References

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A detailed analysis of a genotype-environment study on rice in Sri Lanka

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Abstract

Genotype × Environment (variety × location) interactions are very important in variety trials repeated over different locations. The presence of interaction suggests that recommendation of varieties must be done according to their adaptability and stability over diverse conditions. Published research on Genotype - environment studies on rice in Sri Lanka are relatively few. This study focuses on a detailed yield analysis for the seasons Yala and Maha of a local varietal trial of ten 3 ½ -month rice varieties repeated over 7 locations and recommendations for cultivation are given based on the results of a combined analysis and subsequent measures.

1. Introduction

Variety × location interactions [1] usually occur in variety (genotype) trials repeated in different locations (environments). If there is no interaction, then varieties can be recommended uniformly over locations. However, if there is interaction, then the recommendations must be given according to their adaptability and stability over diverse environments.

Rice is the most important food crop for Sri Lankans. For example, per capita consumption of rice has increased from 87 kg in 1973 to 116 kg in 2008. Due to various constraints, increasing productivity is the only solution. This can be achieved only by introducing high yielding yet more stable varieties adapted to a wide range of conditions. Our objective is to analyze yield data from a series of experiments involving ten 3 ½ -month rice varieties in Sri Lanka. Recommendations for cultivation are given over the selected locations for both seasons Yala and Maha.

2. Methodology

A combined analysis of variance (ANOVA) as given by Kempthorne [1] was carried out using SAS® package for the yield from the 3 ½ -month variety trials for each season Yala and Maha (Table 1). The data was provided by the National Coordinated Rice Variety Testing (NCRVT) program of the Rice Research Institute, Batalagoda, Sri Lanka.

Table 1: Details of 3 ½ -month rice variety trials

Variety label	Locations	Experimental design
Bw 04-992, Bw 03-1040, Ld 3-12-50, At 668, At 353, At 570, Bg 04-2236, Ld 1-5-15, Bg 358, Bg 359	Wet Zone: Labuduwa, Bentota Intermediate Zone: Bathalagoda Dry Zone: Ambalanthota, Aralaganwila, Samanthurei, Maha Illuppallama	Randomized complete block design with 4 replications (in each location)

In the presence of variety × location interaction, a 2-way table of means over the locations is computed and the variety means are averaged over all locations to obtain a productivity index (location index). Then, each genotype is regressed on the above index. Interpretations are based on the magnitude of the slopes of these regressions [2-3]. A genotype with slope (β) = 1 is most stable; the genotypes with slope (β) > 1 are highly sensitive to environment changes and are adapted to good environments; genotypes with slope (β) < 1 are stable and adapted to poor environments. Following Ghafoor *et al.*, [4], the stability of varieties can be grouped into several 'stability groups'. Wricke's ecovalance parameter (W_i^2), which is a stability index with lower values implying more stable, is used for ranking varieties.

3. Results

Table 2 shows a summary of the ANOVA for both seasons where the significance of the components was tested using the pooled error mean square.

Table 2: Combined ANOVA for 3 ½ -month varieties

Source of variation	d.f	Mean square	
		Maha	Yala
Location	6	56.55***	100.02***
Variety	9	3.54***	1.61***
Location × Variety	54	0.75**	0.75***

** significant at 1% level; ***significant at 0.1% level.

According to Table 2, there is a significant location × variety interaction in each season. Therefore, one has to carry out further analyses. Table 3 shows the slope of regression of variety performance on the productivity index for both seasons along with a ranking for the varieties based on the index W_i^2. The values of β have already been tested for significance and the conclusion is shown in Table 3.

Table 3: Coefficient of regression (β) of variety performance on the location index and variety rankings based on W_i^2

Variety	Season							
	Maha				Yala			
	β	Conclusion	W_i^2	Rank	β	Conclusion	W_i^2	Rank
Bw 04-992	0.886	β =1	0.86	4	1.224***	β >1	1.10	9
Bw 03-1040	0.893	β =1	0.58	2	1.062	β =1	0.97	5
Ld 3-12-50	1.058	β =1	1.08	7	0.679*	β <1	2.87	10
At 668	0.756	β =1	1.52	9	1.079	β =1	0.58	2
At 353	1.309***	β >1	1.03	6	1.108	β =1	0.66	4
At 570	1.432***	β >1	1.92	10	1.036	β =1	0.58	2
Bg 04-2236	0.878***	β <1	0.18	1	0.933	β =1	1.07	7
Ld 1-5-15	1.204	β =1	0.83	3	1.005	β =1	0.26	1
Bg 358	0.664*	β <1	1.36	8	0.893	β =1	1.03	6
Bg 359	0.898	β =1	0.86	4	0.989	β =1	1.07	7

4. Discussion and Conclusions

Maha Season:

According to Table 3, Bw 04 -992 , Bw 03-1040, Ld 3-12-50 , At 668, Ld 1-5-15,and Bg 359 are stable and can be adapted to any environment. At 353 and At 570 are highly sensitive to environmental changes. Bg 04-2236 and Bg 358 are highly stable and are adapted to poor environments. According to W_i^2, Bg 04-2236 is the most stable variety followed by Bw 03-1040, Ld 1-5-15, Bg 359, and Bw 04 -992. Overall, Bw 03-1040, Ld 1-5-15, Bg 359 and Bw 04-992 are more stable and can be adapted to any environment and At 570 is the most unstable variety.

Yala Season:

All the varieties except the two, Bw 04-992 and Ld 3-12-50, are stable and can be adapted to any environment. However, Bw 04-992 is highly sensitive to environmental changes. On the other hand, Ld 3-12-50 is highly stable and adapted to poor environments only. According to W_i^2, Ld 1-5-15 is the most stable variety followed by At 570 and At 668. Ld 1-5-15 is the only stable variety in both seasons that is adapted to any environment.

5. References

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