

Marker-Assisted Backcrossing of Traits into Soft Winter Wheat

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Introduction

Typically in plant breeding programs, advanced lines are developed that have many important traits, but they might lack one or several traits that, if present, would make the lines commercially more valuable. Traits for which closely linked DNA markers have been identified can be rapidly incorporated into the otherwise excellent advanced lines by backcrossing and marker-assisted selection (MAS).

Objective

To incorporate new useful traits into soft winter wheat advanced lines by two backcross cycles per year and MAS.

Materials and Methods

Several advanced breeding lines in the Purdue wheat-breeding program were identified as recurrent parents (Table 1). These lines are high-yielding, have combinations of excellent agronomic, grain quality, and disease resistance traits, but are deficient in one or another specific important traits for which DNA markers have been developed.

Two cycles per year of backcrossing are carried out by artificially vernalizing seedlings in a cold chamber for 65 d (July-August) or in a cool greenhouse for 55 d (December-January) and growing the plants in a greenhouse. Crosses are effected in October and March.

F₁ plants are genotyped with DNA markers beginning during vernalization and prior to flowering. Only F₁ plants having specific markers are used to effect the next cycle of backcrossing.

Results

To date, backcrossing has been accomplished to BC₁ - BC₄, depending on when the donor parent was obtained to begin the backcrossing process (Table 1). Backcrossing will be continued through cycle 6, after which populations will be inbred by self-pollination and phenotypic verification for presence of specific traits and performance testing. Genotyping of BCF₁ plants is efficient, because plant genotypes are determined prior to flowering (Fig. 1).

Acknowledgment

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Table 1. Status of backcross program to transfer specific traits into selected recurrent parent soft winter wheat lines with marker-assisted selection.

Trait	Recurrent		Allele or gene	Status April, 03
	Parent	Donor parent	Introgressed	
BYDV res	97395	98134	Bdv2	BC3
WSSM res	961341	Geneva	WSS1	BC1
WSSM res	981517	Geneva	WSS1	BC1
WSSM res	981543	Geneva	WSS1	BC1
Hessian fly res	92201	92226	H9, H13	BC4
Hessian fly res	97395	92226	H9, H13	BC3
Hessian fly res	961341	92226	H9, H13	BC3
Hessian fly res	99793	92226	H9, H13	BC3
Grain texture	961341	CS translocation	Pina-Am1/ Pinb-Am1	BC1
Grain texture	97395	CS translocation	Pina-Am1/ Pinb-Am1	BC2
Preharv sprout res	91202	Cayuga	Main QTL for resistance to PHS, linked to Xgwm550	BC2
Rust res	97395	92201	Yr17/Lr37/Sr38	BC3
Rust res	91202	92201	Yr17/Lr37/Sr38	BC3
S. tritici res	961341	Tadinia	Stb4	BC1
S. tritici res	981543	Tadinia	Stb4	BC1
Leaf rust res	961341	HRS Yecora Rojo - Lr47	Lr47	BC2
Leaf rust res	99751	HRS Yecora Rojo - Lr47	Lr47	BC3
Leaf rust res	99793	HRS Yecora Rojo - Lr47	Lr47	BC3
FHB res	961341	Ning 7840	QTL on 3BS	BC3
FHB res	981517	Ning 7840	QTL on 3BS	BC3
FHB res	99751	Ning 7840	QTL on 3BS	BC3
FHB res	99793	Ning 7840	QTL on 3BS	BC3
FHB res	97395	Ning 7840	QTL on 3BS	BC3
Eyespot res	99751	Madsen	Pch1	BC2
Eyespot res	961341	Madsen	Pch1	BC1
Eyespot res	97395	Madsen	Pch1	BC2
Eyespot res	961341	Capelle Deprez	Pch2	BC1
Eyespot res	981543	Capelle Deprez	Pch2	BC1
Eyespot res	97395	Capelle Deprez	Pch2	BC1

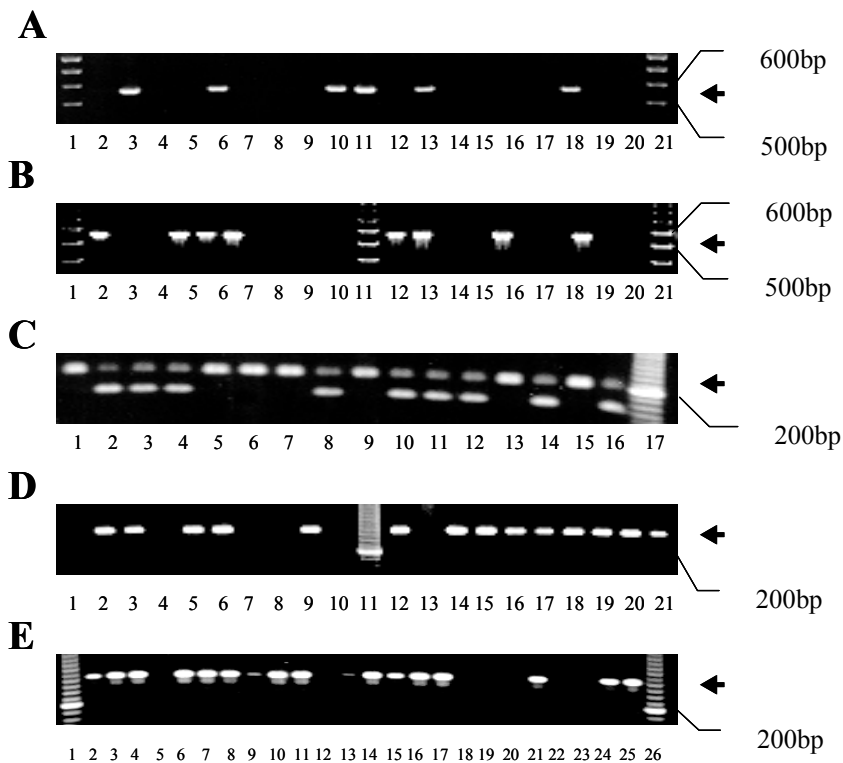


Fig. 1. Examples (A-E) of segregation for DNA markers associated with genes being backcrossed to adapted advanced wheat lines.

A. STS markers of *Pina-A^{m1}*. 1= DNA ladder (100bp); 2= C.S.; 3= donor of soft-textured grain (C.S.5A^m); 4-20= BCF₁ segregating population (C.S.5A^m); 21= DNA ladder (100bp).

B. DNA marker for wheatgrass YDV resistance. 1-10= BCF₁ segregating population; 12= DNA ladder (20bp); 12-21= BCF₁ segregating population.

C. SSR marker (Xgwm 493) in BCF₁ segregating population: 1= Ning 7840 (donor of FHB); 2-16= BCF₁ segregating population; 17= DNA ladder (20bp).

D. STS marker for Lr37-Sr38-Yr17: 1-10= BCF₁ segregating population; 11= DNA ladder (20bp); 12-21= BCF₁ segregating population.

E. DNA markers of Lr47. 1= DNA ladder (20bp); 2-25= BCF₁ segregating population, 26= DNA ladder (20bp).