nur.	60	8	1	5	2	0	2
UEN Yield Nur.	7	54	9	6	3	8	2
USN & UEN	11	0	3	0	0	0	0
Total No.	78	62	13	11	5	8	4
Yield Nur. = 862							
21% of Elite Lines Evaluated in FHB Nurseries				FHB Nur. = 181			

FHB / 2008 USN	11 / 38	29%
FHB / 2009 USN	4 / 36	11%
FHB / 2008 UEN	18 / 41	44%
FHB / 2009 UEN	12 / 38	32%

FHB Resistant Soft Wheat Varieties I

Cultivar	Origin	Year of Release	Source of Resistance	FHB	FDK	DON
				Index		
				% Lower than: Pion2545 / Coker9835		
Freedom	OH	1991	Native	47 (3)	52 (3)	45 (3)
Ernie	MO	1994	Native	44 (3)	59 (3)	45 (3)
				65 (3)	68 (3)	44 (3)
Coker 9476	Syngenta	1994	Native	77 (1)	70 (1)	72 (1)
Foster	KY	1996	Native	24 (2)	47 (1)	36 (2)
Roane	VA	1998	Native	50 (3)	43 (3)	61 (3)
Goldfield	IN	1999	Native	56 (1)	61 (1)	63 (3)
Pion 25R18	Pioneer	1999	Sumai 3	68 (1)	47 (1)	0 (1)
Renwood 3260	VA	2000	Native	48 (3)	43 (3)	50 (3)
McCormick	VA	2002	Native	66 (2)	61 (2)	51 (2)
Tribute	VA	2002	Native	54 (4)	57 (4)	61 (4)
Neuse	NC	2003	Native	63 (1)	51 (1)	32 (1)
INW0304	IN	2003	Native	21 (1)	58 (1)	66 (1)
Truman	MO	2003	Native	69 (3)	61 (3)	63 (3)
INW0411	IN	2004	Ning 7840	40 (1)	22 (1)	46 (1)
INW0412	IN	2004	Xing 117	69 (1)	61 (1)	40 (1)
USG 3342	VA	2005	Native	38 (2)	30 (2)	51 (2)
Jensen (SWW)	NY	2005	Native	23 (3)	0 (3)	31 (3)



FHB Resistant Soft Wheat Varieties II

Cultivar	Origin	Year of Release	Source of Resistance	FHB		
				Index	FDK	DON
				%Lower than: Pion2545 / Coker9835		
Bess	MO	2005	Native	58 (3)	55 (3)	64 (3)
				76 (2)	77 (2)	61 (2)
Coker 9511	Syngenta	2005	Native	75 (2)	67 (2)	71 (2)
IL00-8061	IL	2006	Native	60 (3)	69 (3)	73 (2)
Jamestown	VA	2007	Native	61 (1)	69 (1)	65 (1)
OH02-13567	OH	2007	Native	56 (3)	44 (3)	54 (3)
GA981621-5E34	GA	2008	Native	56 (2)	46 (2)	22 (2)
Bromfield	OH	2008	Native	48 (3)	54 (3)	61 (3)
Malabar	OH	2008	Native	59 (2)	66 (2)	36 (2)
Coral (SWW)	MI	2008	Native	39 (2)	56 (2)	21 (2)
IL00-8109	IL	2008	Native	38 (1)	63 (1)	70 (1)
IL00-8530	IL	2008	Native	40 (3)	47 (3)	73 (3)
IL01-11934	IL	2008	Native	51 (3)	56 (3)	74 (3)
IL01-16170	IL	2008	Native	51 (1)	53 (1)	79 (1)
IL02-19463	IL	2008	Native	37 (3)	60 (3)	57 (3)
B030543	Syngenta	2009	Native	57 (1)	73 (1)	76 (1)
NC04-20814	NC	2009	Native	42 (1)	30 (1)	0 (1)





Soft Wheat Cultivars Having Exotic FHB Resistant Parents

- ◆ 8 Exotic vs. 41 Native FHB Res. Cultivars
- ◆ 1999: Pion 25R18 – *Fhb1* (Sumai 3)
- ◆ 2001: Pion 25R42 – *Fhb1* (Sumai 3)
- ◆ 2003: Pion 25R35 – Non-*Fhb1* (Ning8319)
- ◆ 2003: Pion 25R54 – Non-*Fhb1* (Sumai 3)
- ◆ 2004: INW0411 – (Ning 7840)
- ◆ 2004: INW0412 – (Xing 117)
- ◆ 2005: Pion 25R51 – *Fhb1* (Sumai 3)
- ◆ 2008: INW0801 – (Fundulea 201R)



Limited Mapping in Native Sources of FHB Resistance

- ◆ Mapping studies have been reported in Freedom, Ernie, Goldfield, and IL94-1653
- ◆ QTL with moderate R^2 values (most <0.20) were identified on multiple chromosomes:

Ernie	2B, 3B, 4B, 5A	(Liu et al. 2007)
Freedom	2A, 3B, 5A, 7B	(Gupta et al. 2001)
Goldfield	2B	(Gilsinger et al. 2005)
IL94-1653	2B, 4B	(Bonnin et al. 2007)



Haplotyping of the Mapped QTL Regions is not conclusive for presence/absence of FHB resistance genes

- ◆ Ernie and Freedom differ for markers tested in the 5A QTL region
- ◆ Ernie and IL94-1653 may have the same QTL on chromosome 4B, yet they differ for marker alleles in this region
- ◆ Ernie alleles in the 5A and 4B QTL regions are common in both FHB resistant and susceptible germplasm
- ◆ The 2B QTL region has not been analyzed in Soft Winter Wheat germplasm



The resistance QTL mapped in the 3BSc region may be an important factor contributing to native resistance

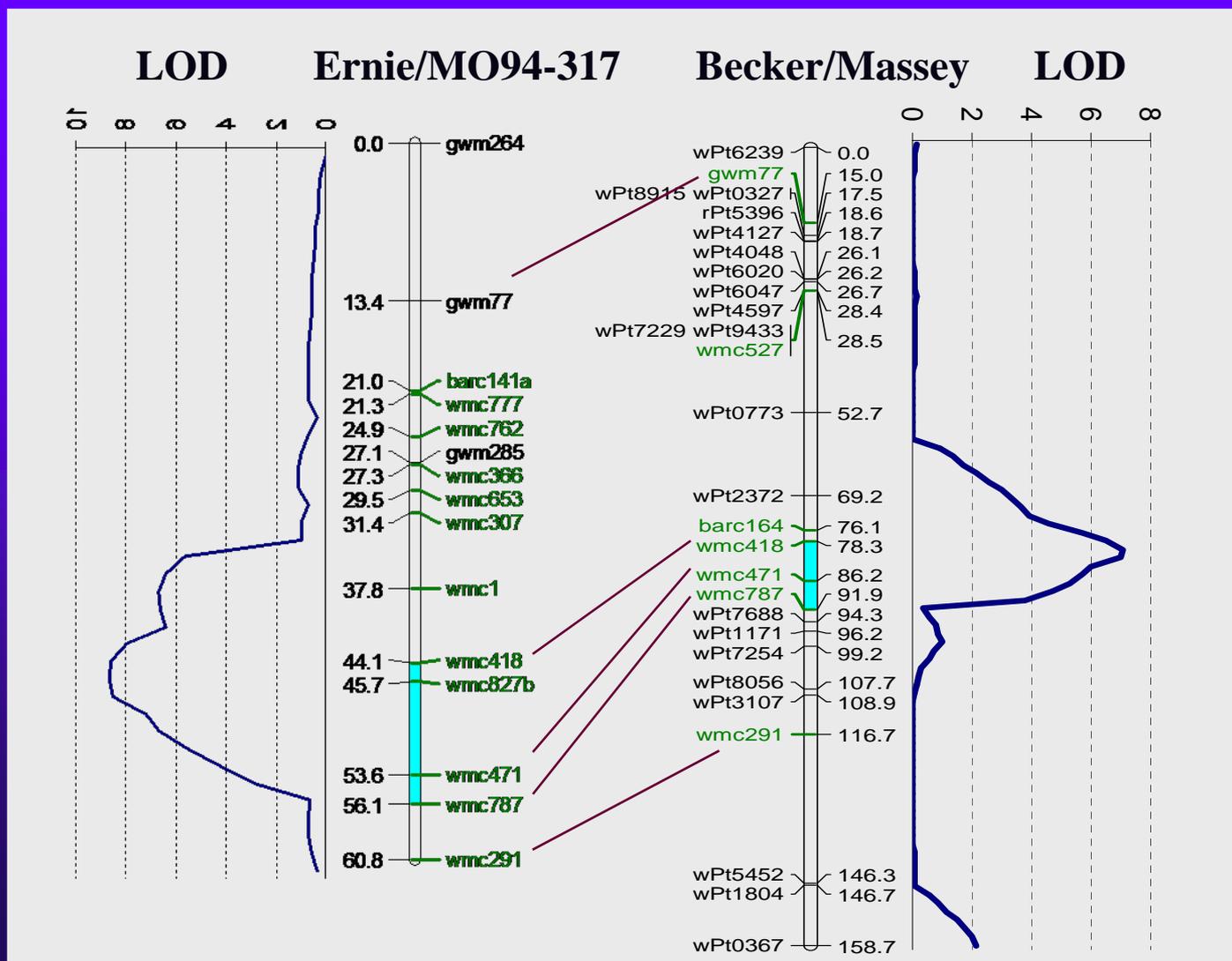
- ◆ A resistance QTL was reported on 3BSc in both Freedom and Ernie (*Xgwm285*)
- ◆ Freedom and Ernie have an identical haplotype in this region across eight SSR loci:

Xwmc78, Xwmc231, Xwmc777, Xwmc612, Xwmc625, Xgwm285, Xwmc307, Xwmc418

- ◆ This complete or partial haplotype is present in a number of SRWW lines with native FHB resistance:

Ernie, Freedom, Massey, Roane, INW0304, Jamestown, IL00-8530, IL01-11934

Same 3BSc QTL was mapped for type II resistance in both Ernie and Massey





Native FHB Resistance

- ◆ Most soft wheat lines with native resistance do not share haplotypes with other mapped sources of FHB resistance
- ◆ Multiple unique sources of FHB resistance likely originated and are represented in different germplasm pools

Summary of Efforts in Soft Winter Wheat Breeding Programs for FHB Resistance

- ◆ >70% Entries: Native Resistance Sources
- ◆ 84% Cultivars have Native Resistance
- ◆ Many/most lines having Exotic FHB Resistance also have Native Resistance
- ◆ Among the 32 cultivars evaluated in Uniform FHB Nurseries:
 - 17 (53%) have FHB Index \leq Ernie
 - 11 (34%) have FDK Values \leq Ernie
 - 22 (69%) have DON Values \leq Ernie





Exotic FHB Resistance Sources

- ◆ Asian FHB Parents: 63% to 74%
 - 26% Ning 7840 (31% SRW derivatives)
 - 10% Sumai 3 (61% Pion 25R18)
 - 6% Shanghai 4 (73% SRW derivatives)
 - 6% W14 (17% SRW derivatives)
 - 6% Futai 8944 and Xing 117
- ◆ European FHB Parents: 5% to 20%
 - 8% Fundulea 201R
- ◆ CIMMYT FHB Parents: 0% to 15%
 - 6% Catbird, CIM1FHB#5, Super Zlatna
- ◆ South American FHB Parents: 0% to 8%
 - 4% Frontana



Summary of Breeding Efforts in Soft Winter Wheat Programs for FHB Resistance

- ◆ 21% of the entries in the 2000 – 2009 Uniform Southern and Uniform Eastern Yield Nurseries also were evaluated in Uniform FHB Nurseries
- ◆ 37% of these entries were evaluated in Uniform FHB Nurseries prior to Uniform Yield Nurseries
- ◆ 47% of these entries were evaluated during the same year in Uniform FHB and Yield Nurseries
- ◆ 11% to 44% of Entries in 2008 and 2009 Uniform Yield Nurseries also were/are being evaluated in Uniform FHB Nurseries

Current Needs & Future Perspectives

- ◆ Native FHB resistance sources need to be genetically characterized, mapped, validated, and diagnostic markers developed for MAS.
- ◆ Unique and **complementary** types of FHB resistance having significant and **cumulative** effects on FHB incidence, severity, FDK, and DON need to be identified and validated.
- ◆ There continues to be an urgent need for reliable markers to facilitate incorporation and pyramiding of diverse, effective and **complementary** FHB resistance genes from exotic and native sources in cultivar development programs.

