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Research Article

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Genetic Variability Studies on Early Maturing Direct Seeded Rice (*Oryza sativa* L.) Genotypes for Yield Component Traits

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ABSTRACT

The experimental material for the present investigation consisted of an about 40 early maturing direct seeded rice genotypes were evaluated in a randomized block design with two replications at Agricultural Research Station, Gangavati during Kharif 2015. The analysis of variance revealed that for treatments i.e. mean sum of squares due to genotypes showed significant differences for all characters under studied i.e. field emergence, plant height, reproductive tiller number/plant, days to 50% flowering, grain filling duration, panicle length, panicle weight, filled and unfilled grains/panicle, test weight and grain yield/plant. The higher magnitude of PCV and GCV were recorded for filled grains per panicle and unfilled grains per panicle and it was moderate for number of reproductive tillers/plant, panicle weight. PCV and GCV were low for the characters like field emergence, plant height, days to 50% flowering, grain filling duration, panicle length. High heritability coupled with high genetic advance as per cent of mean was recorded for number of reproductive tillers/plant, panicle weight, number of filled grains, number of unfilled grains indicating the major role of additive gene action. Thus, these characters may serve as an effective selection parameter during breeding programme. High heritability coupled with moderate genetic advance as per cent of mean was recorded for plant height, grain yield/plant. Moderate heritability coupled with low genetic advance as per cent of mean was recorded for days to 50% flowering, grain filling duration, panicle length shows role of non additive gene action in the inheritance of these characters.

Key words: *Direct seeded rice, PCV, GCV.*

INTRODUCTION

Rice (*Oryza sativa* L.) is a unique grain used as human food and also as feed[22]. Globally, rice is cultivated an area about 161.40 million hectare and production of about 506.30 million tonnes with the productivity of 3.14 tonnes per hectare. In India, rice is being cultivated with an area of 44.8 million hectare and ranks second in production (104 million tonnes) next to china[3].

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The average yield of rice in India is 2.4 tonnes per hectare. Rice (*Oryza sativa* L.) is commonly grown by transplanting seedlings into puddled soil (wet tillage) in Asian countries. This production system is labor, water and energy intensive and is becoming less profitable as these resources are becoming increasingly scarce. It also deteriorates the physical properties of soil, adversely affects the performance of succeeding upland crops and contributes to methane emissions. These factors demand a major shift from puddled transplanting to direct seeding of rice (DSR) in irrigated rice ecosystems.

Direct seeding of rice refers to the process of establishing a rice crop from seeds sown in the field rather than by transplanting seedlings from the nursery.

There are three principal methods of direct seeding of rice (DSR):

- Dry seeding (sowing dry seeds into dry soil)
- Wet seeding (sowing pre-germinated seeds on wet puddled soils)
- Water seeding (seeds sown into standing water)

Dry seeding has been the principal method of rice establishment since the 1950s in developing countries. In recent years, there has been a shift from Transplanting rice (TPR) to DSR cultivation in several countries of Southeast Asia[19].

To date, no specific varieties have been developed for this purpose; however existing varieties used for TPR do not appear to be well-adapted for seedling growth in an initially oxygen-depleted microenvironment. As a result, farmers often resort to the costly practice of increasing the seeding rate for DSR by 2–3 times. New varieties suitable for DSR must be able to emerge and grow from a non-flooded soil[9].

In order to increase the area of cultivation and yield potential under water scarce area, it is essential to develop/ create a new plant type which is suitable for direct seeded rice condition system, it requires more efforts on the part of the plant breeder to understand the genetic background of the material being handled. Information on the nature and magnitude of variability among different genotypes under investigation help us to know the differential performance of genotypes under direct seeded condition

Several genetic parameters *viz.*, analysis of variance of each mean value, phenotypic and genotypic variances, phenotypic and genotypic coefficient of variation (PCV and GCV), broad sense heritability (h^2) and genetic gain as per cent of mean (GAM) on which the breeding methods are formulated for its further improvement. The extent of variability is measured by genotypic and phenotypic coefficient of variation which provides information about relative amount of variation present in different characters.

MATERIAL AND METHODS

The experimental material for the present investigation consisted of an about 40 early maturing direct seeded rice genotypes (110-125 days to maturity) were evaluated in a randomized block design with two replications at Agricultural Research Station, Gangavati during *Kharif* 2015, which is situated in the Northern Dry Zone of Karnataka between 15^{o}–15'40" North latitude and 76^{o} – 31'40" East longitude and at an altitude of 419 m above mean sea level. All the genotypes were sown separately in each experimental unit. The field experiment was taken up by using dibbling method of direct seed sowing into two replicated blocks of 4 m length and 1.6 m width with spacing of 20 x 15 cm. The recommended agronomic practices followed to raise good crop stand. The data were recorded on 5 randomly selected plants from each replication for various quantitative traits studied were *viz.*, field emergence, plant height (cm), reproductive tiller number/plant, days to 50% flowering, grain filling duration (days), panicle length (cm), panicle weight (g), filled and unfilled grains/panicle, test weight (1000 seeds), grain yield/ plant. Mean values were subjected to analysis of variance to test the significance for each character as per methodology advocated by Cochran and Cox[7].

PCV and GCV were calculated by the formula given by Burton and Devane[5], heritability by Allard[2] and genetic advance as percent mean was calculated by using the procedure given by Lush[18] and Johnson *et al.*[11] in order to estimate the genetic variation direct seeded rice genotypes.

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed that for treatments *i.e.* mean sum of squares due to genotypes showed significant differences for all characters under study at 1% level of significance and some traits like days to 50% flowering, grain filling duration showed significance at 5% level, suggesting that genotypes were genetically diverse for majority of the characters in early maturing direct seeded rice genotypes. These results were in conformity with the earlier findings of Kumar *et al.*[17].

The phenotypic of coefficient of variability indicating that wide range of variability was present for all the characters under studied. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits which may be due to interaction of genotypes with the environment[13]. Phenotypic and genotypic coefficient of variation (Table 2) were higher for filled grains per panicle and unfilled grains per panicle indicating more opportunity of selection for these characters and it was moderate for number of reproductive tillers/plant, panicle weight indicating moderate opportunity of selection for these characters and it was showed moderate PCV and low GCV for the characters like 1000 grain weight, grain yield/plant selection for these characters were not be efficient because variation mainly influenced by environment. Phenotypic and genotypic coefficient of variation were low for the characters like field emergence, plant height, days to 50% flowering, grain filling duration, panicle length indicating little opportunity of selection for these characters.

High coefficients of variability for characters like filled grains per panicle and unfilled grains per panicle observed. These findings are in close agreement with the findings of Krishna *et al.*[15]. Karthikeyan *et al.*[12], reported moderate amount of variability for reproductive tillers per plant and panicle weight. High coefficient of variability indicated that there is a scope of selection and improvement of these traits. Low values indicated the need for creation of variability either by hybridization or mutation followed by selection. Similar findings were also reported by Krishna *et al.*[15].

The proportion of genetic variability which is transmitted from parents to offspring is reflected by heritability[18]. Robinson *et al.*[21] viewed that the knowledge of heritability of a character is important to the breeder, as it indicates the possibility and extent to which improvement is possible through selection. It is a measure of genetic relationship between parents and their progeny and has been widely used in determining the degree to which a character may be transmitted from parents to offspring. High heritability is not enough to make efficient selection in the advanced generations unless it is accompanied by substantial amount of genetic advance Dinesh *et al.*[8]. Burton[4] pointed out that the heritability in combination with intensity of selection and amount of variability present in the population influences gains to be obtained from selection. Thus, genetic advance is yet another important selection parameter which although independent, represents the expected genetic advance under selection. According to Panse[20] if a character is governed by non-additive gene action, it may give high heritability but low genetic advance, whereas, if it is governed by additive gene action, high heritability along with high genetic advance provided good scope for further improvement. In the present study, high broad sense heritability estimates were obtained for the characters like field emergence, Plant height, Number of reproductive tillers/plant, Panicle weight, Number of filled grains, Number of unfilled grains, grain yield/plant indicating the major role of additive gene action in inheritance of these traits. The high broad sense heritability of these characters are in accordance with those of Chaudhary and Motiramani[6] for plant height, number of reproductive tillers/plant, number of filled grains, grain yield/plant. Broad sense heritability estimates was moderate for the characters like days to 50% flowering, grain filling duration, panicle length, 1000 grain weight. The moderate broad sense heritability of these characters is in accordance with those of Patil *et al*. for panicle length and days to 50% flowering.

High heritability alone does not guarantee large gain from selection unless sufficient genetic advance as per cent of mean (GAM) attributed to additive gene action is present. High heritability coupled with high genetic advance as per cent of mean was recorded for number of reproductive tillers/plant, panicle weight, number of filled grains, number of unfilled grains. These findings are in close agreement with the findings of Akinwale *et al.*[1]. High heritability coupled with moderate genetic advance as per cent of mean was recorded for plant height, grain yield/plant. These findings are in close agreement with the findings of Khare *et al.*[14]. Moderate heritability coupled with low genetic advance as per cent of mean was recorded for days to 50% flowering, grain filling duration, panicle length (cm). These findings are in close agreement with the findings of Gampala *et al.*[10]. High heritability coupled with low genetic advance as per cent of mean was recorded for field emergence. High heritability and low genetic advance suggesting greater role of non-additive gene action in their inheritance of these characters. Therefore heterosis breeding could be used to improve these traits.

Table 1: Analysis of variance (ANOVA) for different yield and yield related characters in early maturing rice genotypes

Source of .	Mean Sum of Squares											
	df	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
Genoty	39	54.23**	119.24**	7.77**	14.90*	5.08*	4.03**	0.49**	1152.35**	32.05**	11.03**	7.11**
Error	39	9.92	15.34	0.43	7.50	2.20	1.17	0.02	28.78	0.10	2.89	1.67
CV		3.69	4.29	5.78	3.24	4.96	5.08	5.25	4.59	3.98	7.20	6.98

**and* indicates Significance at 1 and 5% level respectively

X1: Field emergence X2: Plant Height (cm) X3: Reproductive tiller number /plant
X4: Days to 50% flowering X5: Grain Filling Duration X6: Panicle Length (cm)
X7: Panicle Weight (g) X8: Filled Grains/panicle X9: Unfilled Grains /panicle
X10: 1000 grain weight (g) X11: Yield/plant (g)

Table 2: Estimates of mean, range and other genetic parameters for different yield and yield attributing characters in early maturing rice genotypes

Sl. No	Character	Mean	Range		Variances		Coefficient of variation (%)		h^2bs (%)	GA	GAM (%)
			Min.	Max.	Phenotypic	Genotypic	PCV	GCV			
1	Field emergence	85.34	72.45	93.95	32.07	22.15	6.63	5.51	69	8.05	9.44
2	Plant height (cm)	91.28	77.70	110.30	67.29	51.94	8.98	7.89	77	13.04	14.29
3	Number of reproductive tillers/plant	11.35	8.50	18.15	4.10	3.67	17.84	16.88	89	3.73	32.89
4	Days to 50% flowering	84.38	78.00	89.50	11.20	3.70	3.96	2.27	33	2.27	2.69
5	Grain filling duration(days)	29.88	27.00	33.50	3.64	1.44	6.38	4.01	39	1.55	5.20
6	Panicle length(cm)	21.34	19.10	25.20	2.60	1.43	7.56	5.60	54	1.82	8.55
7	Panicle weight (g)	2.89	1.60	3.94	0.25	0.23	17.53	16.72	91	0.94	32.86
8	Number of filled grains	116.72	59.30	170.50	590.56	561.77	20.81	20.30	95	47.62	40.79
9	Number of unfilled grains	8.21	2.80	22.90	16.08	15.97	48.84	48.68	99	8.20	99.95
10	1000 grain weight (g)	23.64	16.60	30.96	6.96	4.06	11.16	8.53	58	3.17	13.42
11	Grain yield / plant (g)	18.54	15.62	22.20	4.39	2.71	11.30	8.88	61	2.66	14.39

PCV: Phenotypic coefficient of variation GCV: Genotypic coefficient of variation GA: Genetic advance
GAM: Genetic advance as per cent of mean h^2 bs: Heritability (Broad sense)

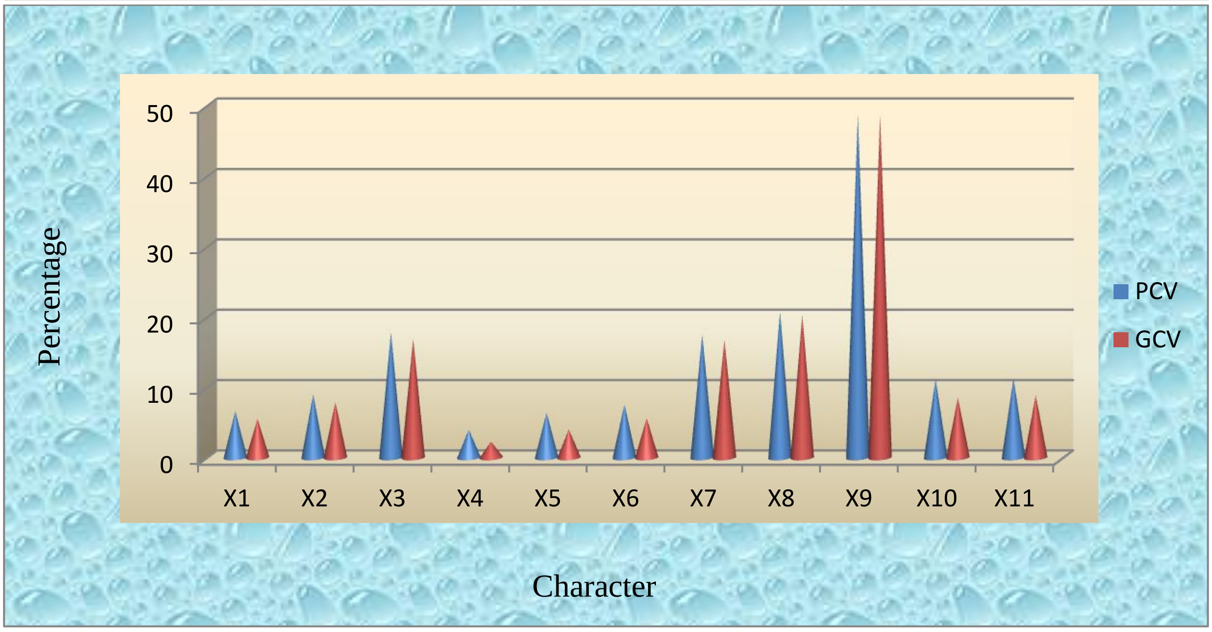

Fig. 1: Phenotypic and genotypic coefficient of variability for yield and yield attributing characters in Direct seeded rice genotypes

X1: Field emergence
X2: Plant Height (cm)
X3: Reproductive tiller number /plant
X4: Days to 50% flowering
X5: Grain Filling Duration
X6: Panicle Length (cm)
X7: Panicle Weight (g)
X8: Filled Grains/panicle
X9: Unfilled Grains /panicle
X10: 1000 grain weight (g)
X11: Yield/plant (g)

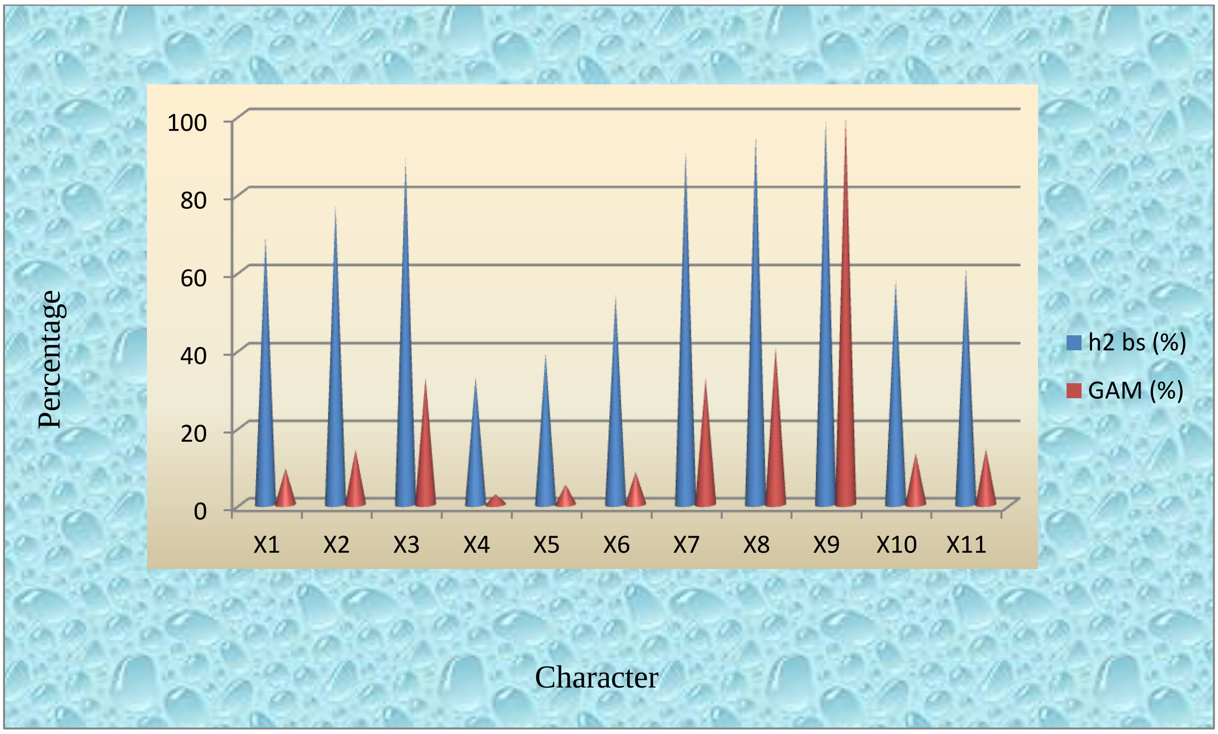

Fig. 2: Heritability and genetic advance as percent mean for yield and yield attributing characters in Direct seeded rice genotypes

X1: Field emergence
X2: Plant Height (cm)
X3: Reproductive tiller number /plant
X4: Days to 50% flowering
X5: Grain Filling Duration
X6: Panicle Length (cm)
X7: Panicle Weight (g)
X8: Filled Grains/panicle
X9: Unfilled Grains /panicle
X10: 1000 grain weight (g)
X11: Yield/plant (g)

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