UNIVERSITY OF PERADENIYA
SRI LANKA

PROCEEDINGS
OF THE
ANNUAL RESEARCH SESSIONS
1996

August 10, 1996

RECOMMENDATION OF RICE CULTIVARS BASED ON STABILITY ANALYSIS

R.O. THATTIL, B. MARAMBE, N.R. ABEYNAYAKE AND
S de Z. ABEYSIRIWARDENA*

Department of Crop Science, Faculty of Agriculture,
University of Peradeniya and
* Central Rice Research Station, Batalagoda.

ABSTRACT

Stability analysis was performed on yield data from the co-ordinated rice varietal trials, which were conducted at 13 locations using 34 cultivars (varieties). The data used in the analysis came from the trials conducted in 1993 Yala, 1993/94 Maha and 1994 Yala seasons.

The stability parameters (β_i and λ_i) and the variance components of the genotype x environment interaction were evaluated for each cultivar. Based on the results of the analysis general and specific recommendations can be made. In the 4 - 4½ month age group the varieties BG 1528, BG 1222 and BG 1959 performed consistently well in all locations and seasons and can be used for general recommendation. In the 3½ month age group BG 1639 and BG 94-1 can be recommended for general use throughout all locations, while in the 3 month group none of the varieties are suitable for general recommendation. Some varieties though not consistent in performance over all seasons and locations, performed well in 1 or 2 sites in 1 or more seasons. They are suitable specifically to these sites. Varieties BW 306-2 and AT 90-332 of the 4-4½ age group can be recommended to Maha-Illuppallama (in Yala) and Ambalantota (in Maha)respectively. The variety BW 326-3 (3½ month) can be recommended to Paranthan, while BG 1492 (3 month) can be recommended to Labuduwa, and to Ambalantota and Paranthan in Yala.

Introduction

Stability of performance in a crop is the ability of the crop to show a minimum of interaction with the environment, i.e. less variability of yields over different seasons and/or locations. In co-ordinated rice varietal trials conducted by the Government Department of Agriculture several rice cultivars are tested at different locations, using conventional block designs at each location. The trials are repeated over different seasons. The average yield of each cultivar (variety) and the stability of yield over different locations and seasons are used in the recommendation of cultivars, for general use in all sites, as well as cultivars for specific locations and/or seasons. Several parameters have been developed to judge the stability of a given cultivar.

Materials and Methods

Co-ordinated rice varietal (CRVT) were conducted at 13 locations using 34 varieties in 1993 Yala, 1993/94 Maha and 1994 Yala seasons. The yield data, and other parameters such as days to heading, height of plants etc. were recorded for each cultivar in every season and location. However only the yield data is used in this study. The locations used were Ambalantota, Bombuwela, Girandurukotte, Labuduwa, Maha-Illuppallama, Paranthan, Inginimitiya, Batalagoda, Gannoruwa and Aralaganwila. The cultivars used came from 3 different age groups i.e. 3 month,

3½ month and 4-4½ month age groups. Most cultivars were of the BG type while, LD, BW and AT cultivars were also used.

Eberhart and Russel (1966) developed two stability indices based on the regression technique. In varietal trials conducted at different locations the regression model can be written as,

$$y_{ikr} = \mu + \tau_i + \beta_i I_k + \varepsilon_{ikr}$$

where y_{ikr} is the yield of the ith variety in the rth replicate of the kth location; τ_i = Effect of kth variety; I_k = Environmental index $= \bar{y}_{.k.} - \bar{y}_{...}$; δ_{ik} = Deviation from linear response; β_i = Regression coefficient of ith variety when yield of the ith variety is regressed on the environmental index; and ε_{ikr} = Random error component.

For a given cultivar(i) the first stability measure is the estimate of the regression coefficient $ß_i$ A second stability measure is obtained by considering the deviation from linear regression and is given by

$$\lambda_i = n \sum \delta_{ik}^2 / (l - 2) MS_{error}$$

where n = number of replicates and l = number of locations.

The breeder usually wants a variety that does above average in all environments and deviation from regression as small as possible. Thus, a variety that has average stability ($ß_i = 1$ and $\lambda_i = 1$) and a high mean yield can be recommended in general to all sites (general adaptability). A variety that has $ß_i > 1$ (below average stability) and low average yield but performing well in a favourable site can be recommended for that particular site, while a variety that has $ß_i < 1$ (above average stability) and low average yield but performing well in an unfavourable site, can be similarly recommended for that site.

In addition to the above, the stability parameter derived by Abeysiriwardena et at (1991) was used. They calculated the variance in genotypic deviations for each genotype (S_i^2), to be used as another stability parameter.

$$S_i^2 = [S_k d_{ik.}^2 - (S_k d_{ik.})^2/l] / n (l - 1)$$

Where $d_{ikr} = Y_{ikr} - \bar{Y}_{.k.}$ (yield deviation from location mean) and n, l are defined as before.

A value close to zero for S_i^2 indicate that the genotype does not interact with the environment in an unpredictable manner and thus as the environment improves the performance of the genotype improves in a predictably proportional manner.

Results and Discussion

The mean yield (kg/100m^2) and stability parameters of 4-4½ month varieties of paddy tested at different locations during Maha season (1993/94) are given in table 1. The results are given only for some of the varieties, selected specifically to bring out the major points in the discussion.

The BG cultivars 1528, 1959 and 1222 of the 4 - 4½ month age group have above average yield means (positive d_i values). The stability parameters ($ß_i$ and λ_i) are close to 1 and S_i^2 values are not too high. They are good candidates for general recommendation. The cultivar AT 90-332

2

has a negative variety effect (low average performance over all locations). In terms of the stability parameters λ_i and S_i^2 are high and thus it is not suitable for general recommendation. However, Table I, shows that at Ambalantota the yield of AT 90-332 is 54.6 kg/100m^2, which is comparable to the yield of the best variety at Ambalantota. Therefore AT 90-3332 can be specifically recommended to Ambalantota.

Table I. Yield (kg/100m^2) and stability parameters of 4 - 4½ month varieties of paddy tested at different locations during the Maha season (1993/94)

Location	AT 90- 332	BG 1528	BG 1959	BG 1222
Ambalantota	54.6	55.3	49.6	53.5
Bombuwela	27.6	39.0	38.3	44.0
Girandurukotte	29.1	39.2	54.6	48.6
Labuduwa	32.2	32.0	35.2	34.8
Maha-Illuppallama	26.5	34.6	31.1	33.4
Paranthan	51.0	57.9	58.6	54.7
Rahangala	10.9	9.0	21.0	15.7
Aralaganwila	23.7	50.7	46.4	48.8
Variety effect (d_i)	-5.9	3.3	3.4	4.6
Variety contribution to v*L variance (S^2_i)	88.9	52.2	78.0	56.3
λ_i of variety	9.6	1.9	2.7	2.0
ß$_i$ of variety	0.9	1.2	0.9	1

The cultivars (varieties) that can be recommended for general use are given in Table II, along with the stability parameters and mean yield (kg/100m^2).

In the 4 - 4 ½ month age group the varieties BG 1528, BG 1222 and BG 1959 performed consistently well in all locations and seasons and can be used for general recommendation. Both stability parameters are close to 1 except for BG 1528 in 93 Yala season due to very low yield in only 1 site (Labuduwa). In the 3 ½ month group BG 1639 and BG 94-1 can be used for general recommendation. None of the varieties in the 3 month group can be recommended generally.

3

Table II. Stability parameters and mean yield (kg/100 m^2) of varieties that can be used for general recommendation

Age group 4-4 1/2 months	93 Yala			93/94 Maha			94 Yala		
	β_i	λ_i	$\bar{y}_{i..}$	β_i	λ_i	$\bar{y}_{i..}$	β_i	λ_i	$\bar{y}_{i..}$
BG 1528	1.5	13.8	50	1.0	3.3	54	1.2	1.4	40
BG 1222	1.1	2.4	45	0.9	5.0	57	1.0	2.0	42
BG 1959	-	-	-	1.0	1.7	54	0.9	2.7	42
3 1/2 months									
BG 1639	1.2	3	50	1.1	1.5	55	1.1	0.6	47
BG 94-1	1.1	1.6	50	1.1	3.3	47	1.1	9.7	43

Table III gives the varieties that can be used for specific locations and seasons.

Table III. Varieties that can be used for specific recommendation

Variety	Age (month)	Location	Season(s)
BW 306-2	4 - 4 1/2	Mahailluppallama	Yala
AT 90-332	4 - 4 1/2	Ambalantota	Maha
BW 326-3	3 1/2	Paranthan	Maha/Yala
BG 1492	3	Labuduwa	Maha/Yala
		Ambalantota	Yala
		Paranthan	Yala

The varieties listed in Table III did not give consistent yields over locations and seasons. However, they performed well in 1 or 2 sites, in 1 or more seasons. Varieties BW 306-2 and AT 90-332 of the 4 - 4 1/2 month age group can be recommended to Maha-Illuppallama (in Yala) and Ambalantota (in Maha) respectively The variety BW 326-3 (3 1/2 month group) can be recommended to Paranthan in both Maha and Yala seasons while BG 1492 (3 month group) can be recommended to Labuduwa in both Maha and Yala and to Ambalantota and Paranthan in Yala.

The varieties will be tested by the Government Department of Agriculture in farmers fields prior to making final specific and general recommendations.

Acknowledgements

References

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

Abeysiriwardena, D.S. de Z., Buss, G.R. and Reese Jr., P.F. 1991 Analysis of multi-environmental yield trials for testing adaptability of crop genotypes, Tropical Agriculturist, 147 , 85 - 97.