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GENETIC VARIABILITY AND CHARACTER ASSOCIATION STUDIES IN RICE UNDER ABIOTIC STRESS-DEEP WATER

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ABSTRACT

Fourteen varieties of rice were studied for genetic variability and correlation. Highly significant differences were found for all the characters under deep water condition. The characters days to flower, days to maturity, yield/plot and plant height exhibited high estimates of heritability, while yield/plot, plant height and no, of chaff grains showed high genetic advance in percentage of mean. The only character yield/plot and plant height had high heritability with high genetic advance. Yield was negatively correlated with no. of chaff grains/panicle, while significant positive association with plant height, EBT plant^{-1} and fertile grains panicle^{-1} at both the level. However the association of days to flower was positively correlated with days to maturity and no. of chaff grains and days to maturity with no. of chaff grains at both genotypic and phenotypic level in deep water condition.

Key words : *Rice heritability, genotypic, phenotypic.*

Rice (*Oryza sativa* L.) is an important cereal crop of the world and occupies a notable position among the food grains not only in terms of acreage and production but also in adaptation in wider range of agro climatic conditions. Globally rice paddy is planted to about 164 million ha and harvested 722 million tons annually. Of this, Asia accounts for 90% of the production and consumption of rice. Only about 35 million tons of rice is traded through international market. Leading rice exporting countries are Thailand, Vietnam, USA, India and Pakistan. Thus it is imperative and rice production and supply for domestic consumption is entirely the national responsibility.

India has the world's largest area under rice with 44.0 million ha and is the second largest producer (96.0 million tonnes-2010) next only to China. It contributes 21.5% of global rice production. Within the country, rice occupies one-quarter of the total cropped area, contributes about 40 to 43 percent of total food grain production and continues to play a vital role in the national food and livelihood security system. During 2007-08 India exported a record 6.5 million tons of rice worth Rs. 12,000 crores and was second only to Thailand. Rice export contributes nearly 25% of total agriculture export from the country. The average productivity of rice in India, at present, is 2.2 tons/ha, which is far below the global average of 2.7 tons/ha. The productivity of rice is higher than that of Thailand and Pakistan but much lesser than that of Japan, China, Vietnam and Indonesia. India needs to produce 112.8 and 121 million tons for the year 2020 and 2030, respectively, if the rice production grows at 1.34% from the present growth rate of 1.14% per annum. But it will remain in deficit of around 2.5 million tons, if the present growth rate of 1.14% continues up to the year 2030.

Genetic variability is the basis of plant breeding. Therefore it is very essential to have knowledge of variability for yield and its component characters and their relative contribution to yield, as well as relationship amongst themselves. Hence the present investigation was undertaken to know the magnitude of genetic variability, heritability, genetic advance, genetic advance in percentage of mean along with correlation coefficients of characters, which will be of immense help in selecting suitable plant type in rice for deepwater condition (50-100 cm of water depth).

MATERIALS AND METHODS

A field experiment with 14 varieties (11 exotic and 3 indigeneous) of rice (*Oryza sativa* L.) was conducted in randomized block design with four replications at Crop Research Station, Ghaghraghat, Bahraich during Kharif-2008 under waterlogged condition in a plot size of 2.0m x 0.6m with inter and intra-row spacing of 20 and 15 cm, respectively. Five plants were selected randomly in each plot and observations on yield and its seven contributing characters namely; days to flower, plant height, ear bearing tillers, panicle length, maturity and no. of fertile and chaff grains/panicle were recorded. The analysis of variance was done on the mean basis of each entry/plot. The genetic variability and heritability were worked out by the formula of (1 and 2), respectively. Whereas genetic advance and correlation coefficient in accordance to (3, 4) respectively.

RESULTS AND DISCUSSION

Genotypic and phenotypic coefficients of variability, heritability %, genetic advance and genetic advance in percent of mean (Table-1) indicated the PCV in general was higher than GCV for all the characters indicating the extent of environmental influence on the manifestation of these characters. The high magnitudes of PCV and GCV

Table-1 : Heritability, Genetic advance, Genetic advance in % of mean, Genotypic and phenotypic coefficients of variation in rice.

Characters	Heritability (%)	Genetic advance	Genetic advance in % of mean	Genotypic coefficient of variation	phenotypic coefficient of variation
Yield/ plot	96.07	0.49	90.14	40.00	41.81
Days to 50% flowering	99.72	24.92	19.05	9.26	9.26
Plant height (cm)	91.18	49.60	57.78	29.26	30.77
No. of Panicle bearing tillers	62.66	2.18	35.97	22.60	28.54
Panicle length (cm)	53.28	2.20	9.64	6.48	8.89
Maturity	99.71	26.64	16.87	8.19	8.20
No. of fertile grain/panicle	55.25	31.81	29.16	22.47	35.72
No. of chaff grain per panicle	65.35	22.25	114.92	69.00	85.38

Table-2 : Correlation studies on grain yield and its components in deep water rice

Characters		Plant Height	EBT/ Plant	Panicle Length	Days to Maturity	No. of fertile grains panicle	No. of chaff grains panicle	Grain Yield
Days to 50% flowering	G	-0.231	-0.257	-0.047	0.978**	-0.562*	0.700**	0.115
	P	-0.241	-0.222	-0.038	0.995**	-0.422	0.565**	0.260
Plant Height	G		-0.674**	-0.053	-0.221	0.433*	-0.231	0.530**
	P		-0.533**	-0.024	-0.215	0.543*	-0.195	0.490*
EBT/Plant	G			0.256	-0.261	-0.220	-0.198	0.516**
	P			0.014	-0.233	-0.157	-0.079	0.473*
Panicle Length	G				-0.023	0.397	0.207	0.493*
	P				-0.021	0.354	0.249	0.286
Days to Maturity	G					-0.572**	0.738**	0.101
	P					-0.475*	0.596**	0.208
No. of fertile grains/panicle	G						-0.614**	0.637**
	P						-0.379	0.592**
No. of chaff grains/panicle	G							-0.335
	P							-0.412

were recorded for number of chaff grains/panicle, grain yield, plant height, number of fertile grains/panicle and ear bearing tillers/plant, suggesting large variability and thus score of genetic improvement through selection of these traits. The level of genotypic and phenotypic variability for days to flower, panicle length and days to maturity was very low (Table-1). Similar results reported earlier by (5) for days to flowering and panicle length. Very narrow difference in between PCV and GCV for days to flowering and maturity implied little environmental influence on these characters and predominant role of genetic factors on the expression of these traits. Closeness between PCV and GCV of these two traits indicating higherresistance to environmental influence as DW-rices are strictly photosensitive which must be flower in a particular day length of photo period.

The heritability estimates coupled with expected genetic advance indicate the mode of gene action in the expression of a character, which helps in choosing appropriate breeding methodology. The heritability estimates (broad sense) ranged from 99.72 (days to flower) to 53.28% (panicle length). While on examining the estimates of genetic advance as percent of mean varied from 9.64% for panicle length to 114.92% for number of chaff grains per panicle.

In the present study height heritability associated with high genetic advance in percent of mean was found for grain yield, plant height, no. of chaff grains/panicle. Which suggested the preponderance of additive gene effects in the expression of these characters. Therefore, breeding method based on progeny testing and mass selection could be useful in improving these traits (6) has also suggested that high heritability value with high genetic advance is much important in predicting the resultant effect for selecting the best individual in comparison to heritability value alone. Moderate heritability value with moderate genetic advance was observed in ear bearing tillers/plant and number of fertile grains/panicle suggested that additive and non-additive gave effects were equally important in the inheritance of these traits. While high heritability estimates with low to moderate genetic advance was observed in days to 50% flower, days to maturity was predominantly governed by non-additive gene action, low to moderate heritability values for grain yield were observed by (5). However (6) high heritability for this traits.

The estimates of genotypic correlation coefficients are essential in evaluating the possibility of simultaneous improvement of many characters. Genotypic correlation in general, were higher than the corresponding phenotypic correlation coefficient. This indicates a strong inherent association among grain yield and component traits. Days to 50% flowering was positively and significantly correlated with days to maturity and no. of chaff grain. Similarly, days to maturity had highly positive association with chaff grains at both the levels. While days to 50% flowering and maturity showed significant negative association with number of filled grain/panicle. This suggests that increase in growth duration would tend to increase higher number of chaffy grains and decreased the fertile grains/panicle. In deep water areas, it always risky to grow early duration varieties in which reproductive phase completely damaged by increased water level whereas long duration varieties suffers from coldness and produced more number of chaffy grains and ultimately affect the yield. Thus, varieties must be flower in a particular days length i.e. photosensitivity of the DW-varieties is the first pre-requisite for successful growing of DW-rice. Further, grain yield had significant positive association with number of fertile grains panicle, EBT plant and plant height at both the level while panicle length at genotypic level or plant height had also closed significant in positive affinity direction with number of fertile grains/panicle and negative significant association with EBT/plant. Plant height (elongation of internodes) are the survival trait in DW-rices. Therefore, increased plant height reduces EBT/plant in DW-situation because elongation follows during tillering phase and energy diverted in elongation of internodes for their survival. Similar results were also observed by (7) for number of grains/panicle and yield. (8) for yield and panicle length in rice. The present investigation suggest that improvement in grain yield in DW-situation could be achieved by exercising simultaneous selection for number of fertile grains/panicle, EBT/plant, plant height and straight selection for yield.

A highly significant positive association was observed between maturity and number of chaff grains/panicle. The fertile grains/panicle exhibited significant negative association with maturity and chaff grains/panicle, only at genotypic level. It indicated that in the event of enhancement of maturity, the fertile grains/panicle diminished, while the chaff grains increased significantly and vice-versa. Yield/plot showed positive association with panicle length and fertile grains/panicle, EBT/plant and plant height which revealed that panicle length and fertile grains/panicle, EBT/plant and plant height play major role in increasing yield in DW-rice. Therefore the importance should be given while selecting the desirable plants for higher yield potential in deep water conditions of rice. Similar results were also observed by (9) for no. of grains/panicle and yield. (8) for panicle length and yield and (10) for yield and panicle length in rice.

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