YIELD PERFORMANCE OF SEVEN RICE POPULATIONS IN RAINFED LOWLAND SYSTEMS IN THAILAND

J. Basnayake[1], S. Rajatasereekul [2], S. Seevisut[3], S. Fukai[1] and M. Cooper[1]

[1]School of Land and Food, The University of Queensland , Brisbane, Qld. 4072.
[2]Chum Phae Rice Experiment Station, Department of Agriculture, Thailand.
[3]Surin Rice Experiment Station, Department of Agriculture, Thailand.

Abstract

Seven rice populations were evaluated for their performance in seven rainfed lowland environments in Thailand. In total, 1070 lines were tested in small plots using a randomized complete block design. Plant height, days to flower and grain yield were measured and the data were analyzed separately and in combination across the seven environments. In most environments, significant genotypic variation among and within populations was identified for each attribute. The magnitude of variation within populations was greater than among populations. The variance components for population-by-environment interaction were higher than those for population. This interaction affected the ranking of the mean yield of the populations across environments and indicated that selection based on results from particular environments was unlikely to identify populations or lines that performed well in other environments.

Key words: Population-by-environment interaction, variance components, rainfed lowland rice.

Rice cultivation under rainfed lowland conditions in Thailand is highly prone to periods of moderate to severe drought (1). In this system, yield reduction depends on the timing and intensity of drought during the growth period (2). As a preliminary investigation of appropriate selection strategies for rainfed lowland rice in Thailand, the magnitude of the variance components (VC) among and within populations for yield, days to flower and height was examined in a multi-environment trial conducted across seven sites in 1996 for seven breeding populations in Thailand.

Methods

The locations were Surin (SRN), Chum Phae (CPA), Phitsanulok (PSL), Sanpatong (SPT), Sakon Nakhon (SKN), Ubon Ratchathani (UBN) and Phimai (PMI). In total, 1070 lines were tested in a randomised block design with 2 replications. Seedlings were transplanted in small plots of 3 m by 2 rows with 25 and 20 cm between and within row spacing, respectively. Irrigation was applied only just before transplanting. Measurements were taken on days to flower, plant height and grain yield at maturity. Data were analyzed separately and in combination across the seven environments using the procedure of Residual Maximum Likelihood (REML). Components of variance were estimated for among and within populations for each environment, and for population, environment and population-by-environment interaction from the combined analysis.

Results and discussion

Significant genotypic variation ($P<0.05$) among and within populations was identified for grain yield in most environments. Populations 6, 7 and 3 produced the highest mean yield of 2873, 2860 and 2849 kg/ha,? respectively. The magnitude of the variation within populations was generally greater than that among populations (Table 1). However, at UBN, a low yielding environment, the among population VC was larger the than the within population VC. The VC for population-by-environment interaction (0.61?0.05 10^5) was higher than the VC for population (0.34?0.01 10^5). This interaction affected the ranking of mean yield of the populations across environments.

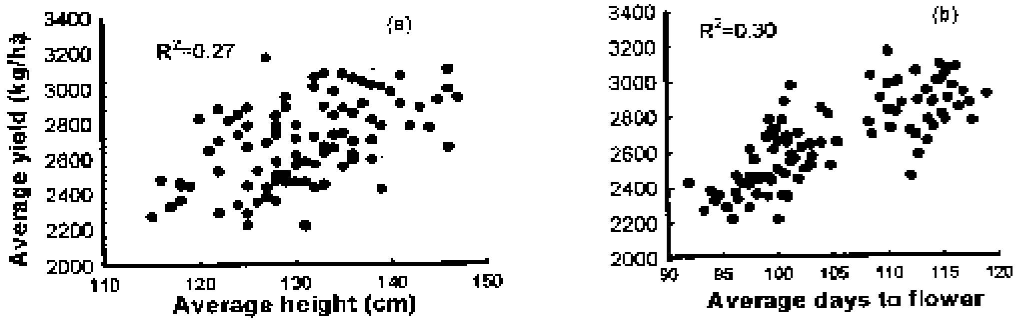

Figure 1. Relationship between plant height and grain yield and days to flower and grain yield among lines from populatios 3.

The results suggested that selection based on results from a particular environment was unlikely to identify populations? that performed well in other environments.

Both among and within population variation were significant ($P<0.05$) for days to flower and height in the seven environments. The VC estimates for lines within population were higher than among populations. The combined analysis for days to flower and height showed that most of the variation accounted for population (21.2?8.5, 96.03?12.5) while population-by-environment interaction (4.6?0.35, 8.96?1.25) had a limited influence. There was a positive relationship between height and grain yield (Fig. 1a) and days to flower and grain yield (Fig.1b) within populations.

The presence of genetic variation among and within populations suggests that any selection strategy must consider selection at both the population level as well as selection within populations. Similarly, the presence of population-by-environment interaction requires evaluation of populations across number of environments. Evaluation of many lines from within populations in small plots can be complicated by variation for plant height and flowering time and inter-plot competition. Further investigations are being continued to assess the impact of these competitions.

Acknowledgements

Table 1. Components of variation and approximate standard errors for grain yield, days to flower and plant height for population, line within population and experimental error estimated from the analysis of variance at individual site.

		Environments (E)						
	Components	CPA	PSL	SPT	SKN	UBN	PMI	SRN
Grain Yield (kg/ha x 10^{-1})	Population	1.26+0.14	0.82±0.51	0.58±0.31	0.41+0.24	0.79+0.47	1.83±1.07	0.20±0.12
	Line/Population	2.52+0.16	8.72+0.39	2.03±0.37	0.64±0.09	0.29±0.11	1.75±0.28	0.18±0.14
	Exp. Error	2.45±0.10	0.59±0.02	5.48±0.23	2.28±0.09	3.35±0.14	6.80+0.31	4.48±0.19
Days to Flower	Population	36.1±20.4	40.7+23.8	11.4+6.7	22.9±13.7	25.2±14.8	15.1+8.8	28.4±16.6
	Line/Population	53.0±2.41	80.5+3.74	21.3+1.1	23.3±6.36	43.3±2.30	23.8+1.6	48.7±2.27
	Exp.Error	35.1±1.50	11.1±0.48	7.1+0.3	16.5±7.70	17.8±0.77	20.8±0.9	7.2±0.31
Plant Height (cm)	Population	105.1±62	205.3+51.1	107+63.4	84±49.4	83.3+49.0	72.4±42.6	78.5±46.3
	Line/Population	264.8±13	433.5±8.71	256+13.2	105±8.9	155.2±9.1	79.5+12.7	184.9±9.76
	Exp.Error	54.7±2.3	140.2±6.44	89+3.87	145±6.8	98.5±4.3	314±14.0	73.9±3.20

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References

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