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Correlation and Path Analysis of Quantitative Characters of Rice Ratoon Cultivars and Advance Lines

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ABSTRACT

Thirty varieties and advanced lines of rice were used to study the rice ratoon grain yield, ratoon rating, quantitative parameters, and their correlation and path coefficients. Grain yield showed positive correlation with plant height, ratoon rating, 1000 grain weight, number of panicles, panicle length, seed length, and tillers at harvest. Path analysis indicated that ratoon crop parameters had low positive direct effects. It was revealed from the contribution of individual characters to the variance of yield that the contribution of the characters to the determination of yield was largest for total tillers at harvest, panicles per plant, panicle length and finally ratoon rating. The study suggests that selecting varieties may base higher ratoon rice grain yields or advanced lines, which has higher tillers, more panicles per plant, lengthy panicles, and high ratoon rating.

Key Words: Correlation; Path analysis; Rice ratoon; Yield parameters

INTRODUCTION

Lack of acceptance of rice ratooning by commercial farmers has been attributed to low yields, lack of good ratooning varieties, uneven maturity, disease and insect problem, lack of locations, specific cultural practices, inferior grain quality and lack of assured return from investment (Chauhan *et al*., 1985). Ratooning ability has been found to be a varietal character (Balasubramanian *et al*., 1970; Bahar & De Datta, 1977; Haque, 1975; Nadal & Carangal, 1979). Further, Nadal and Carangal (1979) identified three rice selections without standing tillering capacities and high ratoon yields under varying soil moisture regimes. Stem thickness is correlated with higher carbohydrate content in the stubbles. This could have induced more vigorous regeneration of ratoon tillers, resulting in the production of a larger number of tillers and higher grain yield (Palchamy & Purushothaman, 1988). Ratoon growth of rice depends upon the amount of Total Carbohydrate Content (TAC) in the stem base, at early growth. The large amount of TAC is required to produce many tillers, and it would be achieved by high cutting of main crop stubbles, because the amount of TAC in the stubbles increases with cutting height (Ichii & Ogaya, 1985). Ratoon growth after the early stage was affected not only by the amount of reserves in the stem base but also by photosynthetic products in foliage. However, the dependence of photosynthesis in the foliage is far less important in determining tiller number than it is in determining foliage weight, because tiller number became constant more rapidly than foliage weight after main crop harvest. Ratoon plants should have sufficient tillers in the early stage after the main crop harvest to achieve high yields. Cultivars and cultural practices, including cutting height and fertilizer management, which provide a large quantity of reserves at harvest, may be advantageous for rice ratooning (Ichii, 1984). Tillers that regenerated from higher nodes formed more quickly grew faster and matured earlier (Prashar, 1970). Thus, the rice ratooning offers an opportunity to increase cropping intensity per unit of cultivated area because a ratoon crop has the short growth duration than the main crop. In addition ratoon crop may be grown with 50% less labour. Neither land preparation nor planting is needed and the crop uses 60% less water than the main crop and the yield of the ratoon crop may be achieved by 50% of the main crop (Oad *et al*., 2002). The knowledge of the interrelationship of grain yield with other important characters is necessary to determine which of these characters could be used for high rice ratoon grain yield. Correlation coefficient has been employed for this purpose. However, the correlation coefficient between two characters does not necessarily imply a cause and effect relationship. The inter-relationship could be grasped best if a coefficient could be assigned to each path in the diagram designed to measure the direct influence among it. Different researchers also have suggested that the prospect of successful ratoon cultivation depends largely on ratooning of a variety.

The present study was made to understand the association of ratoon grain yield and some economically important quantitative characters, which have direct contribution to the variation of ratoon grain yield.

MATERIALS AND METHODS

The field experiment was laid-down to evaluate the ratoon grain yield potentials of thirty 30 rice cultivars and advanced lines lines under lowland conditions during wet season at Philippine Rice Research Institute (PhilRice) located at Maligaya, Munoz, Nueva Ecija, Philippines. The experiment was laid out in RCBD, replicated three times.

Varieties tested. Thirty varieties and advance lines belonging to early and medium maturity were collected form PhilRice. Twelve varieties/lines used were from Philippine Seed Board and 18 were promising lines from PhilRice. The list is as under:

PR 23373-13	IR 54950-181-2-1-2-3	IR-59682-49-16-1-3	C 3563-B-5-1
IR 57311-95-2-3	PR 22909	PR 22378-848	PR 22892-235
PR 22186-446	PR 23364-13	IR 58082-126-1-2	R 23352-7
C 3008-8-2-2-1-2	IR 5809941-2-3	IR 57298-31-2-2	PR 23468-1
IR 56381-1-39-2-2	MRC 23365-12	IR 66	IR 65
IR 62	IR 72	IR 36	IR 56
PSB Rc 8	IR 64	BPI Ri 12	BPI Ri 10
PSBRc 6		PSBRc 4	

Fertilizer. Basal fertilizer for the main crop was 60-30-30 kg NPK ha^{-1}. This was applied at final harrowing, while, the remaining 40 kg N ha^{-1} was top dressed in two equal splits i.e. at active tillering and at panicle initiation stage. In ratoon crop, 40 kg N ha^{-1} was applied in two equal splits, first at harvest of main crop as basal N and second at 20 days after harvest of main crop.

Water management. Recommended water level 4-5 cm (flooded condition) was maintained in all plots after transplanting upto five days before harvesting. The plots were drained five days before the harvesting date. The first irrigation to ratoon crop was applied five days after harvest of main crop.

Harvesting the main crop. The main crop was harvested 30 days after heading and more specifically at the start of yellowing of culm (Parago, 1963).

Ratoon vigour. This was measured using the following scale:

1= Excellent growth (The plants were free from disease, insect pests and had 20 tillers).

5= Intermediate growth (The plants were free from disease, insect pest and possessed 10-20 tillers).

9= Tillers were very small and weak, and were few in number at most 5.

Ratoon rating. This was computed as follows:

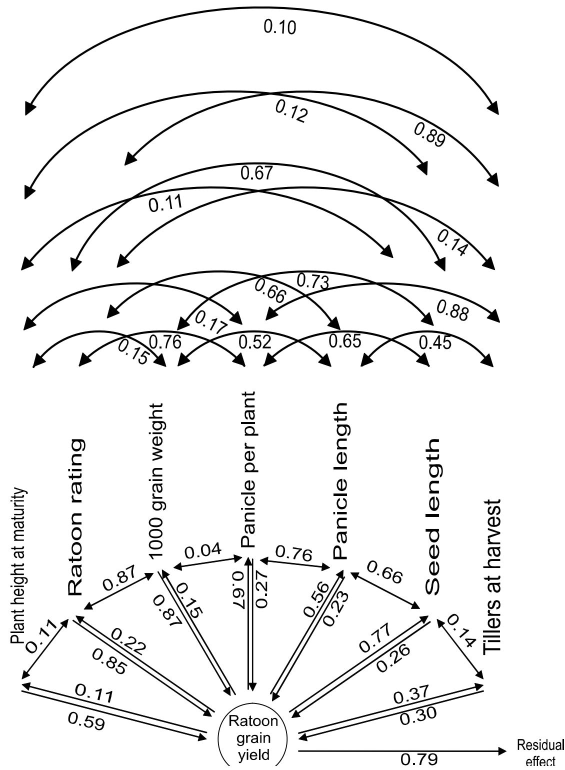
Ratoon rating = (1-0.1 ratoon vigour) x 1 (Missing hills/plot)/(total hills/plot) x (Total tillers/hill/16)

All data were analyzed following the procedures of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

All possible correlations among the different characters were measured (Table I, II and III; Fig. 1). Ratoon grain yield showed positive correlation with plant height (r=0.59), ratoon rating (r=0.85), 1000 grain weight (r=0.87), number of panicles per plant (r=0.67), panicle length (r=0.56), seed length (r=0.77), and tillers at harvest (r=0.73). Plant height at maturity showed non-significant association with all other growth parameters by recording correlation coefficient values i.e. Ratoon rating (r=0.11), 1000 grain weight (r=0.15), number of panicles (r=0.17), panicle length (r=0.11), seed length (r=0.12), and tillers at harvest (r=0.10), however, plant height had only positive correlation with ratoon grain yield.

Fig. 1. Path diagram and correlation coefficients of seven characters. Single headed arrow denotes direct effect on yield; double headed arrow denotes the correlation coefficients between traits



Ratoon rating had significantly positive perfect correlation with all the studied yield parameters of i.e. 1000 grain weight (r=0.87), number of panicles (r=0.76), panicle length (r=0.88), seed length (r=0.67), and tillers at harvest (r=0.89). 1000 grain weight was positively correlated with panicle length (r=0.52), and seed length (r=0.73), however it showed non-significant relationship with panicles per plant (r=0.04), and tiller number at harvest (r=0.14). Panicles per plant exhibited positive perfect correlation with panicle length (r=0.76), seed length (r=0.65), and tillers at harvest (r=0.88).

Table I. Correlation coefficients (r) among different traits

Characters	Grain yield	Plant height	Ratoon rating	1000 grain weight	Panicles per plant	Panicle length	Seed length	Tillers at harvest
Grain yield		1.00						
Plant height		0.59**	1.00					
Ratoon rating	0.85**	0.11ns	1.00					
1000 grain weight	0.87**	0.15ns	0.87**	1.00				
Panicles/plant	0.67**	0.17ns	0.76**	0.04ns	1.00			
Panicle length	0.56**	0.11ns	0.88**	0.52**	0.76**	1.00		
Seed length		0.77**	0.12ns	0.67**	0.73**	0.65**	0.66**	1.00
Tillers at harvest.	0.73**	0.10ns	0.89**	0.14ns	0.88**	0.45**	0.14ns	1.00

** = Significant at 1% probability level; ns = Non-significant

Table II. Direct and indirect effects of seven plant characters on yield of rice ratoon

Characters	Grain yield r value	Direct effect	Plant height	Ratooning rating	1000 grain weight	Panicles per plant	Panicle length	Seed length	Tillers at harvest
Plant height	0.59**	0.11	-						
Ratoon rating	0.85**	0.22	0.10	-					
1000 grain weight	0.87**	0.15	0.05	0.23	-				
Panicles/plant	0.67**	0.27	0.06	0.33	0.03	-			
Panicle length	0.56**	0.23	0.08	0.22	0.06	0.12			
Seed length	0.77**	0.26	0.08	0.31	0.32	0.22	0.05	-	
Tillers at harvest.	0.73**	0.30	0.04	0.34	0.11	0.11	0.02	0.14	-

** = Significant at 1% probability level

Table III. Correlation coefficients, path coefficients and variance components due to regression of seven characters on rice ratoon grain yield

			Variance components due to regression	
	Correlation Coefficient With yield (rio)	Path Coefficient to yield (poi)	Direct ($p^2o(i)$)	Total (poi x rio)
Plant height	0.59**	0.11	0.0121	0.00133
Ratoon rating	0.85**	0.22	0.0484	0.01064
1000 grain weight	0.87**	0.15	0.0225	0.00337
Panicles/plant	0.67**	0.27	0.0729	0.01968
Panicle length	0.56**	0.23	0.0529	0.01216
Seed length	0.77**	0.26	0.0676	0.01757
Tillers at harvest.	0.73**	0.30	0.0900	0.02700

** = Significant at 1% probability level

The results of the study agree with the earlier findings of Satpathy and Gagneja (1978) who reported lack of association between ear-bearing tiller and yield. Ish Kumar and Siani (1973) reported that number of effective tiller number was an important character for making selection for yield in a rice breeding programme. Further, it was found that the prospect of successful ratoon cultivation depends largely on ratooning of a variety. Among the plant characteristics sought for high yield potential, plant type and growth economic parameters have received extensive consideration (Poehlman, 1976). Haque (1975) found out that IR2061- U23, IR2145-20-4 and IR1924-36-22 possessed high ratooning ability. In India, C3810, Ratna, CR20-66, and CR156-5021-207 showed superiority in ratooning and yield ability (Das & Ahmed, 1982). In China, some hybrid rices produced high grain yields and had high ratooning ability. The hybrid Zaishelgyou produced the highest main and ratoon crop yields resulting in a significantly higher total yield (11.0 t ha^{-1}).

CONCLUSIONS

This study confirms that in selecting the rice varieties for ratoon grain yield correlation studies are not sufficient enough, but, path analysis could be employed. This application is suitable for breeding programme and obtaining maximum ratoon grain yields.

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