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Research article

EFFECT OF ENVIRONMENT ON GENETIC PARAMETERS OF HYBRID RICE

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ABSTRACT : Field experiments were conducted using 68 hybrids, 17 parents and four checks across two different agroclimatic zones of Andhra Pradesh, South India during Kharif, 2008 and rabi-2008-09 to estimate the genetic variability parameters for yield and yield contributing characters. Pooled analysis over the environments, genotype and environment interactions were significant for traits like panicle weight, flag leaf length, flag leaf width, productive tillers per plant, filled grains per panicle, 1000 grain weight and grain yield per plant, implies differential behavior of genotypes under the four environments for these characters. The estimates of phenotypic coefficient of variation (PCV) were slightly higher than those of genotypic coefficient of variation (GCV) for all the traits studied across the seasons. Slight differences were observed for all the characters with regard to variability coefficients, heritability and genetic advance % of mean in different environments. Panicle weight, flag leaf length, flag leaf width, grains per panicle, yield per plant, 1000 grain weight and productivity per day were recorded moderate to high GCV, PCV, heritability, genetic advance % of mean, characters could be transmitted to the progeny and phenotypic based selection would be effective.

Key Words: Genetic parameters, hybrid rice, seasons

INTRODUCTION

Creation of genetic variability and selection for important traits is crucial activities that any plant breeder should apply to achieve better yield and other desirable agronomic traits. However, to carry out effective selection, the information on available genetic variation among genotypes, the nature of component traits on which selection would be effective and the influence of environmental factors on each trait need to be known. Effective selection not only depends on estimation of genetic variation among genotypes but also on the proportion of heritable variation and the expected genetic gain that would be obtained. Variation is the basis for plant breeding and it is the occurrence of differences between individuals due to variation in their genetic composition and/or the environment in which they are grown (Falconer and Mackay, 1996). A major factor limiting the rate of progress in plant breeding has been low heritability of quantitative traits such as yield. Heritability in broad sense estimates the ratio of total genetic variance, including additive, dominance and epistatic variance to the phenotypic variance (Falconer and Mackay, 1996). The most important function of the heritability in the genetic study of quantitative characters is its predictive role to indicate the reliability of the phenotypic value as a guide to breeding value (Falconer and Mackay, 1996 and Dabholkar, 1992). Characters not greatly influenced by the environment usually have a high heritability. This may influence the choice of selection procedure used by the plant breeder to decide which selection method would be most useful to improve the character to predict the gain from selection and to determine the relative importance of genetic effects (Poehlman and Sleper, 1955). To design an effective selection strategy for the utilization of the existing breeding materials, the knowledge on the extent of variation, heritability of the trait and genetic gain is important. Therefore, this study was conducted to estimate the extant of genetic variability, heritability, expected genetic advance and to identify the important traits for selection of superior genotypes.

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MATERIAL AND METHODS

The sum of 68 F_1 hybrids along with 21 parents (4 CMS B lines, 17 restorers) and four checks (two hybrids *viz.,* DRRH-2 and PSD-3 and two varieties *viz.,* MTU-1010 and JGL-1798) were transplanted in randomized block design in two replications with a spacing of 20 x15 cm during *kharif*, 2008 and 15x15 cm during *rabi,* 2008-09 at Regional Agricultural Research station, Jagtial for Northern Telangana Agro climatic zone and Agricultural Research Station, Kampasagar Southern Telangana Agro climatic zone. Crossed seed of hybrids were treated with Carbendazim solution (0.1%) and directly sown in earthen pots filled with mud. Satisfactory germination was observed on the 4th and 5th day of sowing. Care was taken to avoid water logging and complete drying up of pots. During *rabi* pots were covered with polythene sheet to avoid the cold injury during the nights. Top dressing was given with urea and need based plant protection was under taken for raising healthy and vigorous seedlings. Such healthy, strong and vigorous seedlings of 28 days old were used for transplanting in the main field. During both the seasons, single seedling was transplanted in the main field and each entry was planted in two rows of 1.8 m length. All necessary recommended package of practices of ANGRAU were followed to raise a healthy crop. At flowering and maturity stages, observations recorded on twelve characters.

Statistical analysis: Data obtained from the four environments were subjected to pooled analysis of variance as per Panse and Sukhatme (1985). Genetic parameters were calculated by pooling data both locations for Kharif and rabi saparetly. The genotypic and phenotypic coefficients of variation were calculated as per formula suggested by Burton and Devene (1953). Heritability (broad sense) as per Honson *et al.* (1956) and genetic variance as per Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Analysis of variance

In the present investigation, 93 genotypes including 68 hybrids, 21 parents and four checks were subjected to pooled analysis of variance for twelve characters (Table 1). The analysis of variance of stability revealed, that the genotype and environments were significant for all the traits studied except for flag leaf length, productive tillers per plant, filled grains per panicle and productivity per day for genotype, indicating the diversity among the genotypes and environments studied. The genotypes and environment interactions were significant for traits like panicle weight, flag leaf length, flag leaf width, productive tillers per plant, filled grains per panicle, and 1000 grain weight and grain yield per plant. Significance of genotype x environment interactions implies differential behavior of genotypes under the four environments as also revealed by, Deshpande and Dalvi (2006) Saidaiah et al., (2011) and Sridhar et al., (2011).

Table 1: ANOVA for yield and yield components for stability in rice

Source	Genotype	Environment	Geno. x Envi.	Pooled error
df	92	3	276	368
Days to 50% flowering	57.51**	549.94**	21.6	2.85
Plant height (cm)	112.42**	21574.23**	44.28	1.59
Panicle length (cm)	7.70**	637.17**	3	1.23
Panicle weight (g)	0.38**	47.69**	0.25**	0.02**
Flag Leaf length (cm)	12.07	27.36**	1392.50**	12.05**
Flag Leaf width (cm)	0.06**	0.05**	2.63**	0.01**
Productive tillers per Plant	1.28	3.76**	135.12**	1.71**
Spikelet Fertility (%)	160.92**	641.34**	50.93	3.17
Filled grains per Panicle	85.79	1035.53**	58236.89**	336.51**
Grain yield per Plant (g)	18.20**	806.60**	12.93	1.25
1000 Grain weight (g)	1.06**	0.63**	5.47**	0.21**
Productivity per Day (kg/ha)	113.35	1860.37**	88.61	11.75

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Genetic parameters

Analyses of genetic parameters were compared for all characters in both seasons and locations illustrated in table 2. The estimates of phenotypic coefficient of variation (PCV) were slightly higher than those of genotypic coefficient of variation (GCV) for all the traits studied across seasons. Mufa and lsheikh (2007), Kolet al., (2008) and Mulugeta Syoum et al., (2012) also reported slight difference indicated minimum environmental influence and consequently greater role of genetic factors on the expression of traits. In contrary to the present study which showed close values between GCV and PCV Akinwale *et al*., (2011) and Sadeghi (2011). GCV values ranged from 3.78 (panicle length) to 23.91 (grains per panicle) during kharif and 4.72 (days to 50% flowering) to 32.74 (grains per panicle. GCV and PCV estimates classified as low (0-10%), moderate (10-20%) and high (>20%) classified by Johnson et al., (1955). Moderate to high GCV and PCV values recorded for the traits viz., panicle weight, flag leaf length, flag leaf width, grains per panicle, yield per plant, 1000 grain weight and productivity per day, indicating the presence of high level of genetic variability for these characters over seasons and locations. Days to 50% flowering, plant height, panicle length and spikelet fertility were registered low to medium GCV and PCV values over the environments. Singh et al., (2011) and Venkata Subbaiah et al., (2011) were also reported moderate to high GCV and PCV values for most of the yield contributing traits. Low to moderate values for days to 50% flowering, plant height, panicle length also reported by Prajapathi et al., (2011), Singh et al., (2011) and Ananadarao et al., (2011). Panicle weight, flag leaf length, flag leaf width, grains per panicle, yield per plant, 1000 grain weight and productivity per day had have moderate to high GCV and PCV values, indicating the good scope for yield improvement through phenotypic selection.

Table 2: Mean, variability, heritability and genetic advance for yield and yield contributing traits in hybrids and their parents in rice

Genetic parameters	Seasons	Locations	Days to 50% Flowering	Plant Height (cm)	Panicle Length (cm)	Panicle Weight (g)	Flag Leaf Length (cm)	Flag Leaf Width (cm)	Productive Tillers/ Plant	Spikelet Fertility (%)	Grains/ Panicle	Yield/ Plant (g)	1000 Grain Weight (g)	Productivity/ Day (g)
GCV (%)	Kharif	Jagtial	5.97	8.00	3.78	14.73	9.70	11.62	15.87	7.88	17.70	16.97	10.50	17.54
		Kamasagar	6.35	7.66	8.22	18.91	10.02	11.62	14.37	9.88	23.91	23.01	10.46	22.05
	Rabi	Jagtial	5.04	8.31	8.41	20.99	19.17	12.5	18.13	12.11	30.41	15.57	11.51	17.89
		Kamasagar	4.72	11.59	8.97	19.88	18.47	12.54	14.76	12.20	32.74	20.32	11.51	20.56
PCV (%)	Kharif	Jagtial	6.14	8.22	7.45	15.84	11.16	12.55	18.50	8.01	19.80	17.58	10.71	18.21
		Kamasagar	6.66	7.84	9.34	19.58	11.62	12.93	19.13	10.19	25.00	24.54	11.80	25.16
	Rabi	Jagtial	5.16	8.98	12.07	22.99	23.36	13.45	21.17	12.91	31.71	18.43	12.94	21.31
		Kamasagar	6.29	11.68	12.10	21.94	23.23	13.65	17.98	12.60	33.88	23.38	12.93	23.52
h^2 (Broad Sense) (%)	Kharif	Jagtial	0.95	0.95	0.26	0.86	0.76	0.86	0.74	0.97	0.80	0.93	0.96	0.93
		Kamasagar	0.91	0.96	0.77	0.93	0.74	0.81	0.56	0.94	0.91	0.88	0.79	0.77
	Rabi	Jagtial	0.96	0.86	0.49	0.83	0.67	0.95	0.73	0.88	0.92	0.71	0.79	0.70
		Kamasagar	0.56	0.98	0.55	0.82	0.63	0.92	0.67	0.94	0.93	0.76	0.79	0.76
Genetic Advancement 1%	Kharif	Jagtial	14.05	20.00	1.25	1.31	6.54	0.38	3.25	17.47	56.34	9.71	6.37	21.95
		Kamasagar	15.17	19.81	4.84	1.54	6.78	0.37	2.77	20.62	68.26	10.94	5.92	20.70
	Rabi	Jagtial	12.53	13.68	3.06	1.13	3.21	0.38	8.80	24.51	59.27	5.45	5.97	20.09
		Kamasagar	9.10	24.57	3.81	1.04	2.74	0.38	9.03	24.61	58.28	7.94	5.97	22.54
Gen.Adv as % of Mean 1%	Kharif	Jagtial	15.34	20.57	5.05	36.14	22.26	28.38	35.97	20.47	41.77	43.24	27.20	44.61
		Kamasagar	15.98	19.78	19.07	48.19	22.81	27.57	28.50	25.27	60.38	56.98	24.49	51.01
	Rabi	Jagtial	13.03	20.29	15.48	50.59	41.53	29.42	40.97	29.98	77.02	34.72	27.05	39.64
		Kamasagar	9.36	30.35	17.55	47.53	38.76	28.45	31.98	31.17	83.51	46.65	27.06	47.43

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GCV values only are not enough to determine the genetic variability, this could be done with the help of heritability and genetic advance estimates to assess the heritable portion of total variation and extent of genetic expected gain for selection. Rabinson et al., (1949) classified the heritability estimates as low (0-30%), moderate (30-60%) and High (>60%). In the estimates of broad sense heritability were ranged from 26% for panicle length (Kharif, Jagtial 0 to 98% for plant height (rabi, Kampasagar). Slight differences were observed for all the characters over seasons with regard to heritability. High heritability exhibited for all the characters studied except panicle length, suggest that high component of heritable portion of variation that can be exploited by breeders in the selection of superior genotypes on the basis of phenotypic performance. More than 80% heritability estimates recorded for plant height, panicle weight, flag leaf width, spikelet fertility and grains per panicle. Rita Binse et al., (2009), Verma (2010), Venkata Subbaiah et al., (2011) and Ananadarao et al., (2011) also reported high heritability for most of the yield contributing traits. Since high heritability does not always indicate high genetic gain, heritability with genetic advance should be used in predicting selection of superior genotypes (Ali et al., (2002). In this study high to medium genetic advance as % mean estimates were obtained for all the traits across the seasons, ranged from 5.05 (Kharif, Jagtail) to 83.51 (Rabi, Kampasagar. Across the seasons, high heritability coupled with high genetic advance % mean obtained for the most of yield contributing traits like days 50% flowering, plant height, panicle weight, flag leaf lent and width, spikelet fertility, grains per panicle, 1000 grain weight and productivity per day. These traits could be considered as favourable attributes and as an indication of additive gene action and the consequent high extended genetic gain from selection of superior genotypes. Similar results also reported by Venkata Subbaiah et al., (2011) and Mulugeta Syoum et al., (2012). Moderate to high GCV, PCV, heritability, genetic advance % of mean values were obtained for the panicle weight, flag leaf length, flag leaf width, grains per panicle, yield per plant, 1000 grain weight and productivity per day suggested these characters could be transmitted to the progeny when hybridization would be conducted and phenotypic based selection would be effective.

CONCLUSION

In the present investigation, genotypes and environment interactions were significant for traits like panicle weight, flag leaf length, flag leaf width, productive tillers per plant, filled grains per panicle, and 1000 grain weight and grain yield per plant. Significance of genotype x environment interactions implies differential behavior of genotypes under the four environments. The estimates of phenotypic coefficient of variation (PCV) were slightly higher than those of genotypic coefficient of variation (GCV) for all the traits studied across seasons indicating minimum environmental influence and consequently greater role of genetic factors on the expression of traits. Slight differences were observed for all the characters with regard to variability coefficients, heritability and genetic advance % of mean in different seasons. Panicle weight, flag leaf length, flag leaf width, grains per panicle, yield per plant, 1000 grain weight and productivity per day were recorded moderate to high GCV, PCV, heritability, genetic advance % of mean, suggested these characters could be transmitted to the progeny when hybridization and phenotypic based selection is effective.

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