Electronic Journal of Plant Breeding, 5(3): 442-444 (Sep 2014)
ISSN 0975-928X

Research Article

Stability analysis for straw and grain yield in rice (*Oryza sativa* L.)

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(Received: 02 May 2014; Accepted:11 Jul 2014)

Abstract
Twenty five rice varieties / hybrids were investigated for their stability in grain yield and straw yield during *kharif* seasons of 2009, 2010 and 2011. The highly significant differences among rice genotypes for grain and straw yield over environment and genotype x environment interaction were observed. The genotype Ratnagiri, found stable for straw and grain yield. The genotype Sahyadri 3 (14.276 g) found to perform well under better environmental conditions for straw yield while Ratnagiri 2 (13.541 g) and Panvel 3 (10.410 g) found to perform well under better environmental conditions for grain yield. The genotype Ratnagiri 24 (10.310 g) found to perform well under adverse environmental conditions for straw yield, while genotype Sahyadri 4 (13.510 g) for grain yield. Hence, the genotypes Ratnagiri 1, Sahyadri 3, Ratnagiri 2, Ratnagiri 24 and Sahyadri can be directly used in various breeding programmes for enhancing rice productivity.

Key words:
Rice, Stability, Eberhart and Russel, straw, grain yield.

Introduction:

Rice (*Oryza sativa* L.) is the most important cereal crop of India. As this crop is grown under a wide range of agro-climatic conditions ranging from upland to lowland and irrigated to rainfed situations, their phenotypic responses vary greatly in accordance with the environment. Rainfed lowland environment is mostly unfavorable and characterized by variable water regimes. The rice growing environments were analyzed and have been reported that decline in rice production was due to physical or environmental constraints. The major efforts in crop technology, under unfavourable environment should be yield stabilizing, cost reducing, risk minimizing and returns enhancing. Genotype x environment (GxE) interaction and yield stability analysis continued to be an important in measuring varietal stability and suitability for cultivation across seasons and ecological zones. The analysis of genotype x environment has focused on the identification of stable varieties for cultivation. The genotypes should therefore be highly stable cultivars besides high yielding. Many methods (Finlay and Wilkinson, 1963; Eberhart and Russell, 1966; Perkins and Jinks, 1968; Freeman and Perkins, 1971) are available for assessing the stability of performance of crop varieties. These models are helpful in identification of adaptable genotypes over a wide range of environments; achieving stabilization in crop production over locations; developing phenotypically stable and highly potential cultivars; effective selection for yield stability and prediction of varietal responses under changing environments. The present investigation was aimed at identifying high yielding rice varieties and hybrids having high stability for Konkan region (coastal) of Maharashtra state.

Material and Methods

Twenty five rice varieties / hybrids *viz*., Ratnagiri 73, Ratnagiri 24, Karjat 4, Karjat 184, Ratnagiri 711, Phondaghat 1, Karjat 7, Karjat 1, Ratnagiri 1, Karjat 3, Palghar 2, Karjat 6, Palghar 1, Ratnagiri 4, Karjat 5, Karjat 2, Ratnagiri 3, Ratnagiri 2, Panvel 2, Panvel 1, Panvel 3, Sahyadri 2, Sahyadri 4, Sahyadri 1 and Sahyadri 3 were evaluated for grain and straw yield for three years at Regional Agricultural Research Station, Karjat (MS). All these varieties / hybrids has been released by Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, (MS) and recommended for commercial cultivation in Konkan region of Maharashtra state. The experiment was conducted at Regional Agril. Research Station, Karjat, Dist. Raigad (MS) during *kharif* seasons of 2009, 2010 and 2011.

The varieties / hybrids were sown in raised beds and 25 days old seedlings were transplanted in main field under puddled condition. The single seedling per hill of varieties / hybrids was planted at 20 x 15 cm spacing with plot size of $15m^2$ in Randomized Block Design (RBD) having three replications. Recommended management practices were followed. All the intercultural operations were done as and when required. Observations were made on randomly selected five plants per plot for grain and straw yield and means were utilized for stability studies. Stability parameters were estimated following Eberhart and Russell, 1966 model.

Results and Discussion

The analysis of variance for stability of straw and grain yield in rice over three environments was depicted in Table : 1. The grain yield and straw yield revealed highly significant differences among the varieties and environments. (Table 1). Highly significant mean squares due to genotype × environment (G×E) interaction revealed that the

genotypes interacted considerably with environmental conditions for both the characters. The linear component of environment was found to be highly significant for grain and straw yield. However, only straw yield exhibited highly significant variety x environment linear component. Non-linear components of G×E interaction were found to be significant for straw yield as indicated by highly significant mean squares due to G×E (linear) interaction and pooled deviation.

Eberhart and Russell (1966) defined a stable genotype as the one which showed high mean yield, regression co-efficient (bi) around unity and deviation from regression near to zero. Accordingly, the mean and deviation from regression of each genotype were considered for stability and linear regression was used for testing the varietal response.

i. Genotypes with high mean, bi = 1 with non significant δ2di are suitable for general adaptation, i.e., suitable over all environmental conditions and they are considered as stable genotypes.
ii. Genotypes with high mean, bi > 1 with non significant δ2di are considered as below average in stability. Such genotypes tend to respond favourably to better environments but give poor yield in unfavourable environments. Hence, they are suitable for favourable environments.
iii. Genotypes with low mean, bi < 1 with non significant δ2di do not respond favourably to improved environmental conditions and hence, it could be regarded as specifically adapted to poor environments.
iv. Genotypes with any bi value with significant δ2di are unstable.

The grain yield of rice fluctuates considerably with the change in environmental conditions. Hence, a variety possessing reasonable stability for yield is desirable for minimizing the risk of yield loss under in harsh environments of unfavourable low land situation (Bose *et al*,.2012)

The G x E interactions for both the characters were significant and the significant mean squares due to environment (linear) indicated the existence of real varietal differences in characters for regression over environmental mean. Therefore, the genotypes differed considerably with respect to their stability for yield. Similar results were obtained in rice by Kulkarni *et al.* (1988). The mean grain and straw yields and stability parameters are showed in Table 2. The genotypes *viz*., Phondaghat 1 (12.228 g), Karjat 7 (12.546 g), Ratnagiri 1 (11.660 g), Ratnagiri 4 (16.800 g), Karjat 2 (15.973 g) were found stable for straw yield while, the genotypes *viz.*, Ratnagiri 24 (8.026 g), Karjat 184 (6.776 g), Ratnagiri 1 (9.233 g), Karjat 3 (9.668 g), Palghar 2 (9.366 g), Karjat 6 (10.166 g), Karjat 5 (14.406 g), Ratnagiri 3 (13.886 g) found stable for grain yield. The similar results were reported by Dalvi *et al.* (2007). The genotype Ratnagiri 1 found stable for straw and grain yield. The genotype Sahyadri 3 (14.276 g) found to performed well under better environmental conditions for straw yield and Ratnagiri 2 (13.541 g) and Panvel 3 (10.410 g) found to performed well under better environmental conditions for grain yield. The genotype Ratnagiri 24 (10.310 g) found to performed well under adverse environmental conditions for straw yield, while the genotype Sahyadri 4 (13.510 g) for grain yield. These genotypes can be directly used in various breeding programmes for enhancing rice productivity.

References:

Bose, L. K., Nagaraju M. And Singh O. N. 2012. Genotype x environment interaction and stability analysis of lowland rice genotypes**.** *J. Agrl. Sci*., **57**(1):1-8.

Dalvi V.V., Patel D.U., Vashi T.S and Kshirsagar R.M. 2007. Genotype X Environment interaction for yield and its components in rice hybrids. *J. Maharashtra Agric. Univ.*, **32** (1) : 025-028.

Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing varieties. *Crop Sci*., **6**: 26-40.

Finlay, W; Wilkinson, G W. 1963. The analysis of adaptation in a plant breeding programme. *J. Agric Res*., **14** : 742-754.

Freeman, G.H. and Perkins, J.M. 1971. Environmental and genotype-environmental components of variability. VII. Relations between genotypes grown-in different environments and measures of these environments. *Heredity*, **27**: 15- 33.

Kulkarni, N., Reddy, P.P., Rao, D.V.S.R. 1988. Genotype x environment interaction in rice (Oryza sativa L.). *Indian J. of Agric. Sci*., **58**:473-475.

Perkins, J M. and Jinks, J L. 1968. Non-linear interactions for multiple inbred lines. *Heredity*, **23**:525-535.

Table 1. Anova for stability in rice over three environments

Source	df	Grain yield (g)		Straw yield (g)	
		MSS	F Cal	MSS	F Cal
Varieties	24	20.22	127.89**	40.62	606.06**
Environments	2	7.79	3.86**	34.10	17.05**
Environment + (Variety X Environment)	50	0.96	3.52**	1.92	28.64**
Environment (linear)	1	15.58	98.85**	68.22	1017.84**
Variety X Environment (linear)	24	0.10	0.65	0.99	14.73**
Pooled deviation	25	0.39	2.46**	0.16	2.39**
Pooled error	75	0.16	-	0.07	-

Table 2. Stability parameters for straw and grain yield in rice

Variety / Hybrid	Grain yield (g)			Straw yield (g)		
	$\overline{X}$	bi	$\overline{S}^2_{di}$	$\overline{X}$	bi	$\overline{S}^2_{di}$
Ratnagiri 73	8.046	0.3188	0.736*	9.690	-0.118	0.885**
Ratnagiri 24	8.026	1.1981	-0.085	10.310	0.252	0.727**
Karjat4	7.020	0.3380	0.707*	8.670	0.266	0.013
Karjat 184	6.776	1.0030	-0.120	8.633	0.642	-0.027
Ratnagiri 711	9.230	0.5452	0.512	11.870	0.860	-0.059
Phondaghat 1	9.556	0.5777	0.491	12.228	1.068	-0.007
Karjat 7	9.450	0.3972	0.648*	12.546	1.196	-0.016
Karjat 1	7.080	1.2395	-0.069	8.375	0.285	-0.056
Ratnagiri 1	9.233	1.1237	-0.126	11.660	1.082	0.222
Karjat 3	9.668	1.0826	-0.117	12.533	1.250	0.192
Palghar 2	9.366	1.0797	-0.116	10.753	0.435	-0.028
Karjat 6	10.886	1.0945	-0.112	13.160	0.860	0.021
Palghar 1	12.250	1.2496	-0.084	15.326	1.344	0.178
Ratnagiri 4	14.068	1.2454	-0.073	16.803	1.191	0.164
Karjat 5	14.406	1.0945	-0.112	19.306	1.893	-0.063
Karjat 2	12.296	1.2129	-0.080	15.973	1.102	0.125
Ratnagiri 3	13.886	1.0607	0.163	17.380	1.245	-0.063
Ratnagiri 2	13.541	1.5672	0.069	17.416	1.789	0.338*
Panvel 2	7.575	1.4136	0.411	9.268	0.283	0.036
Panvel 1	10.200	1.2617	-0.062	12.093	0.561	-0.065
Panvel 3	10.410	1.5682	0.556	12.256	0.462	-0.036
Sahyadri 2 (H)	13.370	1.4203	0.428	17.656	1.507	-0.051
Sahyadri 4 (H)	13.510	0.1795	1.763**	17.750	1.505	-0.045
Sahyadri 1 (H)	13.750	0.5156	0.538	18.950	1.898	-0.002
Sahyadri 3 (H)	14.276	1.2129	-0.080	19.760	2.135	-0.060

(H) indicates hybrid