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Genotypic and phenotypic correlations of yield components in rice (*Oryza sativa L.*)

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Abstract

Maximum tiller number, number of panicles per hill, productive tillers (%), high density (HD) grain index (HDI), thousand seed weight (g) and panicle weight (g) of eight varieties of rice (*Oryza sativa* L.) grown in a randomized complete block design with three replications were studied. In general, genotypic correlation coefficients were higher than the corresponding values of phenotypic ones, indicating the masking effect of the environment. The highest productive tillers percentage was observed in medium tillering varieties. HDI and panicle weight were high in low tillering varieties. Maximum tiller number and number of panicles per hill have negative effects on panicle weight. Again the productive tillers percentage also has a similar effect on thousand grain weight. The weak correlations between HDI and other yield components indicate the possibility of improving HDI without sacrificing the other yield components.

Introduction

Rice (*Oryza sativa* L) is the most important food crop in the tropical and sub tropical regions of the world. The earliest references to rice cultivation in Sri Lanka dates back to about 543 B.C. (Nanayakkara, 1987). Production of adequate quantities of food, specially rice to meet the requirements of the expanding population in Sri Lanka is one of the main aims of our development strategy. With the present rate of population growth, Sri Lanka's population in the year 2000 would be around 20 million (Nanayakkara, 1987). The farmers of Sri Lanka, therefore face a formidable challenge to produce more and more rice each year to make the country self-sufficient in rice. Unfortunately present potential yield of rice appear to have reached a plateau (Anon, 1988). Therefore a knowledge of the interrelationship among yield components is important to explore the possibilities of further modifying the present high yielding plant type of rice.

Plants grow within the confines of horizontal (HS) and vertical (VS) space. HS provides anchorage, VS furnishes solar energy, Co_2 , O, water and mineral nutrients. Crop productivity depends primarily on the plants' ability to utilize HS and VS. An efficient plant would be one which occupies the minimum HS, but the maximum VS (Janoria 1989). Efficient use of HS by a rice cultivar implies maximum panicles per unit of HS without reduction in main panicle yield. This requires maximum productive tillers per unit of HS, heavy panicles, high density (HD) grains etc.

Malik et al (1989) showed that grain yield could be improved by increasing HD grains (fully filled grains) percentage. Venkateswarlu et al (1986) reported that HD grains have not only higher weight but also higher milling and head rice recovery. Therefore phenotypic and genotypic correlations among high density grain percentage and other agronomic characters were estimated in this study.

Materials and Methods.

Eight varieties of rice showing considerable variability in agronomic characteristics were used for this study. Experiments were conducted at the Research Farm, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka in 1989.

Rice varieties were grown in a randomized complete block design with three replications. Plot size was 3 x 3 m. Spacing between and within rows was 15 cm. Planting was done at the rate of one seedling per hill. Recommended doses of fertilizer were applied before and after planting. Pests and diseases were controlled by applying recommended doses of pesticides and fungicides.

The observations were recorded on 20 competitive plants selected randomly from each plot. The characters studied were maximum tiller number, number of panicles per hill, productive tillers (%), panicle weight (g), HD grain index (HDI) and 1000 grains weight (g).

Plants were harvested at maturity and spikelets were separated. These spikelets were immersed in 1.2 specific

gravity salt solution. Submerged grains were identified as HD grains. The HDI was calculated as the number of HD grains divided by the number of spikelets per plant.

Results and Discussion.

The study revealed that there were significant differences in yield components among varieties (Table 1). The highest productive tiller percentage was observed in medium tillering varieties (Table 2). Varieties with high tiller number showed low productive tiller percentages. This may be due to the fact that late tillers were mostly small and non flowering. HDI and panicle weight were high in low tillering varieties. This indicated that HDI of primary tillers was higher than that of secondary or tertiary tillers. Similar results were reported by Rao (1987).

Table 1. Analysis of variance for yield components of rice.

		Mean Squares					
Source of variation	df	Maximum tiller number	Number of panicles per hill	Productive tiller (%)	HDI (%)	1000 grain *weight*	Panicle weight
Blocks	2	0.8861	0.7141	44.3052	47.4686	0.8574	0.8231
Varieties	7	26.3176[a]	5.3885[a]	162.8490[a]	598.8858[a]	5.3046[a]	1.5224[a]
Error	14	0.7006	0.3455	13.4175	21.0719	0.2451	0.0524

[a] *p< 0.001*

Table 2. Means of the yield components of eight rice varieties.

Variety	Maximum tiller number	Number of panicles per hill	Productive tiller (%)	HDI (%)	1000 grain weight (g)	Panicle weight (g)
BG 350	14.92^{a}	5.29^{ab}	40.41^{c}	19.37^{cd}	25.69^{b}	3.18^{c}
BG 94-1	13.92^{a}	4.63^{bc}	39.35^{c}	32.21^{bc}	27.02^{a}	3.49^{c}
BG 1165-1	12.23^{b}	6.20^{a}	55.25^{ab}	26.45^{c}	23.73^{cd}	2.14^{d}
BG 846	10.25^{c}	5.10^{b}	55.58^{a}	35.96^{b}	24.38^{c}	3.16^{c}
BG 797	9.33^{cd}	4.80^{bc}	59.35^{a}	50.61^{a}	26.03^{b}	3.82^{bc}
BG 1492	8.53^{d}	3.73^{c}	54.73^{ab}	38.89^{b}	23.43^{d}	3.50^{c}
BG 276-5	7.60^{de}	2.38^{d}	47.93^{b}	17.18^{d}	26.46^{ab}	4.10^{b}
BG 300	6.82^{e}	2.57^{d}	48.61^{b}	57.26^{a}	26.07^{b}	4.53^{a}

In a column, means followed by the same letter are not significantly different at 5% level by DMRT.

In general, genotypic correlation coefficients were higher than the corresponding values of phenotypic ones, indicating the masking effect of the environment (Table 3). Maximum tiller number per hill exhibited a significant positive correlation with number of panicles per plant. But it was not correlated with productive tiller percentage. The panicle weight had a significant negative correlation with maximum tiller number and number of panicles per plant. This may be due to the fact that an increase of the tillers and panicles resulted in low storage food of each panicle. Hayashi (1976) reported that the low tillering varieties produced heavy panicles. Tanaka (1965) reported that weak tillers and small panicles decreased grain yield. Thousand grains weight had a

significant negative correlation with productive tiller percentage. But it had a significant positive correlation with panicle weight. HDI has not shown any significant correlation with the other characters studied.

Table 3. Genotypic and phenotypic (within parentheses) correlation coefficients among 6 characters in rice.

Character	Maximum tiller number	Number of panicles per hill	Productive tiller (%)	HDI (%)	1000 grain weight
Number of panicles per hill	0.7931[a] (0.7342)[a]				
Productive tiller(%)	-0.5404 (-0.4763)	0.1176 (0.2422)			
HDI (%)	-0.5434 (-0.4811)	-0.2268 (-0.2403)	0.5643 (0.3579)		
1000 grain weight (g)	0.1645 (0.1013)	-0.4894 (-0.4312)	-0.7231[b] (-0.5166)	0.1342 (-0.0024)	
Panicle weight (g)	-0.7013[b] (-0.6914)[b]	-0.9338[a] (-0.8689)[a]	-0.1304 (-0.1748)	0.4647 (0.4231)	0.7256[b] (0.5432)

[a] $p<0.05$, [b] $p<0.01$

Venkateswarlu et al (1987) have found that HD grain yield was not related to vegetative growth duration. Samantasinghar and Sahu (1986) reported that there was no significant decrease in HD grains with increase spikelets number per

panicle. Rao (1987) found that HDI was higher in early varieties compared to late varieties. Choi and Kwan (1985) and Zhang et al (1987) reported that varieties with moderate tillering capacity, large panicles and HDI were the most desirable in terms of high yields.

Conclusion.

The interrelationship among yield components would help the breeder in selection of rice varieties for high yield and good quality. The weak correlations between HDI and other yield components indicate the possibility of improving HDI without sacrificing the other yield components.

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