ENHANCING HOST RESISTANCE TO FUSARIUM HEAD BLIGHT: PYRAMIDING GENES IN SPRING WHEAT

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INTRODUCTION

Fusarium graminearum Schwabe [telemorph *Gibberella zea* (Schwein)] causes Fusarium head blight (FHB) or scab of cereal crops in the U.S. Northern Plains. Scab decreases yield, lowers kernel quality, and results in the accumulation of mycotoxins in the kernels. A Type II resistance has been attributed to genes on chromosome 3B of the spring wheat, 'Sumai 3', as well as genes on chromosome 3A of *Triticum turgidum* L. var *dicoccoides*. 'Alsen' spring wheat has the Sumai 3 resistance (Frohberg et al., 2006). In several examples, pyramiding different sources of resistance in wheat increased the level of expressed resistance to FHB (Miedaner et al., 2006; Tamburic-Ilincic et al., 2006).

OBJECTIVE

To compare the level of expressed resistance to FHB of Line 1, which has only the Sumai 3 source of resistance with Line 2, which has resistance QTL from both Sumai 3 and *Triticum turgidum* L. var *dicoccoides*.

MATERIALS AND METHODS

A Synthetic hexaploid wheat developed by Hartel et al. (2004) was used to transfer FHB resistance from *T. dicoccoides* to Alsen.

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Production of Alsen backcrossed-derived lines (Fig. 1)

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Screening with microsatellite and STS markers *Xgwm533* and STS3B-256 for Sumai 3; *Xgwm2* and *Xgwc501* for *T. dicoccoides* (Table 1)

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Inoculation

10 µl inoculum of 50,000 spores ml^{-1}

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Phenotypic evaluation

Greenhouse seasons (Table 2)

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Disease assessment

a.) Severity at 7, 14, and 21 d after inoculation (dai) using scale developed by Stack and McMullen (1995)

b.) Percent Fusarium-damaged kernels (FDK)

c.) Deoxynivalenol (DON) content

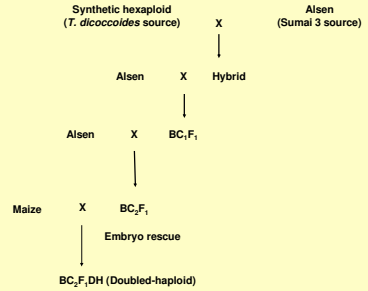

Fig. 1. Schematic showing production of Alsen backcrossed-derived lines.

Table 1. Genotypes evaluated for FHB resistance.

Treatments	Gene source	
	Sumai 3	*T. dicoccoides*
Line 1 (BC_2 DH)	+	-
Line 2 (BC_2 DH)	+	+
Alsen	+	-
ND2710	+	-
LDN (Dic 3A)	-	+
Synthetic wheat	-	+
Choteau	-	-
McNeal	-	-
Butte 86	-	-
AC Vista	-	-

Table 2. Greenhouse seasons and conditions.

	GH-1	GH-2	GH-3
Planting date	Aug to Sept 2005	Nov to Dec 2006	Apr to May 2007
Inoculation date	Nov to Dec 2005	Jan to Mar 2007	June to Aug 2007
	ºC		
Temperature, max./min.	31 / 18	29 / 11	28 / 18
	%		
Humidity, max./min.	55 / 26	61 / 22	87 / 48

RESULTS

Molecular Marker Screenings

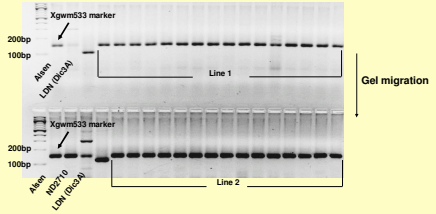

Fig. 2. Genotypes screened with *Xgwm533* on 3% agarose gel. Both Line 1 and Line 2 have the *Xgwm533* marker.

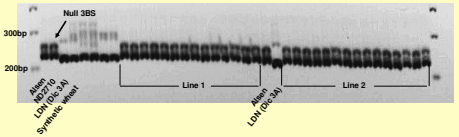

Fig. 3. Confirmation screening with STS3B-256 on 6% non-denaturing gel. Both Line 1 and Line 2 show the null 3BS marker.

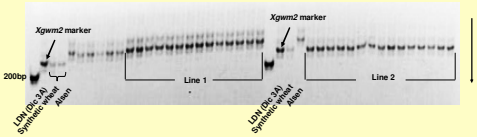

Fig. 4. Genotypes screened with *Xgwm2* on 6% non-denaturing gel. Line 2 shows the *Xgwm2* marker allele but Line 1 does not.

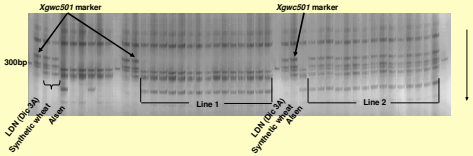

Fig. 5. Confirmation of the 3A QTL from *T. dicoccoides* on a denaturing gel shows Line 2 has the *Xgwc501* marker.

Phenotypic Evaluations

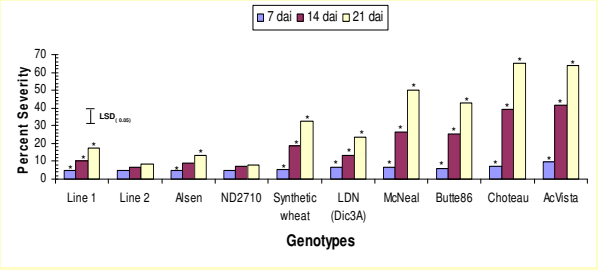

Fig. 6. Disease severity means across greenhouse seasons. Asterisks indicate significance (5% level) when comparing means between all dai within a genotype. LSD bar compares means between genotypes within a given dai.

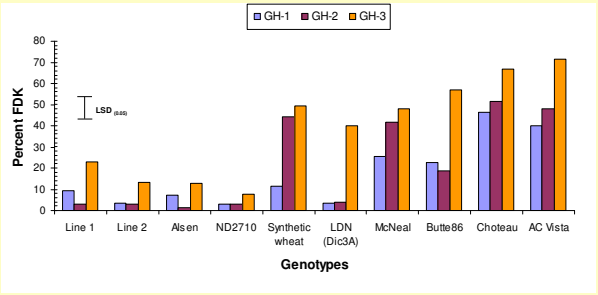

Fig. 7. Means for FDK in each greenhouse season.

Mean DON accumulation was significantly higher in GH-3 compared with GH-1 and GH-2. But within each greenhouse season, mean DON accumulation was not significantly different between Line 1, Line 2, Alsen, and ND2710. Mean DON accumulation for the synthetic wheat was not significantly different from accumulation between resistant genotypes in GH-1 and GH-3, but the synthetic wheat accumulated significantly higher DON in GH-2.

CONCLUSIONS

- Across GH seasons, disease severity of Line 2 was significantly lower than Line 1.
- Significant differences were not observed between Line 1 and Line 2 for percent FDK and DON accumulation.
- Across GH seasons, FHB resistance of Line 2 was less variable than Line 1.

REFERENCES

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Hartel et al., 2004. Plant Breed. 123:516-519.
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