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Research Note

A study on hybrid sterility in rice (*Oryza sativa* L.) using wide compatibility variety

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Abstract:
To generate promising breeding material with high degree of cold tolerance together with good grain characteristics for different agro ecologies of the valley, use of wide compatibility variety was deployed in the present experiment to overcome the genetic impediment like hybrid sterility.

Key words: Rice, hybrid sterility, wide compatibility variety, Kashmir

Rice is the staple food and most important crop of Kashmir valley and occupies an area of 0.141 m ha and is cultivated from 1650-2500 m above mean sea level. Hence tolerance to low temperature at seedling and reproductive phases is the main requirement of varieties in order to adapt under such conditions. In the plain areas of the valley moderately cold tolerant early maturing *indicas* and under high altitudes highly cold tolerant *japonica* varieties are under cultivation. The *japonica* varieties are known to possess a very good degree of cold tolerance , early maturity, lodging resistance and responsiveness to higher doses of fertilization , whereas *indica* varieties are mostly popular for better grain quality, wider adaptability and high yielding nature. To combine the traits across the two sub species, hybrid sterility is the popularly studied genetic bottleneck but with the identification of wide compatibility varieties (WCVs) carrying sterility neutralizing genes, the transfer of genes across the two sub-species has become possible. A number of WCVs have been identified in the last two decades and several of them have been subjected to genetic analysis and put to application (Ikahashi and Araki, 1986, liu *et al*.,1992, Zhang *et al*., 1997, Liu *et al.,* 1997). Thus to generate promising breeding material with high degree of cold tolerance together with good grain characteristics for different agro ecologies of the valley, use of WCV was deployed in the present experiment to overcome the genetic impediment like hybrid sterility. The research presents the level of overcoming in hybrid sterility in terms of pollen and spikelet sterility by deploying the WCV.

The experimental material generated through different mating patterns during *Kharif* 2008 was subjected to analysis for pollen and spikelet sterility during *Kharif* season 2009. The mean pollen sterility of *indica* x *japonica* crosses amounting to 58.26 per cent, got reduced to the level of 30.80 per cent and enhancement in fertility was achieved using WCV (Dular) through three-way crosses(Table-1). The six *indica /japonica* (*i* x *j)* cross combinations recorded pollen sterility estimates of more than 90 per cent and the value was more than 80 per cent using WCV. Similarly mean percentage in spikelet sterility through three-way crosses using WCV was 63.92 per cent. Seven cross combinations manifested a higher 74 per cent by using WCV. The highest overcome in the sterility was recorded on three-way cross (L4 x D) x T3 (86.25) followed by (L5 x D) x T3 (85.58 %) and (L1 x D) x T3 (84.25 %). Differential expressions of hybrid sterility and wide compatibility in different backgrounds could be due to inadequate nature of WC source used in the study. Besides, other genetic phenomena like epistasis or non allelic interactions, role of additional genes, other loci with minor effects, and effect of modifiers, role of different genetic backgrounds and different degrees of cold stresses and environment might have played the role in the form of different degrees of expression. Kubo and Yoshimura (2005) and Kubo *et al*.(2008) also were on similar lines. Thus *indica* compatible *japonica* lines and vice-versa were generated using this fashion by deploying neutral alleles from Dular source. This experiment has facilitated the introgression of useful traits across the two sub-species which otherwise was impossible. Further experimental material generated has now been advanced under different agro-ecologies of Kashmir to look for promising/ improved lines and super rice varieties suitable for such, conditions. In addition neutral alleles from other sources can be deployed in order to develop broad spectrum compatible varieties for developing *indica*/ *japonica* hybrids and expected to be of more heterotic potential compared to inter varietal (*i* x *i* and *j* x *j*) crosses.

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Table-1: Comparative estimates of pollen sterility and spikelet sterility (%) for *indica x japonica* (i x j) crosses and their corresponding three-way crosses using WCV (Dular)

Cross combination (i x j crosses)	Pollen/spikelet sterility (%)	Cross combination (Three-way crosses)	Pollen/spikelet sterility (%)	Percentage overcome in sterility
Jhelum x Koshihikari L_1 x T_1	95.85 (75.81)	(Jhelum x Dular) x Koshihikari (L_1 x D) x T_1	19.18 (15.44)	79.98 (79.63)
Jhelum x K-332 L_1 x T_2	47.05 (31.81)	(Jhelum x Dular) x K-332 (L_1 x D) x T_2	14.90 (21.69)	68.33 (31.69)
Jhelum x Kohsar L_1 x T_3	92.03 (86.08)	(Jhelum x Dular) x Kohsar (L_1 x D) x T_3	15.47 (13.56)	83.19 (84.25)
SK-382 x Koshihikari L_2 x T_1	62.06 (60.58)	(SK-382 x Dular) x Koshihikari (L_2 x D) x T_1	47.49 (40.39)	23.47 (30.67)
SK-382 x K-332 L_2 x T_2	17.25 (81.09)	(SK-382 x Dular) x K-332 (L_2 x D) x T_2	25.55 (47.35)	-48.11 (33.28)
SK-382 x Kohsar L_2 x T_3	37.21 (82.56)	(SK-382 x Dular) x Kohsar (L_2 x D) x T_3	21.71 (20.89)	41.65 (74.70)
SR-1 x Koshihikari L_3 x T_1	91.66 (84.20)	(SR-1 x Dular) x Koshihikari (L_3 x D) x T_1	39.26 (21.45)	57.17 (74.52)
SR-1 x K-332 L_3 x T_2	20.79 (85.64)	(SR-1 x Dular) x K-332 (L_3 x D) x T_2	26.43 (30.69)	-27.13 (64.16)
SR-1 x Kohsar L_3 x T_3	44.65 (69.52)	(SR-1 x Dular) x Kohsar (L_3 x D) x T_3	7.69 (23.34)	82.78 (66.43)
China-1039 x Koshihikari L_4 x T_1	55.43 (44.77)	(China-1039 x Dular) x Koshihikari (L_4 x D) x T_1	6.41 (20.41)	88.43 (54.41)
China-1039 x K-332 L_4 x T_2	61.67 (96.60)	(China-1039 x Dular) x K-332 (L_4 x D) x T_2	93.88 (43.74)	-52.23 (54.72)
China-1039 x Kohsar L_4 x T_3	96.3 (93.05)	(China-1039 x Dular) x Kohsa (L_4 x D) x T_3	32.40 (12.79)	66.35 (86.25)
Chenab x Koshihikari L_5 x T_1	8.3 (83.22)	(Chenab x Dular) x Koshihikari (L_5 x D) x T_1	7.53 (17.27)	9.28 (79.25)
Chenab x K-332 L_5 x T_2	92.60 (91.05)	(Chenab x Dular) x K-332 (L_5 x D) x T_2	91.40 (37.29)	1.30 (59.24)
Chenab x Kohsar L_5 x T_3	51.10 (81.35)	(Chenab x Dular) x Kohsar (L_5 x D) x T_3	12.84 (11.73)	74.87 (85.58)
Mean	**58.26 (76.51)**		**30.80 (25.75)**	**36.62 (63.92)**
Range	**8.3-96.3 (31.80-96.60)**		**6.41-93.88 (11.73-54.10)**	
CD at 5 % level	**7.97**		**7.65**	

(Fig in parenthesis denote spikelet sterility),D= Dular