

Stability Analysis of Grain Yield and its Components in Rice (*Oryza sativa* L.) Genotypes

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Abstract

The Genotype (G) x Environment (E) interaction and stability for grain yield and associated traits were studied for 13 rice genotypes in five environments from *kharif* 2007 to *kharif* 2011. The stability analysis showed significant differences among genotypes for all the traits studied including grain yield. The linear component of environment was significant for all the characters and the pooled deviation was significant for plant height, productive tillers/plant, panicle length and test weight. Based on the stability parameters, BPT 2411 followed by BPT 2409 and BPT 2295 showed higher grain yield over the mean with regression coefficient near unity and non significant deviation from regression. Thus they found to be stable and may be recommended for commercial cultivation in this region.

Key words: Stability, regression, yield components

Rice is one of the main sources of food in the world where the increased demand for rice is expected to enhance production in many parts of Asia, Africa and Latin America (Subathra Devi *et al.*, 2011). Yield is a complex character which is dependent on a number of other characters and is highly influenced by many genetic factors as well as environmental fluctuation. For stabilizing yield, it is necessary to identify the stable genotypes suitable for wide range of environments. Stability of a cultivar refers to its consistency in performance across environments and is affected by the presence of genotype and environment interaction (Sharma *et al.*, 1987). Wider adaptability and stability are prime considerations in formulating efficient breeding programme. Stability analysis is a good technique for measuring the adaptability of different crop varieties to varying environments (Morales *et al.*, 1991). Therefore, the present study was undertaken to estimate the G X E interactions through stability parameters and performance of

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some other characters of 13 rice genotypes across environments and to identify suitable genotypes for future breeding programme.

Materials and Methods

The experimental material comprised of 13 rice genotypes including five released varieties *viz.*, Samba Mashuri (BPT 5204), Sona Mashuri (BPT 3291), Bapatla Sannalu (BPT 1768), Bhavapuri Sannalu (BPT 2270) and Akshaya (BPT 2231) along with eight pre-released cultures (BPT 2295, BPT 2403, BPT 2405, BPT 2406, BPT 2408, BPT 2409, BPT 2411 and BPT 2425) developed at Rice Research Unit (RRU), Bapatla. The pedigree and the physical grain quality characters of the genotypes were given in Table 1. The genotypes were evaluated in low land situation during five consecutive *kharif* seasons from 2007 to *kharif* 2011 at Rice Research Unit, Bapatla. The experiment was laid out in Randomised Block Design with three replications. Seedlings aged 25-30 days were transplanted at a spacing of 20 x15 cm between and within the rows respectively and the plot size was 7.2 m². All the recommended cultural practices were adopted to raise the crop. Observations on days to 50 % flowering, plant height, productive tillers/plant, panicle length, test weight and grain yield/plant were recorded

at maturity. The mean values for all the traits across the seasons were subjected to stability analysis (Eberhart and Russel, 1966).

Results and Discussion

The results of the combined analysis of variance after Eberhart and Russell model are presented in Table 2. Partitioning of mean sum of squares into that of genotypes, environment + (genotypes x environment) and pooled error revealed that genotypes were highly significant for all the characters studied indicating the presence of genetic variability in the experimental material under study. Mean sum of squares due to environment were significant for days to 50% flowering, plant height, productive tillers/plant and test weight. The linear component of environment is significant for all the characters studied indicating the existence of variation among the environments tested and the linear component of genotype x environment interaction was significant for plant height, productive tillers/plant, panicle length and test weight. The linear component of genotype x environment interaction was highly significant than the non-linear component of genotype x environment for the characters *viz.*, productive tillers/plant and test weight. This indicated significant

differences among the genotypes for linear response to environments. Similar findings were previously reported by Ramya & Senthilkumar (2008) and Sreedhar *et al.* (2011).

The estimates on the three stability parameters, mean performance (X_i), regression coefficient (b_i) and deviation from regression (S^2_{di}) for different yield attributing traits are presented in Table 3. The deviation from the regression for grain yield was significant in the genotypes BPT 2406 (22.15) and BPT 2425 (31.78). Among the genotypes tested, BPT 2411, BPT 2409, BPT 2295 and BPT 2405 showed unit regression and non significant deviation from regression for grain yield. The deviation from regression for days to 50% flowering was significant for the genotypes BPT 2231 and BPT 2408. However, BPT 5204, BPT 2409 and BPT 2270 showed unit regression and less deviation from regression for this trait. All the genotypes except BPT 2409, BPT 2425 and BPT 2403 exhibited non significant deviation from regression for plant height. A unit regression and non significant deviation from regression was observed in plant height for the genotypes BPT 2411, BPT 3291, BPT 2231 and BPT 2406. The rice variety Bapatla Sannalu (BPT 1768) recorded more

number of days for 50% flowering while the variety Bhavapuri Sannalu (BPT 2270) manifested maximum plant height. The trait namely productive tillers/plant recorded significant values for deviation from regression in BPT 2231, BPT 2403 and BPT 2408. Among all the genotypes tested, BPT 2408 and BPT 2411 showed unit regression and less deviation from regression for productive tillers/plant. The S^2_{di} value for panicle length was significant for only one genotype BPT 2403 where as the genotypes BPT 1768, BPT2411 and BPT 2425 exhibited unit regression and non significant deviation from regression for panicle length. Among the 13 test entries, seven genotypes manifested significant value for S^2_{di} while BPT 1768 and BPT 2403 showed unit regression and less deviation from regression for test weight. Any generalization regarding the stability of a genotype for all the traits is quite difficult. Some of the genotypes used in the present study did not exhibit uniform stability and response pattern for different traits.

In addition to grain yield, the genotype BPT 2411 also manifested regression coefficient nearer to unity for plant height, productive tillers/plant and panicle length and thus finally exhibited stability for grain yield. Based on the individual stability

parameters, the genotypes BPT 2411 and BPT 2295 recorded higher grain yield over the general mean with regression coefficient near unity and non significant deviation from regression indicating their average stability (Amirthadevarathinam, 1987 and Dushyantha Kumar *et al.*, 2010). Hence, the above genotypes could be recommended for cultivation with stable performance, Moreover, BPT 2295 completed three years of minikit testing in Krishna zone of Andhra Pradesh and BPT 2411, a cross between BPT 5204 and BPT 4358 was also given for minikit testing in Krishna zone to test its suitability over locations.

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Table 1: The pedigree and physical grain quality characters of the genotypes

S.No	Designation/ Name of the variety	Cross combination	Kernel length (mm)	Kernel breadth (mm)	L/B ratio	Grain type
1	BPT 5204	GEB24/TN(1)//Mashuri	5.12	1.79	2.86	MS
2	BPT 3291	Sona/Mashuri	5.05	1.83	2.76	MS
3	BPT 1768	BPT3301/Mashuri mutant	4.6	1.8	2.56	MS
4	BPT 2270	BPT5204/CRMR1523	5.21	1.81	2.88	MS
5	BPT 2231	BPT4358/IR64	5.4	2.02	2.67	MS
6	BPT 2295	BPT 1768/NLR 33641	5.21	1.81	2.87	MS
7	BPT 2403	BPT5204/NLR33641// BPT5204	5.02	1.85	2.71	MS
8	BPT 2405	BPT5204/NLR33641	5.2	2.01	2.59	MS
9	BPT 2406	BPT5204/NLR33641	5.15	1.83	2.81	MS
10	BPT 2408	BPT5204/BPT3291	5.03	1.81	2.78	MS
11	BPT 2409	BPT5204/IR64// MTU4870/MTU1001	5.11	1.78	2.87	MS
12	BPT 2411	BPT5204/BPT4358	5.76	2.19	2.64	MS
13	BPT 2425	BPT5204/IR64// MTU4870/MTU1001	5.32	2.10	2.53	MS

L/B ratio: Length/breadth ratio; MS: Medium slender

Table 2: Analysis of variance for stability performance for grain yield and component traits

Sources	df	Mean sum of squares					Grain yield (kg/ha)
		Days to 50%flowering	Plant height	Productive tillers/plant	Panicle length	Test weight	
Varieties	12	259.10***	245.22***	6.88***	7.56***	19.25***	754.2***
Environment	4	18.67**	67.24**	14.31***	1.10	0.69*	644.6
Variety x environment	48	4.73	17.51	1.79*	0.61	0.46*	548.9
Env.+ (Var*Env.)	52	5.80	21.33*	2.76**	0.65	0.48*	556.3
Env. (linear)	1	74.67***	268.96***	57.23***	4.42**	2.77**	2578.5*
Var.*Env.(Lin.)	12	4.37	30.08*	3.80**	0.99*	1.01***	2117.3
Pooled deviation	39	4.48	12.30***	1.04*	0.44**	0.25***	24.1
Pooled error	120	3.52	3.59	0.67	0.21	0.06	546.8

*Significant at 10% level: **Significant at 5% level: ***Significant at 1% level

Table 3: Estimates of different stability parameters for grain yield and it's component traits

Varieties	Days to 50% flowering			Plant height			Productive tillers/plant			Panicle length			Test weight			Grain yield		
	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	X	Bi	S ² di
BPT 5204	113.7	1.14	-2.7	90.33	-0.63	-0.29	9.6	0.32	0.18	20.89	-3.0*	0.08	15.17	-0.31	0.30**	5.2	-0.75	-5.89
BPT 3291	104.3	0.64	-2.5	92.95	1.09	-0.59	8.1	-0.19*	-0.39	20.64	-0.25*	-0.16	19.34	7.0*	0.31***	4.9	-0.141*	-8.10
BPT 1768	130.1	0.46	-3.3	104.4	0.21	1.03	10.0	0.23*	-0.34	23.08	1.01	-0.07	19.62	1.29	0.0425	5.7	0.543	-2.32
BPT 2270	128.6	1.27	-1.4	110.6	0.31	3.57	11.1	-0.05*	-0.56	24.35	2.13	-0.08	14.69	-1.92*	-0.05	6.1	-0.066*	-8.22
BPT 2231	127.1	0.29	20.4***	104.6	0.98	-0.36	10.8	0.67	3.29***	23.89	0.57	0.11	19.33	1.80	0.12*	6.2	0.336*	-8.15
BPT 2295	123.8	0.49	-1.0	106.1	-0.01	-0.36	11.2	-0.01*	-0.34	24.22	0.29	-0.13	15.66	-0.99*	0.01	6.3	0.753	-4.37
BPT 2403	129.1	2.79	1.3	91.42	2.72	17.96**	11.0	1.37	2.37**	24.32	4.09	0.36*	15.10	0.78	0.15	4.9	-3.445	5.39
BPT 2405	125.5	1.43	-3.0	90.64	3.08	-2.43	10.2	1.68	0.06	23.79	0.31	0.26	14.87	1.74	0.15*	6.0	1.524	4.25
BPT 2406	124.0	0.26	0.2	94.27	0.96	-0.51	9.9	2.0	0.58	23.97	2.34	0.00	14.47	0.62	0.88***	5.6	4.912	22.15*
BPT 2408	123.3	2.61	9.4*	92.68	-0.09*	-3.99	10.2	1.48	0.32	24.27	2.71	-0.10	13.94	2.53	0.39***	5.3	5.153*	-1.78
BPT 2409	124.9	1.20	-2.6	99.53	0.34	50.67***	11.5	1.66	0.47	23.58	0.66	0.26	15.91	0.67	0.29**	5.9	0.806	7.22
BPT 2411	120.1	0.23*	-3.3	91.70	1.12	-2.56	10.3	1.55	0.11	23.78	1.09	0.15	15.82	0.25	0.01	6.3	1.120	5.55
BPT 2425	117.1	0.18	0.8	101.9	2.93	45.14***	9.5	2.29	4.65***	23.62	1.12	2.41	16.31	-0.44	-0.05	5.5	2.26	31.78**