Short Communications

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Biparental mating in early segregating generation of aromatic rice (*Oryza sativa*)*

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Genetic variability is the most important pre-requisites for any successful crop improvement programme. It has been aurged that one of the reasons for failure to achieve a major breakthrough in productivity of self-pollinated crops like rice (*Oryza sativa*) is the lack of sufficient variability. The presence of large linkage blocks and inverse relations among the correlated characters are most common. On the other hand, biparental mating is expected to break linkage blocks and provide better opportunities for recombination's than the selfing series. It is also a useful system of mating for generation of increase variability and may appropriately be applied where lack of desired variation is the immediate need in the breeding programme. Though sharply differing views have been expressed on the effectiveness of biparental mating approach in self-pollinated crops, it has been successfully employed in some self-pollinated crops like wheat (Nanda *et al.* 1990) and safflower (Parameshwarappa *et al.* 1997). However, no report on the effectiveness of biparental mating population is available in basmati rice.

The present investigation was therefore, planned to compare the performance of biparental progenies with selfed ones with respect to creating genetic variability for yield and its contributing traits.

Two basmati genotypes, Improved Pusa Basmati 1(P 1460) and Pusa Sugandha 4 (P 1121) were selected on the basis of their contrasting characteristics (like, high yield potential, maximum no. of panicles/m^2, long cylinder fine grain quality of seed and moderate resistance to blast and bacterial blight etc.). The F_2 generation of the cross between these two lines was thus an ideal material to effect biparental mating and hence about 200 F_2 plants were selected for selective intermating on the visual basis of vigour, plant type, earliness and resistant to blast and bacterial blight. These F_2 plants used in biparental intermating were also selfed to generate F_3 progenies (200 F_3 and 400 BIPs families). The experiment was conducted at the experimental field of Agricultural Research Station, Ummedganj, Kota, during rainy (*kharif*) season of 2009. The biparental population and their corresponding F_3 population were sown in 10 rows each in 5 m length with 20 cm. spacing between rows and 10 cm between plants within the rows. The data were recorded on all the plants in BIP and F_3 for days to 50% flowering, plant height (cm), no. of panicles/m^2, spikelet's/panicle, panicle length (cm), days to maturity, 1 000-seed weight (g) and yields /plant (g). The mean, range and various components of variance were worked out in the biparental as well as F_3 progenies. The phenotypic and genetic coefficients of variances were computed considering the variances of segregating generations to be an indicative of environmental variance (V_e). Assuming the variance in segregating population (V_p) to be equal to the sum of variance due to genotype (V_g) and variance due to environment (V_e), the parameter V_g was computed by substracing mean variance of non-segregating generations from the variance of F_2.The phenotypic and genotypic co-efficient of variation, heritability in broad sense and genetic advance were computed as per standard methods.

The mean and range for different yield-attributing traits of biparental progenies and F_3 populations are presented in Table 1.The results indicated that the mean and range values of biparental progenies for all the traits were found higher than the F_3 population. Upper limit of range was especially higher in BIP than the F_3 populations indicating that, the intermating has helped in releasing more variability than selfing generations by expecting breakage of linkage blocks. It may also be due to accumulation of favourable genes as BIP progenies were developed by crossing between the segregants selected on the basis of better performance. The general shifts in the value of range of expression of characters

*Short note

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Table 1 Mean and range of expression in respect of various quantitative traits in intermated (BIP) and selfed (F_3) population of basmati rice

Character	Mean ± SE		Range	
	F_3	BIP	F_3	BIP
Days to 50% flowering	104 ±1.89	106 ± 2.01	99-112	96-114
Plant height (cm)	107.21 ± 4.56	110.68 ± 4.02	98.33-115.0	95.33-118.67
Panicles/m^2	245.72 ± 9.53	275.40 ± 8.23	201-279.67	197.0-324.67
No. of spikelets/panicle	115.17 ± 5.84	130.45 ± 5.56	90.0-145.67	84.67-156.33
Panicle length(cm)	28.19 ± 0.44	29.10 ± 0.65	24.87-30.40	24.30-32.03
Days to maturity	136 ± 0.93	139 ± 1.01	134-139	133-142
1 000-grain weight (g)	19.84 ± 0.30	21.54 ± 0.32	17.40-22.93	17.0-24.1
Grain yield (g)/plant	14.65 ± 0.78	17.62 ± 0.93	9.75-20.64	8.70-22.07

by biparental approach were also reported in rice by Amudha and Arumugachamy (2008) and in chickpea by Kampli *et al.* (2002) and Singh (2004). It is also interesting to note that the mean performance improved considerably in respect of panicle /m^2, spikelets/panicle and seed yield/plant. Superior mean performance of biparental progenies appeared to be due to better exploitation of additive and non-additive gene effects. The non-additive gene effects contributing to the expression of characters is a function of an interaction of alleles which influencing the characters. In BIP, which provide a better scope for the reshuffling of the alleles concerned would certainly help in the better exploitation of the non-additive gene effect and hence results in the increase in mean performance. It is also attributed to the creation of more genetic variability by breakage of undesirable linkage which otherwise conceal the genetic variation in the small size F_2 generations (*Amudha et al.* 2007).The results of the present investigation are in agreement with the earlier reports on safflower (Naik *et al.* 2009) and chickpea (Kampli *et al.* (2002) and Singh (2004).

The estimates of different parameters of genetic variability were presented in Table 2. In general, the variability parameters are higher for biparental progenies than the F_3 population in respect of all the traits studied. Similar results were also reported in rice by Naik *et al.* (2009) and Amudha and Arumugachamy (2008), in chickpea by Singh (2004) .Higher value of genetic and phenotypic coefficient of variation were recorded for grain yield (34.00 and 35.21), followed by no. of spikelets/ panicle (22.05 and 23.26) . Whereas, heritability (%) and genetic advance (% as mean) were found higher for 1 000-grain weight (g) and panicles/ m^2, respectively. Similar finding was also reported in rice by

Table 2 Estimates of genetic variability parameters in respect of eight quantitative traits in F_3 and BIP population of basmati rice

Character	Population	GCV (%)	PCV (%)	h^2 (bs) (%)	GA (% as mean)	Genetic gain as per cent of mean
Days to 50% flowering	F_3	5.50	6.34	75.26	13.12	11.38
	BIP	7.08	7.81	82.20	17.98	16.30
Plant height (cm)	F_3	7.04	10.19	47.78	13.78	9.53
	BIP	9.15	11.12	67.82	22.03	18.14
Panicles/m^2	F_3	12.08	13.82	76.35	68.47	59.83
	BIP	15.79	16.62	90.28	109.14	103.28
No. of spikelets/panicle	F_3	20.64	22.44	86.19	62.02	57.58
	BIP	22.05	23.26	89.89	72.01	68.28
Panicle length(cm)	F_3	9.11	9.51	87.63	6.49	6.21
	BIP	10.41	11.12	91.63	7.48	7.00
Days to maturity	F_3	1.77	2.13	68.79	5.28	4.38
	BIP	2.03	2.39	72.16	6.35	5.39
1 000-grain weight (g)	F_3	12.92	13.19	96.04	6.63	6.50
	BIP	15.42	15.65	97.14	8.64	8.52
Grain yield (g)/plant	F_3	33.40	34.61	92.80	12.42	11.97
	BIP	34.00	35.21	93.12	15.25	14.72

GCV , Genetic coefficient of variation;PCV,phenotypic coefficient of variation, h^2 (bs), heritability in broad sense; GA, genetic advance; BIP, biparental mating population.

Naik *et al.* (2009), in cauliflower (Kanwar and Korla 2002) and in fenugreek (Gangopadhyay *et al*. 2009). The higher magnitude of GCV and PCV in BIP populations indicating more scope for selecting better segregants for the traits like grain yield, no. of spikelets/panicle and panicles/m^2. The heritability estimates was the highest for 1 000-grain weight (96.04 and 97.14), followed by grain yield/plant (92.80 and 93.12), panicle length (87.63 and 91.63), no. of spikelets/ panicle (86.19 and 89.89) and panicles/m^2 (76.35 and 90.28) for F_3 and BIP population respectively. This suggested that the variation due to environment played a relatively limited role in influencing the inheritance of these characters and thus the expected response to selection is higher in BIP. High heritability in case of BIP over F_3 has also been reported in rice by Naik *et al.* (2009) and Amudha *et al.* (2007), in chickpea by Singh (2004) and Kampli *et al.* (2002).

Among the characters studied, panicles/m^2 and spikelets/ plant (109.14 and 72.01 respectively) showed higher genetic advance, indicating that the gain from selection based on these two traits would be higher in biparental progenies than in their corresponding selfed progenies. High heritability accompanied with low genetic gain was found for panicle length and days to maturity, indicating that, these traits is more likely under the control on non-additive gene action and selection for these traits would be less effective. Rest of the traits had moderate to high heritability with low genetic gain, indicating the influence of environment on these traits. In addition to this, it is also expected to help in maintaining a greater variability for selection to be effective for longer period in crops like rice where lack of variability has been implicated as one of the important causes for limited progress. Hence, the use of biparental mating in early segregating generation (F_2) of an appropriate cross could be of much use in widening variability and consequently in making considerable gains in improving productivity.

SUMMARY

A field experiment was carried out during *kharif* 2009 to study the genetic variability created through biparental mating in the F_2 of Improved Pusa Basmati 1(P 1460)×Pusa Sugandha 4 (P 1121) cross of basmati rice (*Oriza sativa* L.). The biparental population (BIP) had higher mean performance than the F_3 self's for all the characters under study. The lower limit of range was, in general smaller for all the characters in the biparental population. The upper limit had also increased in the desired direction for all the characters. A sufficient high genetic variation was maintained in the BIP population for most of the characters. Highest value of genetic and phenotypic coefficient of variation were recorded for grain yield/plant (34.00 and 35.21), followed by no. of spikelets/ panicle (22.05 and 23.26). Whereas, high heritability (%) and genetic advance (% as mean) were found for 1 000-grain weight (g) and panicles/m^2 respectively. The utility of biparental mating in early segregating generation in aromatic rice is emphasized.

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