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Stability Analysis for Grain Quality Parameters in Rice (*Oryza sativa* L.) under Different Fertilizer Managements

Key words : G × E interaction, Quality traits, Rice, Stability analysis.

Rice (*Oryza sativa* L.) is one of the most important cereal crops of India, grown under diverse climatic conditions and different farming situations. With the introduction of fertilizer responsive semi dwarf varieties, there had been a spectacular increase in rice yields in mid 60's. However, during the past twenty years, rice yields have reached plateau and consumer preference has also shifted towards fine grain quality. Green revolution, though helped to a greater extent for increased production, resulted in soil fertility problems and environmental pollution. As a consequence, the thrust since the last decade had been moving towards more sustainable and/or organic farming practices. However, the major constraint for the farmers is that there is no suitable variety with superior yield and grain quality bred for the organic system to get higher productivity. Therefore, keeping in mind, the current demand for high yielding and fine grain types for conventional system and the growing demand of organic sector in future, there is an immediate need to breed suitable varieties in rice. In order to reach this goal, understanding of G × E interaction and stability parameters provide a better opportunity to breed the varieties for the future demand. Though several studies were conducted for G × E in rice but studies on G × E interaction on quality parameters under organic, integrated and conventional production systems are limited and need to be given priority. Hence, the present study was conducted to assess the rice genotypes for grain quality traits under different fertilizer managements *viz.,* organic, conventional and integrated management systems.

In the present investigation, thirty two rice genotypes were grown during *Kharif,* 2009 in three separate contiguous trials that differ only in fertilizers management i.e. organic, conventional and integrated fertilizer managements using a randomized block design with three replications at S.V. Agricultural College, Tirupati. Thirty days old seedlings of each genotype were transplanted by adopting a spacing of 20 cm between rows and 15 cm between plants within row. Each genotype was grown in 3 rows with a plot size of 2.4 m^2. The crop was grown with the application of FYM equivalent to 120 kg N ha^{-1} and Neemcake in organic fertilizer management trial; recommended dose of chemical fertilizers at the rate of 120 kg N, 60 kg P_2O_5 and 60 g K_2O per hectare in the form of urea, single super phosphate and murate of potash in conventional fertilizer management trial; and 50% organic fertilizers through FYM (which is equivalent to 60 kg N ha^{-1}) and 50% recommended dose of chemical fertilizers (which is equivalent to 60 kg N, 30 kg P_2O_5 and 30 kg K_2O per hectare in the form of urea, single super phosphate and murate of potash) in integrated fertilizer management trial. Standard agronomic practices were followed to raise a good crop. Five competitive plants were selected randomly from the center row of each genotype in each replication and used for recording the observations on quality characters *viz.,* kernel length, kernel breadth, kernel length/breadth ratio, kernel length after cooking, kernel elongation ratio, 1000-grain weight and grain yield per plant. Similar procedure for recording data was followed under organic, conventional and integrated fertilizers management trials separately. The quality characters were estimated as per the standard evaluation system in rice. The mean values for all the traits across the environments were subjected to stability analysis (Eberhart and Russell, 1966) after testing for homogeneity of error variances.

The pooled analysis of variance revealed that there were significant genotype x environment interactions for all the characters *viz.,* kernel length, kernel breadth, kernel L/B ratio, kernel length after cooking, kernel elongation ratio, 1000-grain weight

Table 1. Stability Parameters for quality characters over three environments for 32 rice genotypes.

S.No.	Genotypes	Kernel length (mm)			Kernel breadth (mm)			Kernel L/B ratio		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	Velluthachera	5.28	0.6759	0.1308*	2.41	-0.7883	-0.0016	2.20	-2.4862	0.0108
2	MTU-1031	5.49	2.7191	0.1014*	2.23	3.8544	0.0415**	2.50	5.393	0.1045**
3	Lalnakanda	5.74	-1.8046	0.0296	2.37	-1.0424	0.0470**	2.43	0.2144	0.0718**
4	Vasundhara	5.76	4.5543	-0.0013	2.42	-1.7259	0.0150	2.39	-3.3583	0.0409*
5	MTU-1071	5.63	3.0032	0.0246	2.45	0.2469	0.0035	2.30	-0.2417	-0.0007
6	Plutikamabani	5.79	-3.127	-0.0058	2.35	0.701	0.0008	2.47	2.0016	0.0099
7	MTU-2077	5.66	-0.3319	0.0045	2.26	1.4862	0.0543**	2.52	2.3329	0.0574**
8	MTU-1081	5.87	-2.4578	0.0709	2.28	4.2904	0.0296*	2.60	6.2213	0.0004
9	MTU-9993	6.42	-6.9282	0.0122	2.39	0.3972	0.0019	2.69	2.42	0.0144
10	MTU-5249	5.83	-2.3133	0.1819**	2.19	0.5543	-0.0003	2.66	0.2919	0.0278
11	MTU-1061	5.41	-0.8206	-0.0050	2.16	3.0565	0.0444**	2.54	4.8459	0.0302*
12	ADT-43	5.47	-0.4813	0.1044*	2.13	1.4829	0.0024	2.57	3.3876	-0.0028
13	MTU-7029	5.69	5.0725	0.1004*	2.18	1.8363	0.0182*	2.61	-0.0477	0.0161
14	Bhadraj	5.56	2.8132	0.0433	2.33	-0.2494	0.0078	2.39	-0.723	-0.0012
15	BPT-5204	5.50	3.4112	0.0077	2.26	4.2645	0.0019	2.46	4.2916	-0.0027
16	Lunisree	5.77	-3.1195	0.2353**	2.31	0.2103	0.0151	2.5	2.7832	-0.0013
17	RGL-2537	5.86	4.5602	0.1116*	2.29	3.5545	0.0088	2.58	2.3175	0.0363*
18	NLR-145	5.59	3.9096	0.2055**	2.46	3.3004	0.0988**	2.31	3.8837	0.2342**
19	Triguna	5.60	-1.8979	0.0740	2.17	1.3251	-0.0015	2.59	3.6234	-0.0010
20	Salivahana	5.91	-1.6055	0.0335	2.2	0.3248	0.0503**	2.69	1.404	0.0533*
21	Dular	5.61	7.7919	0.0156	2.23	0.7603	-0.0013	2.51	-1.1884	0.0365*
22	TKM-6	5.82	5.3092	0.1353*	2.14	1.4299	-0.0015	2.71	-0.972	-0.0006
23	Sasyasree	6.04	1.9507	-0.0061	2.24	-0.5625	0.0262*	2.7	-1.2602	0.0577**
24	Mahsuri	5.94	0.5087	0.5471**	2.27	1.0418	-0.0009	2.62	-1.1234	0.0848**
25	MTU-1001	5.87	1.3315	-0.0057	2.44	0.8402	0.0032	2.41	0.6124	0.0027
26	Intivadlu	5.42	-2.7754	-0.0064	2.52	-0.2415	-0.0005	2.15	0.4851	0.0045
27	ARC-5757	5.60	4.106	-0.0048	2.44	1.8671	0.0168	2.30	0.8888	0.0001
28	Accession no.11103	5.27	5.1744	0.1512**	2.39	1.8284	0.0042	2.21	1.6298	0.0811**
29	PR-106	6.51	-4.8429	0.0875*	2.3	-0.4076	0.0833**	2.85	-0.5949	0.2836**
30	TN-1	5.31	2.6593	-0.0046	2.45	-1.1457	-0.0013	2.18	-1.9216	0.0062
31	MTU-2067	5.38	2.012	0.0521	2.15	0.2705	0.0695**	2.51	0.0955	0.0262
32	JGL-1798	5.45	2.807	0.0173	2.08	-0.7728	0.0186*	2.63	-3.2033	0.0228
	Population Mean	5.69			2.3			2.49		

Table contd........

and grain yield per plant. Hence, stability analysis was carried out for all characters where genotypes interacted with the environments as per the model suggested by Eberhart and Rusel (1966). Environment index values revealed that the genotypes for the characters, 1000-grain weight, kernel length after cooking and kernel breadth showed best performance under organic fertilizer management. Similarly the traits, kernel L/B ratio and grain yield per plant responded better under conventional and integrated fertilizer managements, respectively. The range in environmental index values indicated that the selected environments *viz.,* organic, conventional and integrated fertilizers managements were quite varied, contrasting and appropriate to carry out the present experimentation. A genotype was considered stable when the regression co-efficient was near unity, the deviation from regression was either zero or as small as possible with high mean performance. The estimates on the three stability parameters, mean performance (X_i), regression coefficient (b_i) and deviation from regression (S^2d_i) for the different traits are presented in Table 1. The genotypes

Table 1 contd..........

S.No.	Genotypes	Kernel length aftercooking			kernel elongation ratio			1000 grain weight (g)			Grain yield / plant (g)		
		Mean	b_i	S^2d_i	Mean	bi	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	Velluthachera	7.35	-0.6852	0.0638**	1.40	-3.593	-0.0006	24.57	1.0414	-0.5260	20.34	1.3401	-0.7633
2	MTU-1031	8.17	0.771	0.0150**	1.49	2.8426	-0.0006	22.56	0.3883	1.8376	19.42	-1.5078	-0.9177
3	Lalnakanda	8.28	-0.1328	0.0852**	1.45	0.297	0.0060	24.49	2.4128	5.9635	10.47	3.3965	2.2999
4	Vasundhara	8.30	0.4794	0.0547**	1.45	-0.2773	0.0027	24.53	-3.2962	-0.1481	16.19	-1.3256	0.7211
5	MTU-1071	8.27	-0.1538	0.4521**	1.47	-0.454	0.0012	24.87	0.7686	13.6139*	12.64	3.8397	-0.4443
6	Plutikamabani	7.98	6.0926	-0.0002	1.38	4.6505	0.0335**	25.62	3.2161	-0.7168	7.92	2.822	-0.6112
7	MTU-2077	8.27	-0.4587	0.0330**	1.46	0.7991	0.0000	21.97	-1.2386	7.7403	14.53	3.6703	-0.9141
8	MTU-1081	8.36	1.2868	0.0013	1.43	-1.1892	0.0038	23.07	1.6634	5.6891	15.41	0.3714	-0.8923
9	MTU-9993	8.97	0.0248	0.0425**	1.40	-0.786	0.0071*	26.80	1.8993	-0.6190	16.57	0.3913	-0.2845
10	MTU-5249	7.54	-0.2107	0.0490**	1.30	-2.3194	-0.0006	23.43	-3.0805	-0.0302	16.78	-1.2321	5.1942
11	MTU-1061	8.23	-1.2513	0.0155**	1.52	-0.3998	-0.0000	20.91	-2.2707	-0.3638	18.33	0.3957	2.6930
12	ADT-43	8.45	-0.2191	0.0075*	1.55	2.6233	-0.0005	21.79	3.917	0.4232	6.88	1.5065	-0.9168
13	MTU-7029	8.49	1.5886	0.0536**	1.49	0.2183	0.0150**	20.01	9.6814	-0.6484	11.77	0.894	-0.8195
14	Bhadraj	7.20	-0.0816	0.5434**	1.30	3.4864	0.0238**	22.31	1.0559	32.7346**	14.97	-2.4966	-0.4081
15	BPT-5204	8.46	1.3838	-0.0002	1.54	0.7721	0.0015	20.85	-2.911	29.1032**	18.99	1.1529	3.5569
16	Lunisree	8.30	-0.9519	0.0418**	1.44	1.7879	0.0080*	23.01	7.7268	24.6282**	17.58	3.5923	-0.7973
17	RGL-2537	6.99	3.1288	0.0802**	1.20	1.6839	0.0033	22.63	3.0348	30.7253**	14.17	1.8909	0.1556
18	NLR-145	8.32	1.1857	-0.0006	1.50	4.5258	0.0004	24.53	-1.3407	-0.7140	18.37	2.5366	-0.8847
19	Triguna	9.24	0.1121	0.2234**	1.65	0.9635	0.0168**	21.37	-0.4037	1.4525	17.52	1.4584	0.3266
20	Salivahana	7.47	7.859	0.0035	1.27	6.8243	0.0403**	23.68	-1.0826	1.8524	16.76	-0.2939	1.7948
21	Dular	7.34	4.0785	0.0282**	1.31	4.1449	0.0002	22.91	-0.3367	6.8776	13.73	0.6689	6.1461
22	TKM-6	9.2	-0.4738	0.5297**	1.59	-0.3704	0.0649**	22.72	2.4419	16.6353**	13.78	-0.5165	14.3209*
23	Sasyasree	8.46	0.6318	0.0247**	1.40	0.8326	0.0013	25.29	-2.0242	-0.5396	15.41	4.7791	-0.0206
24	Mahsuri	7.43	0.8968	0.1292**	1.26	-4.4171	0.0009	23.87	6.9958	1.0370	15.98	0.752	-0.6163
25	MTU-1001	9.25	-1.1464	0.0096*	1.58	-1.1889	0.0011	21.53	4.1269	3.1470	13.72	1.5263	-0.9035
26	Intivadlu	8.35	2.0706	0.0453**	1.54	0.5126	0.0183**	21.44	-4.6792	13.9039*	12.20	-0.1058	-0.4968
27	ARC-5757	8.35	0.2946	-0.0006	1.49	0.8993	0.0062	22.61	3.9246	25.5871**	9.98	-1.7915	0.4376
28	Accession no.11103	5.85	0.41	0.0000	1.12	2.8273	0.0040	19.60	-1.7417	12.7056*	7.50	0.5316	-0.6005
29	PR-106	9.92	-0.0602	-0.0006	1.49	-0.5143	0.0011	25.08	3.3048	12.0793*	15.27	-1.5002	0.4076
30	TN-1	7.48	2.0047	0.0131*	1.41	2.5696	0.0002	25.31	-2.235	1.3365	14.19	4.2585	6.3162
31	MTU-2067	6.8	3.9596	0.0119*	1.27	5.2053	0.0017	22.20	-1.1207	-0.4143	12.37	1.0401	-0.4602
32	JGL-1798	7.56	-0.4303	0.0000	1.39	-0.9965	0.0056	18.29	2.1287	-0.4522	14.98	-0.0491	-0.5273
	Population Mean	8.08			1.42			22.93			14.52		

Velluthachera and BPT-5204 showed high mean values and regression co-efficients around unity with non significant deviations from regression and hence these genotypes could be considered stable over all the three fertilizer managements.

For kernel length, MTU 1001 found to be stable as per the definition of stability. Similarly, the genotype Mahsuri was considered as stable over three fertilizer managements for kernel breadth. For 1000-grain weight, the genotype Velluthachera could be identified as stable over three systems considered. For all the traits any generalization regarding the stability of genotypes is quite difficult. A non significant deviation from regression (S^2d_i) and mean performance (X_i) or regression coefficient (b_i) indicated that the stability parameters might be under the control of different genes located on different chromosome (Reddy and Choudhary, 1991). Kernel length after cooking was found one of the most important trait to be considered for deciding the grain quality attribute. For this trait the genotype NLR 145 could be considered as stable over the three fertilizer managements.

By and large, based on the stability analysis, it is clearly evident that the expression of the genotypes for yield and grain quality components significantly varied over three different fertilizer management systems, which might necessitate separate breeding programmes for full exploitation of the particular system. Summary of the rice genotypes for different fertilizer managements based on stability parameters revealed that the genotypes Velluthachera, BPT 5204, Mashuri, MTU 1001 and NLR 145 might become potential source for breeding stable high yielding and quality genotypes for different fertilizer management systems. Hence, these genotypes could be recommended directly for cultivation or could be exploited as parents for further improvement of rice genotypes in the respective target fertilizer management.

LITERATURE CITED

Eberhart S A and Russel W A 1966 Stability parameters for comparing varieties. Crop Science, 6: 36-40.

Reddy J N and Choudhary D 1991 Stability analysis for grain yield and its components in rice. Oryza, 28: 295-299.

Virmani S S, Prasad M N and Ish Kumar 1993 Breaking yield barrier in rice through exploitation of heterosis. In New Frontiers in Rice Research. 76-85. Directorate of Rice Research, Hyderabad, India.

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