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# Introgression of *Aegilops triuncialis* into *Triticum aestivum*. A progress report.

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**Key Words**: *Triticum aestivum, Aegilops triuncialis*, Introgression, Gene transfer.

## ABSTRACT

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The wild grass *Aegilops triuncialis* (genomes CCUU) has been crossed with the tetraploid wheat *Triticum turgidum* (AABB) and the resulting ABCU sterile hybrid has been rescued with pollen from the hexaploid *T. aestivum* (AABBDD). Seven spikes from two hybrid plants were pollinated with pollen from *T. aestivum* cv. Almatense and 8 kernels were obtained. After five rounds of selfing, plants with 28 to 41 chromosomes have been derived. Low fertility (3-5 viable kernels per plant) was observed throughout the process. Further crosses to *T. aestivum* will be performed to obtain stable lines that will be screened for *Ae. triuncialis* genetic material with the aid of previously identified biochemical chromosome markers and specially developed DNA probes.

## INTRODUCTION

The transfer of genetic material from wild species to cultivated ones has been extensively exploited as a way to introduce certain agronomic traits, such as resistance to different diseases, into well adapted, highly productive cultivars. Previous work from this laboratory has demonstrated the effectiveness of a particular strategy to transfer genes from the wild grass *Aegilops ventricosa* to the cultivated wheat *Triticum aestivum* (Delibes and García Olmedo, 1973; Delibes et al., 1977; Doussinault et al., 1983; Delibes et al., 1987). The strategy consists in crossing the donor species, *Ae. ventricosa* (genomes $D^vD^vM^vM^v$) with *T. turgidum* (AABB), which acts as a bridge, and rescuing the sterile $ABD^vM^v$ hybrid with pollen from the recipient species *T. aestivum* (AABBDD). Plants resulting from this cross were fertile and after repeated selfing, stable lines with 42 chromosomes were derived from them. A study of meiosis in hybrids of these lines and the recipient hexaploid wheat, together with an investigation of the distribution of biochemical chromosome markers, indicated that genes from the donor had been incorporated into the

transfer lines both by chromosonal substitution and by recombination (Delibes and García-Olmedo, 1973; Delibes et al., 1977; García-Olmedo et al., 1984). The incorporation genes for resistance to eyespot disease, caused by the fungus *Pseudocercosporella herpotrichoides*, and to powdery mildew, caused by the fungus *Erysiphe graminis*, into recombinant wheat chromosomes, following the above strategy, has been demonstrated (Doussinault et al., 1983; Delibes et al., 1987).

We now report our present progress in the application of the described breeding scheme to *Aegilops triuncialis* (genomes CCUU) as donor species, using the same bridge and recipient species as before. In this particular case, enhanced homeologous recombination should occur as a result of the known ability of the C genome to suppress the *Ph* diploidization mechanism of *T. aestivum* and *T. turgidum* (see Kimber and Feldman, 1987).

## MATERIALS AND METHODS

*Triticum aestivum* cv. Almatense H-10-15, *T. turgidum* H-1-1, and *Ae. triuncialis* (Syn. *T. triunciale*) A-1 were used in the described experiments. Seeds were germinated in agar and planted in pots. Crosses were carried out in the greenhouse. Chromosome staining for somatic chromosome counts was carried out by the Feulgen reaction as described by Sharma and Sharma (1965), after allowing the chromosomes to contract in ice-water for 48 h.

## RESULTS AND DISCUSSION

The breeding scheme is represented in Fig. 1. At least two other alternative strategies could have been followed: a) direct crossing with *T. aestivum*, and b) synthesis of an artificial amphiploid AABBCCUU which would then be crossed with *T. aestivum*. Although natural and artificial hybrids of *Ae. triuncialis* with *T. aestivum* seem to yield plants that are sterile but viable, this type of hybrid would be a less adequate intermediate in the gene transfer because it would carry all the hexaploid wheat genomes and, when rescued with ABD pollen, would have a greater tendency to eliminate the alien genetic material while selecting for the euploid chromosome number (2n = 42). On the other hand, the method involving prior synthesis of the AABBCCUU alloploid would be more time-consuming than the adopted strategy.

Three kernels of the intermediate hybrid were obtained, and two of them gave plants that were viable and vigorous, but m-sterile. Seven spikes from these plants were pollinated with pollen from *T. aestivum* cv. Almatense H-10-15, yielding 8 kernels. These were planted and selfed, and their progeny subjected to four additional round of selfing. At all stages, close to 90% of the kernels germinated normally and although 20-40% of the plants died in the greenhouse, the surviving plants were notably vigorous (Fig. 2). These plants had high sterility, yielding 3-5 kernels per viable plant throughout, with no discernible increase in fertility in the more advanced generations.

Somatic chromosome counts were carried out in mitotic roots of plants at the different stages. While in early generations plants with 28 to 41 chromosomes were observed, in the last two generations 95% of the plants had 40 chromosomes and only about 5% had 41 chromosomes (Fig. 3).

The fertility observed in the progeny of the present transfer experiment seems to be significantly lower that in the previous one, involving *Ae. ventricosa* ($D^vD^vM^vM^v$) instead of *Ae. triuncialis* (CCUU). This might be due to the fact that the $D^v$ genome of *Ae. ventricosa* is closer to the D. genome of hexaploid wheat than either of the two different genomes (CU) present in *Ae. triuncialis*, thus possibly leading to a more regular meiosis in the former case and to a probable more extensive chromosomal rearrangement processs in the present case due to the *Ph*-suppressing effect of the C genome.

Backcrosses to *T. aestivum* cv. Almatense H-10-15 are planned both to increase fertility and to obtain stable introgression lines with 42 chromosomes. Genetic transfer from *Ae. triuncialis* will be characterized with the aid of previously identified biochemical chromosome markers and recently developed DNA probes.

## ACKNOWLEDGEMENTS

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## RESUMEN

Varias proteínas de endospermo pertenecientes a una familia de inhibidores de α-amilasas heterologas y de tripsina han sido purificadas y caracterizadas en trigo, cebada y centeno. La comparación de sus secuencias de aminoácidos y la localización cromosómica de sus genes estructurales indican que estos inhibidores están codificados por una familia multigénica dispersa que debió originarse por traslocaciones y duplicaciones intracromosómicas en una especie ancestral de trigo, cebada y centeno. La homología entre algunos miembros de esta familia de inhibidores y varias proteínas de maíz, ricino, mijo indio, etc., indica que la familia se extiende a otras especies filogenéticamente distantes de los tres cereales antes mencionados.

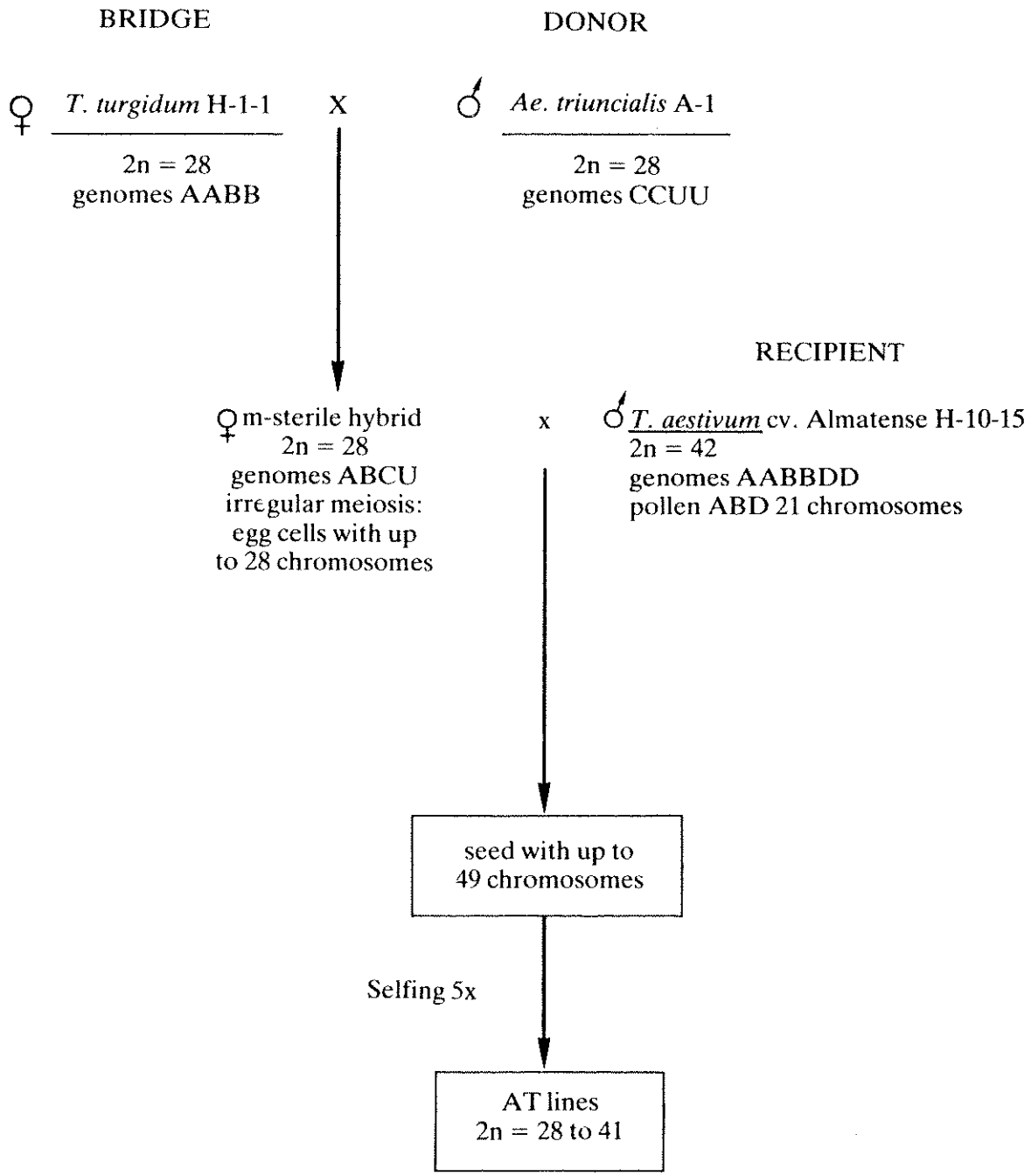



Figura 1.- Scheme followed for the genetic transfer from *Aegilops triuncialis* (syn. *T. triunciale*) to hexaploid wheat (*T. aestivum*).

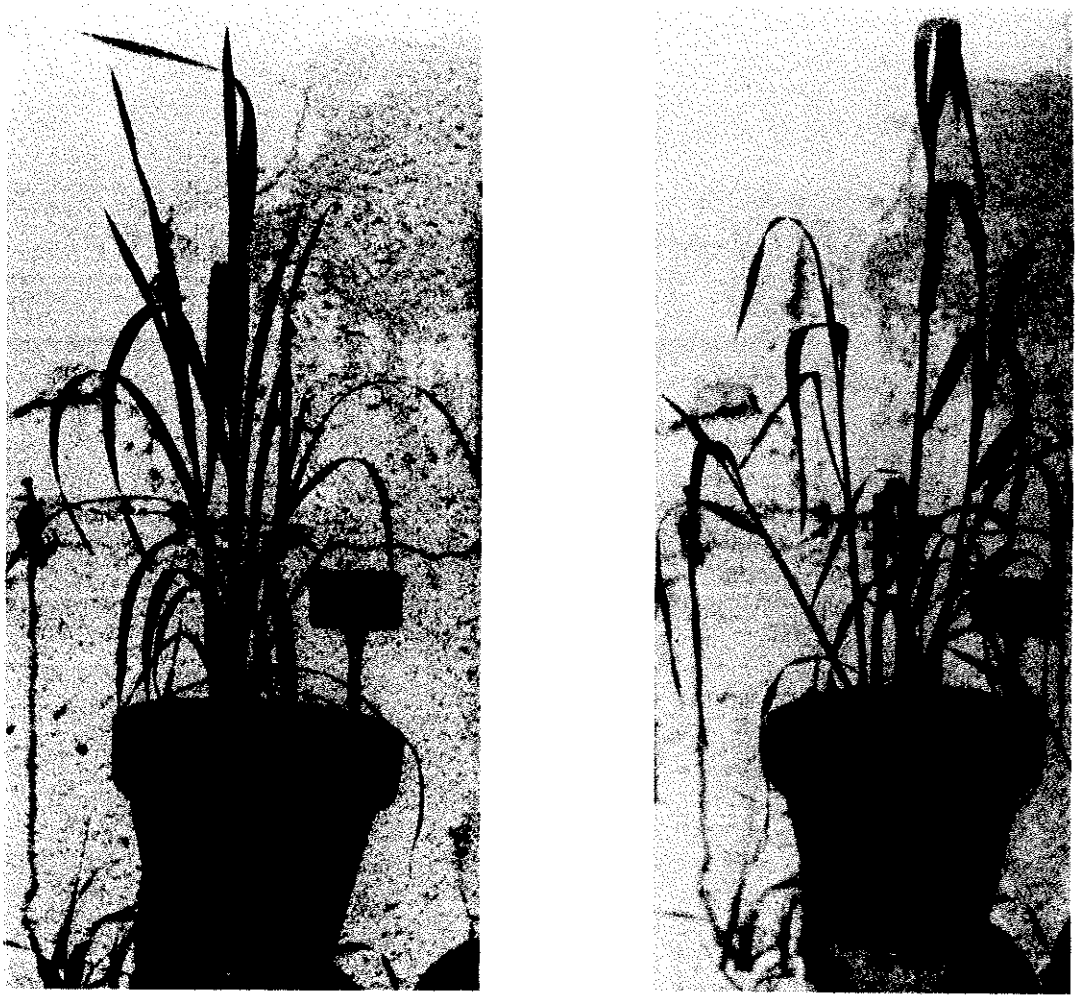
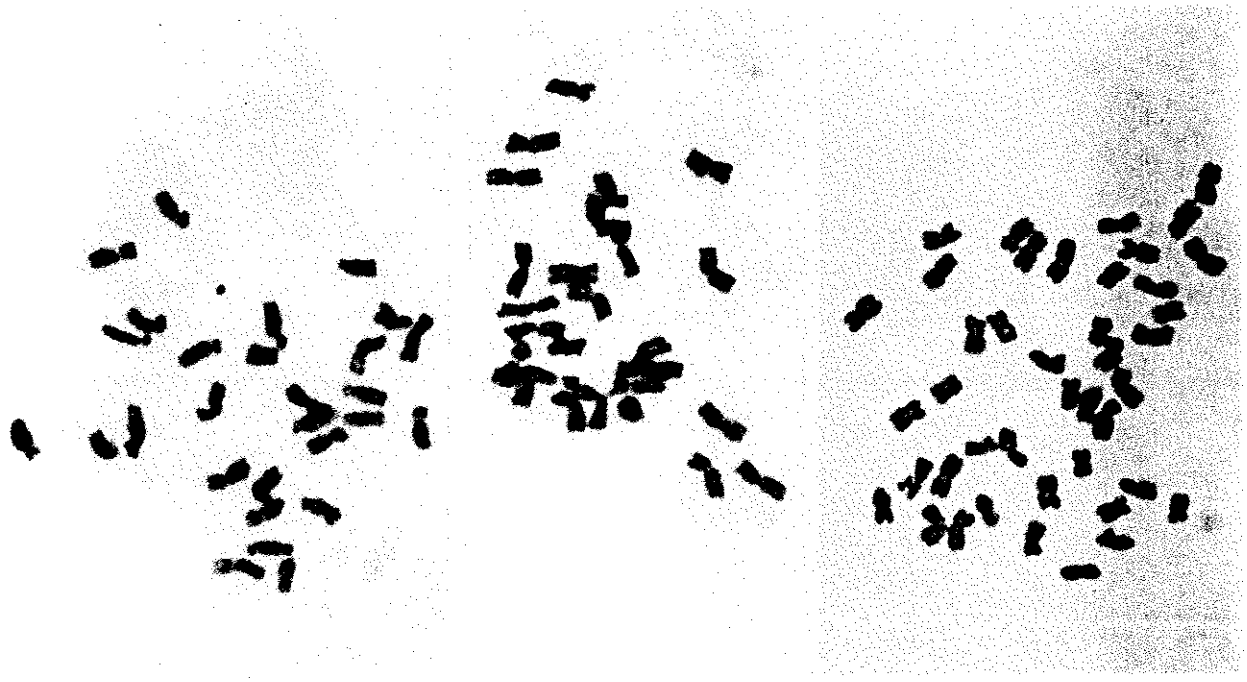
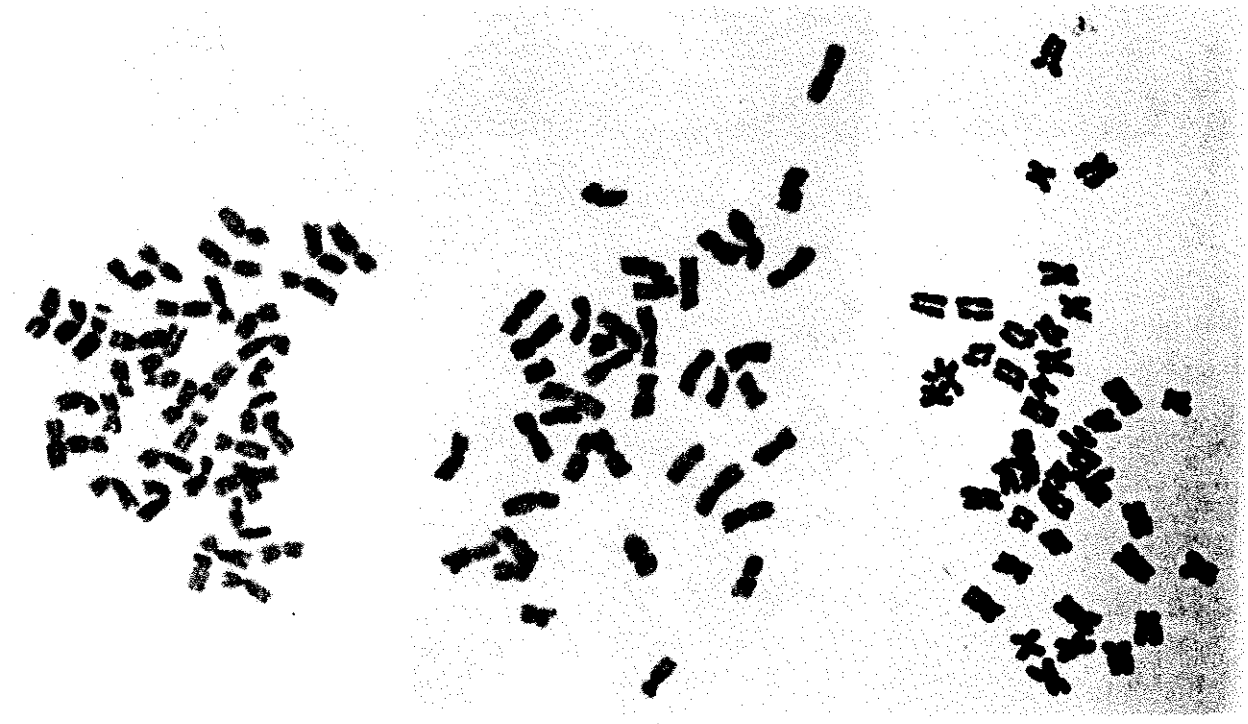


Figura 2.- Plants obtained according to the breeding scheme of Fig. 1.



*Ae. triuncialis* 2n = 28 *T. turgidum* 2n = 28 *T. aestivum* 2n = 42



AT LINES 2n = 40 2n = 40 2n = 41

Figura 3.- Cariotypes of parental material and representative 5 x selfed lines obtained as represented in Fig. 1.