



Research Article

Genotype x Environment interaction and stability analysis for grain yield and its components in Halugidda local rice mutants

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Abstract:

The genotype (G) x environment (E) interaction and stability for grain yield and some associated traits was studied during the year 2002-2006 in eight Halugidda local rice mutants in the hill zone of Karnataka. Significant G x E interaction was observed for all the traits studied. The pooled deviation was significant for the majority of the traits including grain yield and considerable genotypic difference was observed. Both the linear and non-linear components of G x E interaction were significant, but the linear component was more predominant. Based on the stability parameters, rice mutants HSM-23 and HSM-27 showed higher grain yield over the population mean, with regression coefficient near unity and zero deviation from regression. Thus, they were found to be stable and may be recommended for the commercial cultivation in this region/ zone of Karnataka.

Key words:

Rice, Stability analysis, Genotypes x Environment, Halugidda local

Introduction

Rice (*Oryza sativa* L) is grown over an area of 2.85 lakh hectares in eight districts. Rice is cultivated in hill zone of Karnataka mainly during rainfed situation in *kharif* season as mono crop in three different topographical situations *viz.*, low, mid and uplands. Several local cultivars are being cultivated in nearly 30 per cent of the area owing to their local preference despite the drawbacks such as tall plant type, highly susceptible to lodging under high fertility conditions resulting in heavy grain loss and quality beside susceptibility to blast disease. The different genotypes are widely varied over the years due to their unstable yield performance in this zone. It is necessary to test different genotypes in the target environment in order to evolve suitable and stable rice genotypes. Information on the G x E interaction and stability parameters provides a better measure of stable variety and the varietal adaptability.

The present study was conducted to assess the local rice mutants of Halugidda local for their yield stability across the environments.

Material and Methods:

The rice mutants (HSM-1, HSM-15, HSM-16, HSM-19, HSM-20, HSM-21, HSM-23 and HSM-29) were developed through mutation breeding method using Gamma irradiation of Landrace Halugidda Local during 1995-1996 at Zonal Agricultural Research Station, Mudigere, Karnataka. Eight rice mutants along with HS-local and Hemavathi were evaluated in low land situation during *kharif* 2002 to 2006 at ZARS, Mudigere. Nursery sowing was taken up in the 1st week of June and planting (2-3 seedling hill⁻¹) of seedlings was done in the 1st week of July. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Seedlings aged 25-30 days were transplanted at a spacing of 10 cm within rows spaced at 20 cm. Recommended dosage of 'P' and 'K' along with 50% of 'N' (75:75:90 kg NPK/ha) was applied at the time

of planting and 25% of 'N' was top dressed twice-once at 30 and again at 60 days after transplanting. Observations on plant height (cm.), days to 50% flowering, panicle length (cm.), panicle number per plant and grain yield (Kg/Plot) were recorded at maturity. The mean values for all the traits across the environments were subjected to stability analysis (Eberhart and Russell, 1966).

Results and Discussion

The pooled analysis of variances over the three years (2002-2006) showed that the genotype (G) and environment (E) differences tested were significant for days to flowering, plant height and grain yield studied (Table 1), indicating the presence of wide variability among the genotypes. The G x E interaction when tested against the pooled error was significant for all the traits, indicating that the major portion of interaction was linear in nature and prediction over the environments was possible (Satit *et al.*, 2000 and Sarawgi *et al.*, 2000). The pooled deviation when tested against pooled error was significant for most of the traits, including grain yield, suggesting considerable genotypic differences for these traits. Both the linear and non-linear components were significant for the grain yield. Similar findings were reported earlier by Kulkarni *et al.*, 2000 and Senapati *et al.*, 2002. Eberhart and Russell (1966) emphasized the need of considering both the linear and non-linear components in assessing the stability of genotypes. They also suggested to consider both the linear regression coefficient and deviation from regression for phenotypic stability. The data on the three stability parameters, mean performance (xi), regression coefficient (bi) and deviation from regression (S^2d_i) for different traits are presented in Table-2. Four rice mutants (HSM-1, HSM-16, HSM-19 and HSM-21) exhibited significant deviation from regression for grain yield. The deviation from regression for days to flowering was significant in the local rice mutants viz., HSM-15, HSM-16, HSM-19, HSM-20, HSM-21, and HS-local whereas, HSM-1 showed unit regression and low S^2d_i value. For plant height, all the rice mutants along with HS-Local and Hemavathi showed significant deviation from regression. However they showed non significant deviation from regression for the number of panicles per plant. For panicle length, all the genotypes showed significant deviation from regression. HSM-19 exhibited unit regression value for panicle length. Any generalization regarding the stability of a genotype for all the traits is quite difficult. The genotypes used

in this study did not exhibit a uniform stability and response pattern for different traits. The two attributes appeared to be specific for the individual traits for a given genotype. Eberhart and Russell (1966) suggested that, if the traits associated with high yield show stability, the selection of genotype only for yield could be effective. A non-significant correlation between the deviation from regression (S^2d_i) and mean performance (xi) or regression coefficient (bi) indicated that these stability parameters might be under the control of different genes located on different chromosomes (Reddy and Chaudhary, 1991 and Singh *et al.*, 1995).

Based on the individual stability parameters, the rice mutants HSM-23 and HSM-27 exhibited higher grain yield over the population mean, with regression coefficient near unity and zero deviation from regression, indicating their average stability (De *et al.*, 1990, De *et al.*, 1992; Dushyantha Kumar and Shadakshari, 2008). Thus, it is concluded that the rice mutants HSM-23 and HSM-27 were ideally adaptable and stable and could be recommended for multi location trials in this zone or region of Karnataka.

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Table 1: Analysis of variance for stability performance for grain yield and associated traits in Halugidda rice mutants.

Sources	DF	Mean sums of squares				
		Days to 50% flowering	Plant height (cm)	Panicle No.	Panicle length (cm)	Grain yield (Kg/Plot)
Varieties	9	262.25 ^{aa}	875.31 ^{aa}	0.4119	5.626	0.0854
Environments	4	250.61 ^{aa}	128.15	0.3247	8.269	0.7848 ^{aa}
Variety x environments	36	38.01 ^{**}	129.65 ^{**}	0.2839 [*]	5.718 ^{**}	0.0283 ^{**}
Env + (Var x Env)	40	19.75	43.16	0.096	1.991	0.0346
Env (Linear)	1	334.14 ⁺⁺	170.87 ⁺	0.4329 ⁺	11.02 ⁺	1.0464
Var x env (Linear)	9	11.92	38.87 ⁺	0.1111	1.6971	0.0054
Pooled deviation	30	11.62 ^{**}	31.19 ^{**}	0.0802	1.7781 ^{**}	0.0097 ^{**}
Pooled error	72	0.68	0.6514	0.1394	0.0966	0.0027

aa Significant at and P=0.01 when tested against the G x E interaction.

+ and ++ Significant at P=0.05 and P=0.01 respectively when tested against pooled deviation.

* and ** Significant at P=0.05 and P=0.01 respectively when tested against pooled error.



Table 2: Stability parameters for days to 50% flowering, plant height, panicle number, panicle length and grain yield.

Mutants	Days to 50% flowering			Plant height			Panicle number			Panicle length (cm)			Grain yield (kg/plot)		
	X	Bi	S ² di	X	Bi	S ² di	X	Bi	S ² di	X	Bi	S ² di	X	Bi	S ² di
HSM-1	141.66	1.00	1.21	131.90	2.83	17.18**	5.80	1.94	0.12	21.91	1.91	2.21**	1.12	1.54	0.015**
HSM-15	146.73	0.75	2.67**	124.53	-0.067	65.12**	5.66	2.08	-0.057	21.97	1.10	0.72**	1.27	1.09	0.005
HSM-16	142.33	1.96	6.40**	123.85	2.08	1.67*	5.86	1.13	-0.012	22.71	0.63	6.37**	1.20	1.04	0.013*
HSM-19	145.73	1.40	11.09**	129.35	2.18	1.56*	6.00	2.70	0.001	20.99	1.01	0.44**	1.23	0.83	0.014*
HSM-20	149.20	0.17	11.32**	122.8	2.18	24.05**	5.68	0.12	-0.130	21.32	2.25	0.44**	1.31	1.12	0.002
HSM-21	146.93	1.19	37.93**	132.74	3.82	49.95**	6.05	1.93	-0.094	22.99	2.13	1.63**	1.24	0.95	0.008**
HSM-23	144.00	0.23	0.11	130.56	2.09	27.26**	5.96	-1.47	-0.077	22.08	2.53	0.60**	1.25	0.88	-0.001
HSM-27	142.60	1.38	0.57	130.56	1.44	5.38**	5.89	-2.01	-0.069	21.89	-1.06	2.62**	1.20	0.96	-0.001
HS-Local	147.40	1.49	36.57**	143.05	-0.40	43.21**	5.72	1.56	-0.081	22.51	-0.04	0.83**	1.07	0.87	0.005
Hemavathi	134.53	0.39	1.36	114.15	-1.80	70.06**	6.16	2.01	-0.083	21.64	-0.53	0.94**	1.09	0.71	0.010**
Mean	144.11			128.36			5.88			22.00			1.12		

* and ** Significant at P-0.05 and P-0.01 respectively, bi-regression coefficient and S²di-deviation from the regression.