Original Research Article

ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN HYBRID RICE (*Oryza sativa* L.)

ABSTRACT

The current study was conducted at the Indian Institute of Rice Research (IIRR) to look at the genetic characteristics for quantitative characters in 64 hybrid rice genotypes (*Oryza sativa* L.). For all of the characters, the analysis of variance indicated significant differences. The characters with the highest phenotypic and genotypic coefficients of variation were productive tillers per plant, filled grains per panicle, and single plant yield (GCV). Plant height, number of productive tillers per plant, number of filled grains per panicle, grain yield per plant, and test weight all had high heritability and genetic advance as a percent of mean, indicating the influence of additive gene action. As a result, simple selection could likely be effective for improving these traits.

Keywords: Genetic advance, GCV, PCV, Heritability, Hybrid rice.

INTRODUCTION

Rice (Oryza sativa L.) is the world's most important cereal crop, providing 60% of the world's dietary needs, 20% of calories, and 14% of protein. Rice will be consumed by 5 billion people, with a 38 percent increase in demand by 2030. Rice varieties with higher yield potential and greater stability must be developed to address this challenge (Khush, 2006). One method for dealing with the enormous challenge given by ever-increasing populations is to use hybrid rice technology. Hybrid rice types outperform traditionally grown current kinds by 1.0 to 1.5 tonnes per hectare (20 to 30%). China was the first to develop, followed by India, which released the first rice hybrid in 1994 (Janaiah and Hussian, 2003). In order to breed hybrid rice, top parental lines must be developed in either a three-line or two-line system. To generate high-yielding, high-quality varieties, information on the variability and genetic factors of grain quality traits, as

well as their relationships with one another, including grain yield, is needed to establish appropriate breeding techniques for grain quality improvement. An attempt has been made in this study to elucidate information on the type and magnitude of genetic variation identified in certain parents and rice hybrids for yield and yield components.

The phenomena of heterosis is used to create hybrid rice. Heterosis, often known as hybrid vigour, is a phenomenon in which an F1 hybrid outperforms its parents. The value of heterosis in rice for yield and its component features has been reported by Reddy *et al*., (2012) and Gnanamalar and Vivekanandan (2013). The effectiveness of any breeding programme is determined by the selection of appropriate parents for hybridization. The most deserving parental lines are chosen as part of the hybrid rice breeding effort.

MATERIAL AND METHODS

The experiment was carried out at the Indian Institute of Rice Research (IIRR) Farm in Rajendranagar, Hyderabad, in the month of *Kharif* in 2018. The experiment site is 543 metres above mean sea level (MSL), with a geographic bearing of 780231 E longitude and 170191 N latitude. A total of 64 hybrid rice genotypes were included in the materials. The experimental material was planted in a two-replication randomised block configuration. Twenty-one-day-old seedlings were transplanted at a distance of 20 centimetres between rows and 15 centimetres inside each row. Urea, single superphosphate, and muriate of potash were used to deliver a recommended nutritional dose (120:60:40 kg NPK ha-1). Throughout the crop's growing phase, proper soil moisture was maintained. The study included observations such as days to 50% flowering, plant height, panicle length, pollen fertility, number of productive tillers per plant, number of filled grains per panicle, spikelet fertility percentage, 1000 grain weight and grain yield per plant, and per day productivity from five randomly selected plants from each row. The analysis of variance was carried out with the aid of computer software. Version 9.2 of the WINDOWS STAT PACKAGE. Falconer's method was used to compute the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) (1981). Allard's formula was used to calculate heritability (h2) in a broad sense (1960). Burton's formula was used to determine estimates of genetic advance (GA) based on heritability (1952).

RESULTS:

For all of the characters, the analysis of variance indicated significant differences (Table 1). According to Sivasubramanian and Madhava menon, the range of variation estimations were classified as low (less than 10%), moderate (10-20%), and high (more than 20%). (1973). The characters productive tillers per plant (26.31 and 27.76), filled grains per panicle (41.30 and 41.67), and single plant yield (38.29 and 38.82) had high genotypic and phenotypic coefficients of variation (Table 2 and figure 1), while plant height (18.78 and 19.19), panicle length (10.05 and 11.50), and test weight (16.18 and 16.33) had moderate genotypic and phenotypic coefficients of variation (5.96 and 8.04). Johnson *et al*. suggested categorising heritability (h2) estimates as low (0-30 percent), medium (30-60 percent), and high (>60 percent) in a broad sense (1955). Days to 50 percent flowering (96.2 percent), plant height (95.8%), productive tillers per plant (89.9%), panicle length (76.3 percent), pollen fertility (97.9%), filled grains per panicle (98.2%), test weight (98.1 percent), and grain yield per plant had the highest heritability (Table 2 and figure 2). (97.3 percent). The heritability of spikelet fertility (55%) was moderate.

Johnson *et al*. defined the range of genetic advance as a percentage of the mean as low (less than 10%), moderate (10-20%), and high (more than 20%). (1955). Plant height (37.89), productive tillers per plant (51.38), full grains per panicle (84.33), test weight (33.01), and grain yield per plant had the highest genetic gain as a percentage of the mean (Table 2 and picture 2). (77.80). Days to 50% blooming (14.48), panicle length (18.09), and pollen fertility all showed moderate genetic progress as a percentage of the mean (15.23). Spikelet fertility (9.10) was low in terms of genetic progress as a percentage of the mean.

Plant height, number of productive tillers per plant, number of filled grains per panicle, grain yield per plant, and test weight all had high heritability and genetic advance as a percent of mean, indicating the influence of additive gene action. As a result, simple selection would likely be effective for improving these traits.

Pollen fertility, Days to 50% flowering and panicle length showed high heritability with moderate genetic advance as percent of mean, whereas spikelet fertility showed medium heritability with low genetic advance as percent of mean, indicating the influence of non-additive gene action and selection may be ineffective.

The experimental material was discovered to have a significant amount of variability in the current study. As a result, the traits with a high variability value combined with a high heritability and genetic progress should be examined for direct selection. GCV, PCV, Heritability, and Genetic Advance as a percent of mean were all high for the characters productive tillers per plant, full grains per panicle, and single plant yield. As a result, these characters should be selected for direct selection.

Table.1. Analysis of variance for yield and its component traits in hybrid rice

Source of variation	df	DFF	PH	PT	PL	PF	SF	GPP	TW	SPY
Replication	1	0.031	42.51	3.92	0.54	0.002	82.35	1.59	0.72	6.47
Treatments	63	92.63***	758.96***	19.55***	12.16**	87.16***	74.87***	4994.19***	22.91**	153.61***
Error	63	1.78	16.13	1.04	1.64	0.94	21.75	44.47	0.220	2.12
Total	127	46.83	384.83	10.24	6.87	43.70	48.58	2499.51	11.48	77.30
General mean		94.04	102.57	11.56	22.87	87.80	86.42	120.43	20.81	22.73
CV (%)		1.46	3.91	8.83	5.66	1.10	5.39	5.53	2.25	6.41

1. Days to 50% flowering 2. Plant height (cm) 3. productive tillers per plant

4. Panicle length (cm) 5. Pollen fertility (%) 6. Spikelet fertility (%)

7. Filled grains per panicle 8. Test weight 9. Single plant yield

Table 2. Genotypic and phenotypic coefficient of variance (GCV and PCV), Heritability

Characters	Coefficient of variability		Heritability (%) broad sense	Gen. Adance as percent of mean (at 5%)
	GCV%	PCV%		
Days to 50% Flowering	7.16	7.30	96.2	14.48
Plant Height (cm)	18.78	19.19	95.8	37.89
No. of productive tillers per plant	26.31	27.76	89.9	51.38
Panicle Length (cm)	10.05	11.50	76.3	18.09
Pollen Fertility (%)	7.47	7.55	97.9	15.23
Spikelet Fertility (%)	5.96	8.04	55	9.10
Number of filled grains per panicle	41.30	41.67	98.2	84.33
1000 grain weight (g)	16.18	16.33	98.1	33.01
Single plant yield (g)	38.29	38.82	97.3	77.80

(h^2) and genetic advance as percent of mean for different character

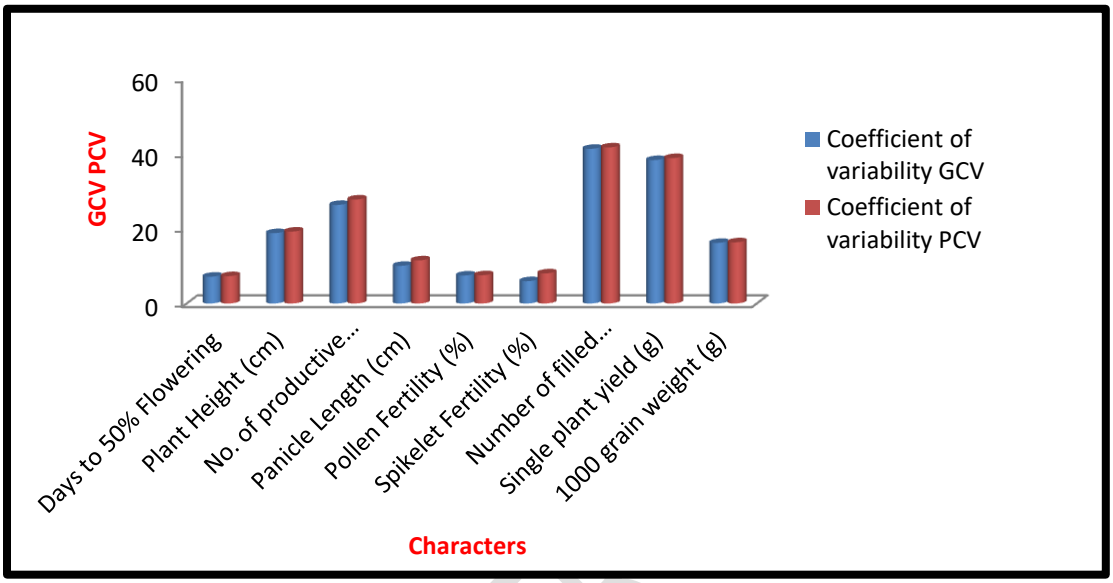

Fig 1. Graphical representation of GCV and PCV for yield and attributing traits in hybrid rice

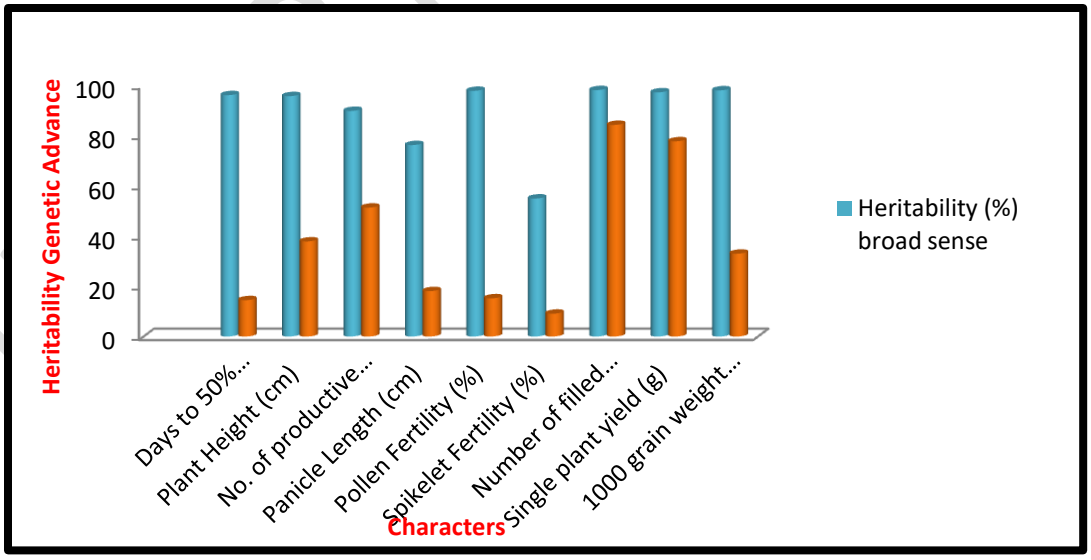

Fig 2. Graphical representation of heritability and genetic advance for yield and yield attributing traits in hybrid rice

DISCUSSION

The present findings of low GCV and PCV for days to 50% blooming were consistent with Padmaja et al. (2008) and Rita et al. (2009) findings, as well as Rohit *et al.* (2009) findings on spikelet fertility and pollen fertility (2017). In line with Prasad et al. (2001) and Padmaja et al. (2001), similar results for high GCV and PCV were seen for productive tillers per plant, full grains per panicle, and single plant yield (2008). For panicle length, there was moderate GCV and PCV, and the test weight results were consistent with venkatesan et al (2017).

Prasad *et al*. (2001) and Padmaja *et al.* (2008) found similar results for high heritability combined with high genetic advance as percent of mean for productive tillers per plant, full grains per panicle, test weight and grain yield per plant, and plant height (2008). Seyoum et al. found high heritability with moderate genetic progress as a percent of mean for days to 50% flowering and panicle length (2012). Seyoum *et al.* (2012) and Rohit *et al.* (2012) found moderate heritability with low genetic progress as a percent of mean for spikelet fertility (2012).

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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