



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 803-805
Received: 22-09-2019
Accepted: 24-10-2019

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Study on genetic variability, heritability and genetic advance for yield and other related traits in rice (*Oryza sativa* L.)

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Abstract

The study was conducted to estimate the genetic variability, heritability and the expected genetic advance upon selection of all studied characters of F1 hybrids populations. In this we studied about eleven characters of the rice crop. The high estimates of variability (>20%) were recorded for the characters panicle bearing tillers per plant and grain yield per plant. The characters exhibit low estimates of genetic variability (<10%) were days to 50% flowering, spikelets per panicle and spikelet fertility. Heritability percentage (H^2_b) was found higher (>75%) for the characters viz., days to 50% flowering, plant height, panicle length, flag leaf area, spikelet per panicle, spikelet fertility, 1000- grain weight, biological yield per plant, and grain yield per plant. There is only harvest index showed moderate (75-50%) h^2_b while none of the character found low broad sense heritability. The genetic advance in percent of mean was to be very high for panicle bearing tillers per plant and grain yield per plant while non of the trait found low genetic advance in study. Thus selection for these traits among these genotypes would be effective in all cases.

Keywords: Variability, genotypic and phenotypic co. of variance, heritability (broad and narrow sense) and genetic advance

Introduction

Rice (*Oryza sativa* L.) is one of the world's most important food crops and a primary source of food for more than half of the world populations. Rice is an important staple food crop in the world. Rice (*Oryza sativa* L., $2n=24$) belongs to the family Poaceae (Graminae). Rice has two cultivated and 22 wild species. The cultivated species are *Oryza sativa* and *Oryza glaberrima*. *Oryza sativa* is a diploid species having 24 chromosomes. The *Oryza sativa* varieties are commonly grouped in to three subspecies namely: indica, japonica and javanica. It is best suited to region which has high humidity, prolonged sunshine and an assured supply of water. The average temperature required throughout the life period of the crop ranges from 21 to 37°C. At the time of tillering, the crop requires a high temperature for growth. Temperature requirement for blooming ranges from 26.5 to 29.5 °C. At the time of ripening, the temperature should be between 20 to 25 °C. Photo periodically rice is a short day plant, however, there are varieties which are non-sensitive to photo periodic condition. Rice is grown under different agro-climatic conditions and production systems but it is rated as an especially Salt-Sensitive Crop. Rice is the only the cereal which can be grown successfully in standing water. For the development of high yielding pure line as well as hybrid varieties in rice or any crop, the information on various genetic aspects of important plant characters is essential for planning and execution of a successful breeding programme. Heritability is an index of transmission of characters from parents to their offspring and it plays an important role in the selection process in plant breeding Genetic advance provides information on expected gains resulting from selection of superior individuals. Heritability and genetic advance are important selection parameters which help in predicting the gain under selection. This study was taken to determine the extent of variability and heritability for yield and other related traits in rice.

Material and Method

The basic material for the present investigation comprised of ten rice genotypes / varieties for seven lines viz., IR11T197, IR11T104, IR11T205, FL-478, pant basmati-1, NDRK5009, IR 12T193 and three testers viz., CSR-10, CSR-36 and Jaya was obtained from various place were utilized for the study. The genotypes were used for crossing programme in a line x tester analysis (7 lines x 3 testers). Field plot was well prepared for sowing of experimental material

(31 genotypes – comprising 10 parents and 21 F_1 's seeds). Their of 10 parents and 1 check varieties (NarendraUsar 3) were evaluated in Randomized Complete Block Design with three replications during *Kharif*, 2016 at (M.E.S of N.D.U.A&T, KumarganjAyodhya). The seeds of each entry were sown on 22st June, 2016 in separate plots and 22 days (14th July 2016) old seedlings were transplanted single seedling per hill in single row plots of 3 m length with inter- and intra- row spacing of 20 cm and 15 cm, respectively. All the recommended cultural practices were followed to raise a good crop. The observations were recorded on five randomly selected competitive plants of a genotype in a plot in each replication for twelve characters. The mean values of observations recorded on five plants of each plot were used for analysis. Observation were recorded on days to 50 per cent flowering, plant height, panicle bearing tillers per plant, panicle length, flag leaf area, spikelets per panicle, spikelet fertility, 1000- grain weight, biological yield per plant, harvest-index and grain yield per plant. Estimates of combining ability were computed according to Kempthorne (1957) [2].

Result and Discussion

The analysis of variance revealed significant genotypic differences for all eleven traits studied indicating that a large amount of variability was present in the material. The variability estimates (phenotypic (PCV) and genotypic (GCV) coefficients of variation), heritability broad sense and genetic advance in per cent of mean for all the eleven characters under study have been presented in Table 1.

In general, the magnitude of phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all the traits. The high estimates (>20%) of phenotypic (PCV) and genotypic (GCV) coefficient of variation were recorded for panicle bearing tillers per plant (PCV=25.25%, GCV= 23.70%) and grain yield per plant (PCV=23.72%, GCV = 22.67%). The moderate estimates (10-20%) of PCV and GCV were recorded for plant height, panicle length, flag leaf area, 1000 grain weight, biological yield per plant and harvest index. The remaining characters, days to 50% flowering, spikelet per panicle and spikelet fertility exhibited low estimates (<10%) of PCV or GCV.

The estimates of heritability in broad sense (h^2_b) and genetic advance in % of mean estimated for 11 characters have been presented in Table 1. The estimates of broad sense heritability ranged from 67% (harvest index) to 98% (Spikelets per panicle and plant height). The high heritability in broad sense (>75%) was recorded for days to 50% flowering, plant height, panicle bearing tillers per plant, panicle length, flag leaf area, spikelets per panicle, spikelet fertility, 1000 grain weight, biological yield per plant and grain yield per plant. Harvest index showed moderate broad sense heritability (>50% to <75%) while low heritability (<50%) was not found for any trait.

The genetic advance in % of mean was to be very high for the characters *viz.*, panicle bearing tillers per plant (45.82%) and grain yield per plant (44.65%). The genetic advance in % of mean was found to be high (<20%) for flag leaf area (37.78%), panicle length (32.70%), 1000 grain weight (32.12%), plant height (22.39%) and biological yield per plant (22.35%). Moderate (>10-20%) estimates of genetic advance in per cent of mean were observed for spikelets per panicle (17.94%), days to 50% flowering (17.35%), harvest index (17.20%) and spikelet fertility (11.16%).

The high estimates of genotypic and phenotypic coefficient of variation and high heritability in broad sense along with high genetic advance in per cent of mean was recorded for panicle bearing tillers per plant and grain yield per plant, which indicated that these two traits would be ideal traits for improvement through selection in context of present material.

Table 1: Estimates of coefficient of variation, heritability in broad and genetic advance at per cent of mean for (11) traits in rice

Character	Coefficient of variation (%)		Heritability Broad sense	Genetic advance In (%) of Mean
	Phenotypic	Genotypic		
D 50 F	8.69	8.55	96%	17.35
PH	11.08	10.97	98%	22.39
PBTP	25.25	23.70	88%	45.82
PL	17.16	16.50	92%	32.70
FLA	19.67	18.99	93%	37.78
SP	8.86	8.78	98%	17.94
SF	5.84	5.62	92%	11.16
GW	16.73	16.15	93%	32.12
BYP	11.31	11.08	95%	22.35
HI	12.47	10.20	67%	17.20
GYP	23.72	22.67	91%	44.65

Traits: D50F = Days to 50% flowering, PH = Plant height, PBTP = Panicle bearing tillers plant⁻¹, PL = Panicle length (cm), FLA = Flag leaf area (cm²), SP = Spikelets per panicle, SF = Spikelet Fertility (%), GW = Grain weight (g), BYP = Biological yield plant⁻¹ (g), HI = Harvest index (%), GYP = Grain yield per plant

Flag leaf area, panicle length, 1000-grain weight, biological yield per plant and plant height recorded moderate PCV and GCV along with high heritability and genetic advance in per cent of mean which suggested these five traits may provide considerable response to selection owing to their moderate variability and high transmissibility.

Remaining characters had low to moderate GCV and PCV values or low to moderate heritability to emerge as poor indices of selection. The moderate estimates of GCV and PCV were exhibited by the characters *viz.*; plant height, panicle length, flag leaf area, 1000- grain weight, biological yield per plant and harvest index while low estimates were found for the traits day to 50% flowering, spikelets per panicle and spikelet fertility.

The estimates of direct selection parameters observed for the above characters are broadly in agreement with earlier reports in rice (Mall *et al.*, 2005; Suman *et al.*, 2005; Singh *et al.*, 2006; Panwar *et al.*, 2007; Babar *et al.*, 2009) [3, 6, 5, 4, 1].

Conclusion

The high estimates of genotypic and phenotypic coefficient of variation and high heritability in broad sense along with high genetic advance in per cent of mean was recorded for panicle bearing tillers per plant and grain yield per plant, which indicated that these two traits would be ideal traits for improvement through selection in context of present material. Flag leaf area, panicle length, 1000-grain weight, biological yield per plant and plant height recorded moderate PCV and GCV along with high heritability and genetic advance in per cent of mean which suggested these five traits may provide considerable response to selection owing to their moderate variability and high transmissibility. Remaining characters had low to moderate GCV and PCV values or low to moderate heritability to emerge as poor indices of selection. The moderate estimates of GCV and PCV were exhibited by the characters *viz.*; plant height, panicle length, flag leaf area, 1000- grain weight, biological yield per plant and harvest

index while low estimates were found for the traits day to 50% flowering, spikelet per panicle and spikelet fertility.

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