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Intergeneric Hybrids of *Triticum aestivum L.* with *Agropyron* and *Elymus* Species

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Summary

Triticum aestivum L. (2n=6x=42, AABBDD) varieties Chinese Spring, Fielder, Fremont, Glennson 81, Nacozari 75 and Pavon 76 were pollinated with several *Agropyron* and *Elymus* species. Twenty-three of these species were successfully hybridized with wheat. Hybrids were identified on the basis of the somatic chromosome count in root-tips. For those combinations where the alien species were hexaploids (2n=6x=42) like wheat, the single dosage of wheat satellited chromosomes (1B,6B,5D) were the identifying markers. The spikes produced on the hybrid plants were phenotypically different from the wheat variety of that particular hybrid combination. Aneuploidy was observed in *T. aestivum/A. repens-A. desertorum* (C-3) hybrids where the chromosome numbers in hybrid plants ranged from 35 to 57 with a telocentric. All hybrids were somatically stable. Further studies on the utilization of these hybrids is briefly discussed.

Introduction

Considerable efforts have been devoted towards hybridizing wheat, *Triticum aestivum L.* (2n= 6x=42, AABBDD), with alien species of the genera *Agropyron* and *Elymus*. It continues to be an important investigative area since several species of these genera possess excellent sources of resistance or tolerance to disease and stress conditions. Relatively few of these have been hybridized with *T. aestivum* as the maternal parent (Sharma and Gill 1983). From those hybrids produced earlier, successful alien transfers from a few have resulted (Mujeeb-Kazi and Kimber, 1984). In this communication are reported the results of some hybrid combinations that we recently produced. Several of these are new, while others were reproduced so that (i) a germplasm base was readily available to us, and (ii) commercially grown spring wheat varieties were utilized in hybridization. The latter hybrid combinations involved alien species that are broadly classed in the *A. intermedium* complex. These species differ in their meiotic associations with *T. aestivum* and hence need individual consideration rather than being given an *A. intermedium* group complex order (Unpublished data). Whether new, or now justifiably reproduced, the hybrids hold tremendous potential for utilization in practical agriculture.

Our results document (1) the hybrids obtained, (ii) chromosome number of the hybrids, (iii) embryo recovery percentage (o/o), (iv) embryo differentiation (o/o), and (v) production of backcross 1 (BCI) seed.

Materials and Methods

Seed of *Triticum aestivum L.* varieties Chinese Spring, Fielder, Fremont, Glennson 81, Nacozari 75 and Pavon 76 were planted on different dates in the field experiment station of Utah State University-USDA in Logan, Utah, USA. The planting was in close proximity to the "grass nursery" that Dr. D. R. Dewey maintains for his forage improvement program. Several hundred spikes of wheat were emasculated and pollinated with pollen from various species of *Agropyron* and *Elymus*. Procedures of pollination, hormone treatment, embryo rescue, plantlet growth and greenhouse maintenance of hybrid plants, were similar to those reported by Mujeeb-Kazi and Rodriguez 1983, Mujeeb-Kazi and Kimber 1984.

For somatic cytology, root-tips were collected and processed using the schedule of Mujeeb-Kazi and Miranda, 1984. Spikes for meiotic analyses were fixed in Carnoy's fixative, which was replaced by 70o/o ethanol after 48 hours. The samples were then refrigerated (4oC). The results of meiotic analyses are to be reported separately.

Backcross 1 (BCI) derivatives were produced with different *T. aestivum* varieties as the pollen parent. BCI seed where set were allowed to mature on the hybrid plants.

Results and Discussion

The *T. aestivum/Agropyron* and *Elymus* species intergeneric hybrids produced are listed in Table 1. The F_1 hybrids differed phenotypically from the wheat variety of that particular hybrid combination, were perennial and self-sterile. All alien species were hybridized with *T. aestivum* var. Chinese Spring, except *E. angustus* which formed hybrids with var. Fremont only. The higher success of var. Chinese Spring is attributed to the kr_1 kr_1, kr_2 kr_2, kr_3 kr_3 crossability genes this variety possesses (Falk and Kasha 1981, Fedak and Jui 1982) for its crossability with rye (Riley and Chapman 1967). Chinese Spring wheat has performed excellently in crosses with *Hordeum bulbosum* (Barclay 1975), *H. vulgare* (Islam et al 1975), and seemingly it also infuences crossability with other genera as evident from the hybridization results of this study (Table 1).

High seed set was obtained for hybrids of *T. aestivum* var. Chinese Spring with *A. acutum, A. caespitosum, A. campestre. A. intermedium, A. junceum* (2n=4x=28), *A. pulcherrimun, A. repens-A. desertorum* (2n=10x=70, C-3), *A. trichophorum*, and *A. varnense* where embryo recovery percentages ranged from 9.3 (*A. junceum*, 2n=4x=28) to 48.0 (*A. intermedium*), Table 1. Except for *T. aestivum/A. campestre*, and *T. aestivum/A. repens-A. desertorum* (C-3), for all other combinations endosperm was present. Hence additional hybrid seed of these combinations were left to mature on the plant and o/o embryo differentiation was not calculated. *T. aestivum/A. junceum-meditterranean* (2n=6x=42) also had endosperm, but because of low seed set all embryos were cultured, of which 1.9o/o differentiated. It was also for some of these

Table I. Intergeneric hybrids from hybridizing *Triticum aestivum L.* varieties with *Agropyron* and *Elymus* species: % embryo recovery, % embryo differentiation and somatic chromosome number of the hybrids.

Pollen Parental Source	Germplasm Id. Source ✪	Female Parent Wheat Variety Source ✫ C	Fr	Ft	G	N	P	%Embryo Recovery	%Embryo Differentiation	Somatic Chromosome Number
A.acutum	PI 202727	●	●	●		●	●	14.6	X	42
A.caespitosum	Jaaska 384	●						43.8	X	35
A.campestre	Cauderon 435	●						10.5	7.9	49
A.curvifolium	PI 287739	●						7.0	2.8	35
A.gentryi	PI 228277	●						5.1	2.8	42
A.intermedium	Cauderon 690	●			●	●	●	48.0	X	42
A.junceum (2X)	Jaaska	●						1.7	0.6	28
A.junceum (4X)	PI 414667	●	●	●			●	9.3	X	35
A.junceum-mediterrean (6X)	Cauderon 471	●						6.2	1.9	42
A.podperae	PI 228387	●						0.5	0.5	42
A.pulcherrimum	PI 401308	●						53.3	X	42
A.rechingeri	Heneen	●						7.6	4.3	35
A. repens	WS-31-25	●						0.7	0.2	42
A.repens-A.-desertorum(C-3)	Dewey	●						17.7	10.1	35 to 56+t
A.scirpeum	Cauderon	●						1.3	1.3	35
A. scythicum	Jaaska-15	●		●		●		6.5	1.5	35
A. stipifolium	E-12-30	●						0.5	0.3	35
A.trichophorum	Jaaska	●				●		46.6	X	42
A. varnense	PI 281863	●	●	●		●	●	42.0	X	42
E.angustus	PI 406461			●				1.3	0.5	63
E. cinereus	Dewey	●						1.1	0.2	35
E. giganteus	Jaaska	●						1.7	0.9	35
E.triticoides	E-7-6	●						0.7	0.1	35

✪ : Identification source from 1982 Rangegrass field book of Dr. D.R. Dewey, Logan, Utah, USA.
✫ C : Chinese Spring; Fr= Fielder; Ft=Fremont; G=Glennson 81; N=Nacozari 75; P=Pavon 76.
● : Hybrids obtained. t=Telocentric chromosome

high frequency *T. aestivum/Agropyron sp.* combinations possessing endosperm, that wheat varieties other than Chinese Spring were successfully hybridized with the same *Agropyron* species. This, however, is not to be generalized since *T. aestivum* varieties Fremont, Nacozari 75, Pavon 76 were hybridized with *A. rechingeri* (7.6o/o) and *A. scythicum* (6.5o/o).

Somatic counts were consistent with expectations of half the chromosome complement of each parent contributing to the total chromosome number observed in the hybrids. In all hybrids a 1B and 6B satellited wheat chromosome was present in several cells and a 5D satellited wheat chromosome was occasionally observed. This superior resolution of secondary constriction sites eliminated any complexity that would have existed in identifying hybrids with 42 chromosomes, but in no way circumvents the need for meiotic analyses.

The aneuploidy present in 29 *T. aestivum/A. repens-A. desertorum* F_1 hybrids ranged from 35 to 56 + a telocentric chromosome. All were stable over the sampled growth stages for their somatic chromosome numbers. The expected chromosome number in these hybrids was 56 (21 from *T. aestivum* +35 from the amphidiploid pollen parent with *A. repens* contributing 21 and *A. desertorum* 14). Whether the two hybrids with a somatic number of 35 are composed of 21 wheat + 14 *A. desertorum* chromosomes is at this time a speculation, as is the possibility that the C-3 amphidiploid pollen parent may itself possess aneuploid propagative tendencies.

It may be sometime before fertile amphidiploids of the hybrids herein reported are produced and backcross progenies from amphidiploids derived. We have hence also adopted the swifter route of producing BCI progeny by pollinating the self-sterile F_1 hybrids with *T. aestivum* varieties. The *T. aestivum/E. angustus* hybrids have not undergone spike initiation delaying BCl production, and initial attempts have been unsuccessful at producing BCI seed from *T. aestivum/E. cinereus*. The scheme of backcrossing and BCI progeny advance for practical utilization shall be similar to that outlined by Mujeeb-Kazi et al. 1983. However, if the BCI progenies show aneuploidy as is common among some Triticeae hybrids (Jewell and Mujeeb-Kazi, 1982; Mujeeb-Kazi and Bernard 1982) cytology of the BC progenies would have to be curtailed only to more advanced generations of those BC derivatives that have been identified for resistance to disease or stress through controlled environment or field testing. Further advance of the BCI progenies shall be facilitated when the F_1 meiotic data are completed. These data would have a significant bearing on wide cross progeny advance especially after the mathematical inputs as described by Kimber 1982 and incorporated by Mujeeb-Kazi and Kimber 1984 are put to effective practical utilization.

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