**Jointed goatgrass (*Aegilops cylindrica* Host)**

**Bianca Assis Barbosa Martins**
**25th Jan 2009**

Wheat and jointed goatgrass are primarily self-pollinating, but several studies have already shown that they can outcross and produce hybrids (Mallory-Smith et al., 1996). When formed, wheat x jointed goatgrass hybrids are expected to be sterile because they are pentaploid (2n = 5x = 35) and hybrids lack chromosome pairing during meiosis except for the chromosomes of the D genomes. The D-genome from wheat and jointed goatgrass are so similar that in the hybrid they complement each other acting as homologous pairs (Zemetra et al., 1998). Yet, because of the lack of meiotic pairing for the other genomes and subsequent unbalanced chromosome numbers in the gametes, Zemetra et al. (1998) found most of the $F_1$ hybrids to be completely sterile.

On the other hand, Wang et al (2001) assessed the fertility of wheat x jointed goatgrass hybrids in an artificial crossing study, reporting 100% male sterility and 0.87% female fertility for the $F_1$ hybrid plants. The hybrids, even male sterile, can produce viable $BC_1$ seeds at low frequency through backcrossing to either of the parental species (Morrison et al. 2002).

In wheat fields from Oregon, *Aegilops cylindrica* was found to be the predominant female parent of $F_1$ hybrids with wheat (Morrison et al. 2002). According to this author, in a population of *Ae. cylindrica* growing within or on the edge of a wheat field and exposed to a massive wheat pollen load, wheat was the predominant male parent of the $BC_1$ generation.

By definition, natural hybridization is related to successful mating in the transfer of adaptations between species of two populations, or groups of populations, which are distinguishable on the basis of one or more heritable characters (Arnold, 1997). In other words, it means production of viable $F_1$ progeny that have some level of fertility. It shows, therefore, that there is a relatively natural hybridization between wheat and jointed goatgrass.

Wang et al (2001) concluded that when jointed goatgrass was used as the male parent to generate backcross generations, the seed-set percentages on $F_1$, $BC_1$ (first backcross generation), and $BC_2$ (second backcross generation) plants were 0.9, 4.4, and 18, respectively. Also a great increase in fertility restoration was observed when the $BC_2S_1$ plants (56% seed set) and the subsequent generation ($BC_2S_2$; 79% seed set) plants were self-pollinated. This observed high proportion of seed set in the backcross generations indicates that a wheat transgene with either a higher fitness or a neutral effect could spread in a jointed goatgrass population, in the case of escape (Wang et al (2001). According to Hedge and Waines (2004), the probability in getting a $BC_2$ individual with the herbicide resistance trait from the cross [$BC_1$ (DDCC) x jointed goatgrass] is is (4/770 000 x 1/8) nearly one in 1.54 million.

Therefore, it is possible to note that gene flow may actually occur. The trait that confers resistance to imidazolinone herbicides (acetolactate synthase inhibitors) in wheat is a partial dominant trait inherited as a single nuclear gene and has been also described like in wheat in other species (Kolkman et al. 2004). Gene flow from cultivated crops to their wild relatives has been documented in some crop species, like rice (*Oryza sativa* L.) (Chen et al. 2004) and canola (*Brassica napus* L.) (Warwick et al. 2003).

## References

Arnold, M.L. 1997. Natural hybridization and evolution. Oxford. 24:227–233. University Press, New York.

Chen LJ, Lee DS, Song ZP, Suh HS, Lu BR (2004) Gene flow from cultivated rice (*Oryza sativa*) to its weedy and wild relatives. Ann Bot 93:67–73

Mallory-Smith CA, Hansen J, Zemetra RS (1996) Gene transfer between wheat and *Aegilops cylindrica*. In: Proc Second International Weed Control Congress. Department of Weed Control and Pesticide Ecology, Copenhagen, pp 441–445

Morrison, L.A., O. Riera-Lizarazu, L. Cre´mieux, and C.A. Mallory-Smith. 2002. Jointed goatgrass (*Aegilops cylindrica* Host) x wheat (*Triticum aestivum* L.) hybrids: Hybridization dynamics in Oregon wheat fields. Crop Sci. 42:1863–1872.

Wang, Z., R.S. Zemetra, J. Hansen, and C.A. Mallory-Smith. 2001. The fertility of wheat x jointed goatgrass hybrid and its backcross progenies. Weed Sci. 49:340–345.

Warwick SI, Simard MJ, Legere A, Beckie HJ, Braun L, Zhu B, Mason P, Seguin-Swartz G, Stewart CN (2003) Hybridization between transgenic *Brassica napus* L. and its wild relatives: *Brassica rapa* L., *Raphanus raphanistrum* L., *Sinapis arvensis* L., and *Erucastrum gallicum* (Willd.) O. E. Schulz. Theor Appl Genet 107:528–539

Zemetra, R.S., J. Hansen, and C.A. Mallory-Smith. 1998. Potential for gene transfer between wheat (*Triticum aestivum*) and jointed goatgrass (*Aegilops cylindrical*). Weed Sci. 46:313-317