Intergeneric Hybridization for Wheat Improvement VIII. Variations in chromosome number in backcross-1 derivative of F₁ hybrids between wheat and two *Aegilops* species

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The intergeneric hybrids are generally sterile and are therefore, advanced by inducing amphiploidy as has been practiced by many scientists, (Dvorak *et al.* 1987, Forster *et al.* 1987, Storey *et al.* 1985). However, if the F₁ hybrids do not respond to amphiploidy, pollinating the self sterile F₁ hybrids with their respective wheat parents can be adopted for advancing the hybrids as has been described by Islam *et al.* (1975). The backcross-1 (BC₁) seeds thus produced would represent a heterogenous population which would segregate for the characters as well as for the chromosomes inherited from both the parents.

In our wide hybridization programme for improvement of salt tolerance of cultivated wheat, we crossed hexaploid wheat (*Triticum aestivum*, L. 2n=6x=42, AABBDD) cultivars Pak-81, LU-26 and Chinese spring with different salt tolerant accessions of *Aegilops ovata*, L. 2n=4x=28, C^uC^uM^oM^o and *Ae. cylindrica*, Host. 2n=4x=28, CCDD (Farooq *et al.* 1990). This paper reports variations in chromosome number of individual backcross-1 seed produced in different F₁ hybrid combinations and their utilization in formulating breeding strategies.

Material and methods

Material used in the study comprised *Triticum aestivum* L. cultivars Pak-81, Shalimar-88, LU-26 and Chinese spring. Wild species comprised *Ae. cylindrica* accessions 502242, D and *Ae. ovata* accession 361881.

F₁ hybrids were produced through normal emasculation and pollination procedure using cultivated wheat varieties as female parents. Hybrids with 35 chromosomes raised through germinating F₁ seeds, were transferred to pots in the month of October, under natural conditions of light (10 hr) and temperature (25±5°C). At flowering, sterile florets of the F₁ hybrids were clipped and pollinated with freshly dehiscent pollens from the wheat cultivars mentioned above. The florets were sprayed with 75 ppm growth hormones (Gibberallic acid) before and after pollination. BC₁ seeds harvested upon maturity were germinated separately on moist filter paper. One centimeter long root tip from individual BC₁ seed was collected and pre-treated with 0.1% colchicine solution. Squash preparations were made after staining the root tips in 1% acetocarmine. Photomicrographs were taken under Olympus Vanox-S microscope using 100X phase contrast objective (NH) and 5X photolense. The negatives (X500) were enlarged on Forte high contrast glossy paper.

Results and discussions

All the F₁ hybrids made between wheat cultivars Pak-81, LU-26 and Chinese spring and different accessions of *Ae. ovata* and *Ae. cylindrica* produced seeds upon backcrossing with

Table 1. Production of backcross seeds in F_1 hybrids of wheat with *Ae. ovata* and *Ae. cylindrica* and their individual chromosome number

F_1 hybrid combinations	Backcross wheat parent	No. of BC_1 seeds	No. of chromosomes of individual BC_1 seeds
<i>C. spring/Ae. ovata</i> acc: 361881	Pak-81	2	56 (1), 49 (1)
	LU-26	20	44 (13), 41 (7)
	Shalimar-88	1	40 (1)
Pak-81/ <i>Ae. ovata</i> acc: 361881	Pak-81	5	41 (3), 42 (2)
	LU-26	13	44 (6), 50 (2), 42 (4), 40 (1)
	<i>C. spring</i>	1	40 (1)
LU-26/ <i>Ae. ovata</i> acc: 361881	LU-26	1	40 (1)
Pak-81/ <i>Ae. cylindrica</i> acc: 502241	Pak-81	5	40 (3), 49 (1), 46 (1)
	LU-26	2	41 (1), 40 (1)
LU-26/ <i>Ae. cylindrica</i> acc: 502242	<i>C. spring</i>	2	40 (2)
Pak-81/ <i>Ae. cylindrica</i> D	LU-26	6	40 (4), 39 (1), 37 (1)
LU-26/ <i>Ae. cylindrica</i> D	Pak-81	8	40 (2), 42 (6)
LU-26/ <i>Ae. cylindrica</i> D	LU-26	3	42 (3)

Figures in parenthesis are number of backcross seeds. acc: accession number. *C. Spring*: Chinese spring.

Fig. 1. Mitotic chromosomes of BC_1 derivatives of wheat $\times$ *Ae. cylindrica*, $2n=7x=49$ (a) and wheat $\times$ *Ae. ovata*, $2n=8x\pm 56$ (b).

recurrent wheat parents as well as with wheat cultivar Shalimar-88. Frequency of BC_1 seed production was generally low and ranged between 2 to 8 seeds for different F_1 combinations of wheat $\times$ *Ae. cylindrica* hybrids compared with that of wheat $\times$ *Ae. ovata* hybrids where seed production ranged between 1 to 20 seeds per F_1 combinations. Of the 43 BC_1 seeds of wheat $\times$ *Ae. ovata*, 34 seeds were produced through backcrossing the hybrids with LU-26, 7 with Pak-81 and one each with Chinese spring and Shalimar-88. F_1 hybrids of wheat with *Ae. cylindrica* produced 26 seeds of which 13 were obtained with Pak-81, 11 with LU-26 and 2 with Chinese spring (Table 1).

Mitotic analyses of individual BC_1 seed revealed variation in chromosome number which ranged between 40 to 56 chromosomes in the hybrids of wheat with *Ae. ovata* and between 37 to 49 in hybrids of wheat with *Ae. cylindrica* (Table 1, Fig. 1). In the hybrids of *T. aestivum* with *Ae. ovata*, the most prevalent chromosome frequency was 44 and was possessed by 19 out of the 43 BC_1 seeds. Of the remaining 24 seeds, one each possessed 49 and 56 chromosomes, 2 possessed 50, 4 possessed 40, 10 possessed 41 while 6 BC_1 seeds exhibited 42 chromosomes (Fig. 2). Similarly, the most prevalent chromosome frequency in the hybrids of wheat with *Ae. cylindrica* was 42 chromosomes and was exhibited by 9 of the 26 BC_1 seeds. Of the remaining 17 seeds, one each possessed 37, 39, 41, 46 and 49 chromosomes while 12 BC_1 seeds possessed 40 chromosomes (Fig. 2).

Theoretically, when F_1 hybrids of wheat $\times$ *Ae. cylindrica* ($n=5x=35$, ABD $\overline{C}D$) and wheat $\times$ *Ae. ovata* ($n=5X=35$ AB $\overline{D}C\overline{M}$) were pollinated with pollens ($n=3x=21$, ABD) form hexaploid wheat, there should be an octoploid ($2n=8x=56$) BC_1 progeny. In the present study however, only one of the BC_1 seeds of *T. aestivum $\times$ *Ae. ovata*//Pak-81 exhibited 56 chromosomes while in the remaining seeds, variations in chromosome number ranged between 37 to 50 chromosomes. Such variations have been reported earlier by Mujeeb Kazi and Bernard*

Fig. 2. Variation in number of chromosomes of different BC_1 derivatives of F_1 crosses of two cultivated wheat varieties with *Aegilops ovata* and *Ae. cylindrica*.

(1982) in the backcross derivatives of intergeneric hybrids of wheat and some members of the perennial Triticeae, *T. timophevii* and *S. cereale*. In the present study, chromosome variations in backcross-1 derivatives are being reported for the first time in the hybrids of wheat with *Aegilops* species. Most important among them are derivatives of wheat $\times$ *Ae. ovata* with 56 and 49 chromosomes and of wheat $\times$ *Ae. cylindrica* with 42 chromosomes. Possibly in the 56 chromosomes derivatives, complete genomes of wheat and *Ae. ovata* are present in diploid and haploid state respectively while in the derivative with 49 chromosomes, one of the genomes of *Ae. ovata* (C^u or M^v) is eliminated. Selfing of these derivatives might help studying possibilities of producing complete set of addition lines through these derivatives. It would also be possible to study the relationship of C^u or M^v genomes of *Ae. ovata* with any of the wheat genomes. However, situation would be different for 49 chromosomes derivatives of wheat $\times$ *Ae. cylindrica*. Since the origin of the D genome of *Ae. cylindrica* is the same as that of the D genome of wheat (Kimber and Zhao 1983) therefore, crossing over between D genome of wheat and of *Ae. cylindrica* is possible in these derivatives which may increase the chances of elimination of C genome from these derivatives. Selfing of such derivatives may completely modify the original D genome present in the F_1 hybrids and in wheat parents used for backcrossing. Selections for the desirable plants can then be made from the segregating population. Similarly, BC_1 derivatives with 42 chromosomes could possibly be modified wheat plants which can further be improved through routine breeding practices (Farooq *et al.* 1992).

References

- Dvorak, J. and Ross, K. 1987. Expression of tolerance of Na, K, Mg, Cl and SO_4 ions and sea water in the amphiploid of *Triticum aestivum* $\times$ *Elytrigia* genome. *Crop Sci.* **26**: 658-660.
- Farooq, S., Shah, T. M. and Iqbal, N. 1990. Variations in crossability among intergeneric hybrids of wheat and salt tolerant accessions of 3 *Aegilops* species. *Cereal. Res. Commun.* **18**: 336-338.
- , Iqbal, N., Asghar, M. and Shah, T. M. 1992. Intergeneric hybridization for wheat improvement. VI. Production of salt tolerant germplasm through crossing wheat (*Triticum aestivum* L.) with *Aegilops cylindrica* and its significance in practical agriculture. *J. Genet. Breed.* **46**: 125-132.
- Forster, B. P., Gorham, J. and Miller, T. E. 1987. Salt tolerance of an amphiploid between *Triticum aestivum* and *Agropyron junceum*. *Pl. Breed.* **98**: 1-8.
- Islam, A. K. M. R., Shepherd, K. W. and Sparrow, D. H. B. Addition of individual barley chromosomes to wheat. *Proc. 33rd Barley genet. Symp.* pp. 260-270.
- Kimber, G. and Zhao, Y. H. 1983. The D genome of *Triticeae*. *Can. J. Genet. Cytol.* **25**: 581-589.
- Mujeeb-Kazi, A. and Bernard, M. 1982. Somatic chromosome variations in backcross-1 progenies from intergeneric hybrids involving some *Triticeae*. *Cereal. Res. Commun.* **10**: 41-45.
- Storey, R., Gorham, R. D. and Shepherd, K. W. 1985. Modification of the salinity response of wheat by the genomes of *Elytrigia elongata*. *Pl. Soil*, **83**: 327-330.
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