Durum Wheats:

Challenges and Opportunities

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WIDE CROSSES AT CIMMYT WITH A DURUM WHEAT FOCUS

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Introduction

Major emphasis of CIMMYT's Wheat Wide Crosses Section over the past decade had been with bread wheat for both intergeneric and interspecific alien introgression. Recently, research interests have been directed towards incorporating alien chromatin into durum wheats, an area that has been actively pursued over the past 2 years.

For such a program to be viable, certain prerequisites exist. These are (recognizing the objectives):

- Production and validation of hybrids,
- Encompass intergeneric and interspecific areas, and
- Support to the above areas with novel techniques.

This paper briefly discusses some developments.

Intergeneric Hybrids

Durum wheats (Laru, Chen, Altar, Memo/Mex, Cndo/Ente//Memo/ Mex, and Aconchi) have been hybridized with alien species belonging to the following groups:

- *Thinopyrum* (perennial),
- *Psathyrostachys*, (perennial),
- *Elymus* (perennial), and
- *Aegilops* (annual).

Some F_1 hybrids have been colchicine-doubled. No hybrid combination gave meiotic evidence of wheat/alien chromosome recombination, hence genetic manipulations will be a necessity. Table 1 lists some of the crosses made between durum wheats and alien species.

Interspecific Hybrids

Findings reported by researchers and our observations with haploids of wheat cv. Chinese Spring (*ph* mutant for high pairing) support the preferential pairing between the A and D genomes, leaving the B genome quite dissociated. In durums, such a *ph* high pairing system exists in cv. Cappelli. Hybrids between Cappelli (*ph*) and *Triticum tauschii* accessions (identified for biotic/abiotic resistances/tolerances) are to pave the way for demonstrating D genome transfers to the A genome and through this bridge hopefully enrich the durum wheats. Our current emphasis is on crossing the susceptible durums to *H. sativum*- and *F. graminearum*-resistant *T. tauschii* accessions identified from field screening of synthetic hexaploids.

Table 1. Intergeneric durum wheat/alien species hybrids/amphiploids produced at CIMMYT.

Durum cultivar	Fertile amphiploid produced	Alien species	F_1 somatic count	Resistance/ tolerance attributes
Yavaros 79		*Th. acutum*(6x)	35	BYDV
Yavaros 79		*Th. intermedium*(6x)	35	BYDV
Yavaros 79		*Th. varnense*(6x)	35	BYDV
Cocorit 71	Yes	*Th. pulcherrimum*(6x)	35	BYDV
Mexicali 75	Yes	*Th. trichophorum*(6x)	35	BYDV
Cocorit 71	Yes	*Th. junceiforme*(4x)	28	Salt
Cocorit 71		*Th. junceum*(6x)	35	Salt
Mexicali 75		*Th. podperae*(6x)	35	Salt
Altar 84		*Th. scirpeum*(4x)	28	Salt
Cocorit 71		*Th. campestre*(8x)	42	Salt
Cndo/..../Mex.		*Ps. juncea*(4x)	28	BYDV, salt, drought
Cocorit	Yes	*E. fibrosus*(4x)	28	*H. sativum*
Yavaros		*Th. elongatum*(2x)	21	Salt
Laru	Yes	*Ae. variabilis*(4x)	28	Al^{+++}, KB
Gan	Yes	*Ae. umbellulata*(2x)	21	KB
Gan	Yes	*Ae. ovata*(4x)	28	KB
Gan	Yes	*Ae. ventricosa*(4x)	28	KB, salt
Gan	Yes	*Ae. vavilovi*(6x)	35	Salt

Hybrids between durum wheats and A genome species (*T. monococcum*, *T. boeticum*, and *T. urartu*, all 2n=2x=14) have been produced. The program needs further development, but the potential of exploiting the A genome traits missing in durums or adding diversity to existing genes is very high.

Hybrids between *T. dicoccum* accessions resistant to the Russian wheat aphid (RWA) (screening data from Germplasm Bank) and susceptible durums are being produced. Into this simplistic cross, backcrossing to elite durum parents and achieving homozygosity through haploidy is projected. The haploid procedure involves durum x maize or durum x *Tripsacum*; procedures routinely used in CIMMYT wheat wide crosses.

Special Areas

Haploid production

Crosses between durum and maize or durum x *Tripsacum*, assisted by 2,4-D application and embryo rescue, have yielded durum polyhaploids with 14 chromosomes. With maize, the embryo recovery percentage is 16.9% (11.8-22.2), with 73.9% plantlet regeneration and 69.5% colchicine induced doubling. With *Tripsacum*, embryo recovery is 26.8% and regeneration is 66.7%. No doubling was attempted for this experiment since it was no longer considered a constraint.

Near isogenic line development

Bread wheat germplasm has received considerable advantage from the 1B/1R chromosome translocation for yield attributes associated by its presence. Unequivocal answers supporting the 1B/1R contribution can be made through evaluation of near-isogenic lines. While these are being developed for bread wheats, several durum wheats are being made recipients of the 1B/1R chromosome. An Altar 84 isogenic line is at the BCVIII selfing stage from which Altar 84 (1B, 1B:Extracted) and Altar (1B/1R, 1B/1R) shall be obtained. There is another batch of eight durums in early BC stages. The 1B, 1B/1R heterozygote was diagnosed by C-banding and GPI isozyme assay.