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Research Note

Effectiveness of selection response on F_3 and F_4 generations for grain yield and yield attributing traits in aromatic rice (*Oryza sativa* L.)

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Abstract
Genetic variability present in the F_2 generation originating from ten crosses of rice genotypes, selection was practiced for high grain yield. Expected selection response was estimated in F_3 generations and compared with F_2 generation. Similar selection practices were made in F_3 generation and selection response was estimated in F_4 generation. F_3 generation showed significant positive selection response for grain yield, number of panicles per plant, plant height and days to 50 % flowering thus indicating the effectiveness of selection for these traits. Grain yield showed non-significant response in F_2 generation which indicates straight selection for this trait during early generation may not be effective. F_4 generation showed significant positive selection response for the entire traits *viz.* grain yield, number of panicles per plant, plant height, number of grains per panicle and days to 50 % flowering this indicating the effectiveness of selection for these traits in F_3 or latter generation. The regression coefficient between F_2 and F_3 generation and F_3 and F_4 generations was significant for all the traits. However, selection for plant height, number of panicles per plant and days to 50 % flowering could be made in early segregating generation while grain yield per plant and number of grains per panicle were effective for selection in latter generation.

Key words
Rice, selection response, variability, regression coefficient, segregation generations

Rice (*Oryza sativa* L.) is an important and stable food of almost half of the world. Rice is grown worldwide over an area of 154 million hectares with total production of 672 million tones. (Savita *et al.* 2015). Among rice growing countries, India has largest area under rice in the world i.e., 36.9 million hectares and ranks second in production with 120.6 million tones. Genetic improvement in any crop, achieved through any breeding method depends on the variability available for selection and methodology of selection (Malieshappa *et .al.,* 1998). Considerable genetic variability can be generated by crossing two desirable chosen parents. Once variability is generated the rate and progress achieved through selection depends on the various factors like selection intensity, available of genetic variability, its genetic association with other related traits and breeding methodology. Grain yield is a complex character and is the result of interaction of many variables due to different gene association that might be existing in different population and might result in quite different relationship. It is also largely influenced by environment. Further genotype and environmental interaction reduce the effectiveness of early generation selection (Rahman *et al.,* 1986). Large environmental differences may lead to failure of parental yield to be indicative of the yield of progeny (Barman and Barah 2012). So, direct selection for improvement of grain yield in early segregating generation may not be effective. The parent progeny correlation and regression between two generations show lesser susceptible to environmental effect and is very useful for selection in segregating generation for the production of new or improved genotypes (Suwarto *et al* 2015). The present investigation was aimed to study the response of selection for grain yield and its component traits through mean percentage of population mean and also through parent progeny correlation and regression method in between F_2 and F_3 and in between F_3 and F_4 generations.

The experimental materials used in the present study were F_1s of each of the ten crosses involving five high yielding existing rice verities (P-1121, P-2511, P-1509, Improved Pusa basmati-1 and Pratap Sugandha-1) . The experiment was conducted during *kharif* 2014 (June –December) at experimental farm of Agricultural Research Station, Ummedganj, Kota. Standard cultural practices and need based plant protection measures were undertaken. Individual plant selection was made in each of ten F_2 populations. Based on performance selection were made on plant height, number of panicles per plant, number of grains per panicle, grain yield and days to 50% flowering. One hundred F_2 recombinant plants were selected and data are yield contributing characters were recorded, selected F_2 progenies were forwarded to F_3 generation.

F_3 generation was raised during kharif *2015* at Agricultural Research Station, Ummedganj, Kota. One hundred F_3 families were raised at the rate of 150 plants per family in a separate sub plot. These families were grown in 3 rows having 50 hills per row with 20 x 10 cm spacing between and within the row. The observations were recorded from ten randomly selected plants from each F_3 family. Progeny mean, range, percentage of population mean for selected individual for each population were estimated irrespective of crosses. Mean values were used to estimate the parent offspring correlation and regression between F_2 and F_3 generation using single plant selections. Seventy best performers were selected and forwarded to F_4 generations.

F_4 generation consisted of 70 families selected from F_3 population were raised in plant progeny rows. 200 plants per family were raised in sub plot. In each sub plot, families were grown in 4 rows having 50 hills per row with the same spacing as in F_3 generation. Data were recorded from 10 randomly selected plants from each family as in F_3 generation. Progeny mean, range and percentage of F_4 population mean of selected individuals were estimated. Progeny mean of F_4 generation and their corresponding mean of individual plant selection in F_3 generation were used to study the parent offspring correlation and regression as in between F_2 and F_3 generation.

The yield performance of F_3 families raised from selected F_2 populations on the basis of phenotypic performance of the cross did not showed much encouraging results (Table-1).Out of 70 family's only 14 families could be isolated as promising families for later generation. Thus there was practically no relationship between the yield of individual F_2 selection and the mean of corresponding F_3 families. This was also provided by the evidence of non significant correlation and regression. Similar type of finding was also reported by Barman and Barah (2012). Thus, selection based on phenotypic performance for yield in early segregating generation is ineffective. In respect of plant height, number of panicles per plant grains per panicle and duration of flowering in F_3 generation showed high mean performance and percentage of population mean than in F_2 generation. Moreover these traits showed strong correlation and regression between F_2 and F_3 generation. Similar findings were earlier reported by Kahani and Hittalmani *(*2016 and Venkanna *et al (*2014), All the F_4 families showed promising results in terms of yield performance and percentages of population mean (Table-1). Thus F_4 generation inherited and retained their parental characteristics under considerations such as plant height, number of panicles per plant, grains per panicle, grain yield and days to 50 % flowering as revealed by the F_3/F_4 correlation and regression. Similar findings were earlier reported by Malieshappa *et al (*1988),

The inter correlation and regression for yield component character are presented in Table-2. The F_2 generation showed significant positive correlation and regression with F_3 generation for plant height, number of panicles per plant, number of grains per panicle, grain yield and days to 50 % flowering. The highest correlation was observed in number of grains per panicle (0.90) followed by number of panicles per plant (0.83), plant height (0.67) and days to 50 % flowering (0.65) .This indicted the effectiveness of selection for these traits. These results were also agreed with the mean performance of the F_2 selection and F_3 progeny mean performance. However, grain yield showed non significant correlation between F_2 and F_3 generation. This indicated that selection for grain yield on the basis of phenotypic performance during early generation might not be advisable. Results of correlation between F_3 and F_4 generation showed that all the traits showed significant correlation. The highest correlation coefficient was observed in number of panicles per plant (0.80), followed by plant height (0.77), grains per panicle (0.53) and days to 50 % flowering (0.49).This indicted the effectiveness of selection for these traits in F_3 or later generations (Warkad *et al (*2013).

Further it was also observed that, the regression coefficient for plant height, number of panicles per plant, umber of grains per panicle and days to 50 % flowering showed higher regression coefficient between F_2 and F_3 generation than between F_3 and F_4 generation. But in respect of grain yield and number of grains per panicle situation was reverse, where the regression coefficient between F_3 and F_4 generation was higher than between F_2 and F_3 generations. From these observations, it could be said that, selection for plant height, number of panicles per plant height and days to 50 % flowering might be made in the early generation , keeping aside the traits number viz grains per panicle and grain yield for selection in later generation Malieshappa *et al (*1988). In the present investigation, it was interesting to find out that, only fourteen families out of total 70 F_4 families were identified as promising for further evaluation to next generation on the basis of significantly higher grain yield.

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Table 1. Mean performance of selected plants in F_2, F_3 and F_4 generations for various characters in aromatic rice

Characters	F_2 Population			F_3 Population			F_4 Population		
	Range	Mean	% of F_2 population mean	Range	Mean	% of F_3 population mean	Range	Mean	% of F_4 population mean
Plant height/plant (cm)	105-118	113	110	106-121	116	130	110-125	119	108
Number of panicles / plant	4-7	5.5	113	5-8	6.3	121	5-9	7.1	131
Number of grains /panicle	145-178	161	111	151-180	169	123	161-189	178	130
Days to 50 % flowering	98-110	107	100	97-105	104	102	99-112	110	103
Grain Yield per plant (gm)	25-34	29	123	26-33	31	133	28-35	33	137

Table 2. Parent offspring correlation and regression of the crosses over segregating generations for various characters in aromatic rice

Characters	Correlation Coefficient		Regression coefficient	
	Between F_2/ F_3	Between F_3/ F_4	Between F_2/ F_3	Between F_3/ F_4
Plant height (cm)	0.67**	0.77**	0.63**	0.56**
Number of panicles per plant	0.83**	0.80**	0.77**	0.66**
Number of grains per panicle	0.90**	0.53**	0.52**	0.57**
Days to 50 % flowering	0.65**	0.49**	0.48**	0.45**
Grain Yield per plant	0.44	0.64**	0.70**	0.72**

*= Significant at 0.05 probability, ** = Significant at 0.01 probability indicate level of significance in the table.

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