Indian J. Genet., 58(4): 423-426 (1998)

THE CROSSABILITY OF WHEAT CULTIVARS WITH *HORDEUM BULBOSUM*

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(Received: May 25, 1998; accepted: October 15, 1998)

ABSTRACT

Thirteen wheat (*Triticum aestivum* L.) cultivars (predominantly winter types) of diverse origin were crossed with diploid *H. bulbosum*. The seed set values in wheat-*H. bulbosum* crosses ranged from 1.3% to 22.7%. A marked variation in seed set values between the spikes of the same cultivar suggested that apart from crossability genes environmental factors and crossing techniques also influence the frequency of seed set. Contrary to the previous reports, results also indicated that the F_1 hybrids between wheat and *H. bulbosum* can be obtained without resorting to embryo culture.

Key words: *Hordeum bulbosum*, polyhaploids, crossability genes, dihaploid.

The finding that the intergeneric hybridization between wheat (*Triticum aestivum* L.) and bulbous wild barley (*Hordeum bulbosum* L. ; 2n=2x=14 or 2n=4x=28) resulted in the production of polyhaploid wheat plants [1] raised hopes that such polyhaploids followed by chromosome doubling could impart practicality to wheat improvement programmes in obtaining instant homozygous lines in the shortest possible time. However, the efficiency of haploid production is profoundly influenced by the crossability of *H. bulbosum* with wheat and is reported to be controlled by three genes, Kr_1, Kr_2 and Kr_3 located on chromosome 5B, 5A [2-3] and 5D [4], respectively. Of these, the Kr_1 locus is the most potent.

Since the crossability of wheat with *H. bulbosum* is restricted to a few wheat cultivars [3], identification of highly crossable wheat cultivars would greatly facilitate the application of *bulbosum* technique to the production of wheat haploids. Keeping this in view, the present study was undertaken to examine a set of wheat cultivars (predominantly winter types) of diverse origin for their crossability with *H. bulbosum* and to identify highly crossable genotypes to make dihaploid production a feasible breeding procedure.

MATERIALS AND METHODS

Thirteen wheat (*Triticum aestivum* L.) cultivars including a morphological variant isolated from the progeny of the ph_1b mutant of wheat cv. Chinese Spring (CS $ph_{1b}\,ph_{1b}$) were used in the present study. All wheat cultivars along with diploid *H. bulbosum* (EC 329042) were grown in the field and all hybridizations with *H. bulbosum* were carried out with wheat as the female parent. For each cross combination, two manually emasculated (1 to 2 days prior to anthesis) wheat spikes were pollinated with freshly collected *H. bulbosum* pollen. Before and after pollination, emasculated spikes were covered with glassine bags to prevent accidental stray pollination. Because of the variation in flowering time, crosses with different wheat cultivars were made at different times during the crossing season. Seed set was scored at maturity. Post-pollination gibberellic acid application or embryo culture was not employed.

RESULTS AND DISCUSSION

The data pertaining to the crossabilities of the wheat cultivars hybridized with *H. bulbosum* are presented in table 1. The data have been summarized over ears of

Table 1. Crossabilities of wheat varieties with H. bulbosum (EC 329042)

	H. bulbosum (pollen parent)	
Wheat Variety	No. of florets pollinated	% seed set
Winter Wheat		
Beserka	64	3.2
Diana	68	2.5
Hobbit	76	1.3
Joss Cambier	81	2.5
Victor-I	75	6.6
Centurk	74	1.3
WW 7	72	2.7
WW 12	76	5.2
WW 19	88	2.3
WW 26	70	8.6
WW 27	72	1.7
Spring Wheat		
WH 542	66	12.1
CS $ph_1b\,ph_1b$ Variant	66	22.7

each variety and the crossabilities expressed as the percentage number of grains set to the total number of florets pollinated. The seed set values ranged from 1.3% to 22.7%. Of the 13 wheat cultivars, the morphological CS ph_1b ph_1b variant showed the highest crossability of 22.7% followed by WH 542, WW 26, Victor-1 and WW 12 with 12.1%, 8.6%, 6.6% and 5.2% seed set, respectively. Other wheat cultivars used in the crossing programme gave an extremely low rate of seed set (< 3.2%). A marked variation in seed set values between the two spikes of the same genotype was also observed.

Although the crossability in wheat following hybridization with *H. bulbosum* is primarily controlled by the crossability (*Kr*) genes [2-4], Sitch and Snape [5] concluded that the ambient temperature during pollinations significantly influenced the frequency of fertilization and consistent reduction in the fertilization with increased temperature reflected a reduced stigma receptivity, pollen grain germination or pollen tube growth.

Contrary to the previous reports [1, 3, 4, 6] that the F_1 hybrids between wheat and *H. bulbosum* can only be obtained by embryo rescue technique, results of the present investigation indicated that a high frequency of seed set can be obtained without resorting to embryo culture. Further, since crossing procedures and environmental factors also appear to profoundly affect the crossability in wheat - *H. bulbosum* hybridization, application of some manipulative techniques such as bud pollination, direct injection of 2, 4-dicholoro-phenoxyacetic acid into culms [7], post-pollination gibberellic acid treatment [5] and better temperature control can significantly enhance the crossability of wheat cultivars and thus facilitate the use of dihaploid technique in wheat improvement.

ACKNOWLEDGEMENTS

Generous seed supply of *H. bulbosum* (EC 329042) and the winter wheats respectively made by the Directorate of Wheat Research, Karnal and Dr. G. S. Sethi, HPKVV, Palampur (HP) is gratefully acknowledged.

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