

Correlation and Path Analysis Studies in Medium Duration Rice Varieties of Andhra Pradesh

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Abstract

The present investigation is carried out to study the correlation and path analysis in twenty five medium duration (120-125 days) varieties of rice (*Oryza sativa L.*). Character association of the yield attributing traits revealed significant positive association of grain yield per hectare with plant height, 1000 seed weight and panicle length. Hence selection in these traits can improve yield. In the present study high genetic coefficient of variation coupled with high heritability and high genetic advance was observed for number of seed/panicle, hence there is scope for improvement of the trait through simple selection. Path coefficient analysis revealed that 1000 seed weight recorded maximum positive direct effect on yield followed by panicle length. Among these characters, 1000 seed weight and panicle length possessed both positive association and high direct effects. Hence selection for these characters could bring improvement in yield and yield components.

Keywords: Correlation; Path analysis; Heritability; Rice; Yield

Introduction

Rice (*Oryza sativa L*) is one of the pivotal staple cereal crops feeding more than half of the world's population. In view of the growing population the basic objective of all the plant breeders would be towards yield improvement. It has been estimated that the world will have to produce 60 per cent more rice by 2030 than what it produced in 1995. Therefore increased production of rice plays a very important role in food security and poverty alleviation. Theoretically, rice still has great yield potential to be tapped and there are many ways to raise yield, such as building of irrigation works improvement of soil conditions, cultural techniques and breeding of high yielding varieties

Development of high yielding varieties requires information on association of characters contributing to yield in addition to their direct and indirect effects towards yield. This kind of analysis could help the breeder to design his selection strategies to improve grain yield. In this context the present investigation was carried out with the objective of studying the character association and path effects of yield components on grain yield in rice varieties of medium duration for their yield improvement. Earlier this work was reported by many researchers in various yield attributing characters like days to maturity [1-3], plant height [4-6], productive tiller/plant, panicle Length [7,8] and 1000 seed weight [6,9,10].

Materials and Methods

In the present investigation, 26 rice varieties of medium duration obtained from the rice research stations of Maruteru, Bapatla, Nellore, Khammam, Jagityal, Warangal, Nandyal and Rajendranagar of Acharya N.G. Ranga Agricultural University, Hyderabad were evaluated. Research stations from where the varieties were developed are furnished in Table 1. The seeds were sown during kharif 2013 at Regional Agricultural Research Station, Nandyal in a randomized block design with three replications. Further 20-30 days old seedling of each variety was transplanted in a 15 m² plot at a spacing of 15 X 20 cm. All recommended packages of practices were followed along with nursery plant protection measures to raise a healthy crop. Observations were recorded on

different parameters like days to 50% flowering, plant height number of effective tillers per plant, panicle length, number of seeds per panicle, 1000 seed weight (g) and grain yield per ha and the data was subjected to statistical analysis, as per the procedures outlined for correlation coefficient [11] and path analysis [12] using software like Indostat Ver 8.5.

S.No	Entry Name	Developed Research Station	Salient features
1	NDLR-7	Regional Agricultural Research Station, Nandyal	High yielding, BPH Blast tolerant, Fine grain (short slender, medium duration) like that of BPT 5204, Fertilizer responsive, Non lodging, Non shattering, suitable to late planting & Suitable to both seasons.
2	NDLR-8		High yielding, BPH Blast tolerant, short bold grain (medium slender, medium duration) like that of BPT 5204, Fertilizer responsive, Suitable to both seasons.
3	BPT 2613	Rice Research Unit, Bapatla	
4	BPT 2676		
5	BPT 2571		
6	BPT 2678		
7	BPT 2618		
8	NLR 3353	Agricultural Research Station, Nellore	
9	NLR 3302		
10	NLR 3349		
11	NLR 3350		
12	NLR 3357		
13	WGL 674	Regional Agricultural Research Station, Warangal	
14	WGL667		
15	JGL 17653	Regional Agricultural Research Station, Jagityal	
16	JGL 18799		
17	MTU 1001	Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru	High yielding BPH Blast tolerant, Medium duration with strong dormancy suitable for both seasons
18	MTU RM 39-52-1-1		
19	MTU 2152-5-1-1-5		
20	MTU 2051-3-2-3		
21	MTU 126-1-6-1		
22	MTU 11 365-62-1-1		
23	KPS 3018	Agricultural Research Station, Kunaraml	
24	KPS 2874		
25	RNR 17470	Rice Research Unit, Rajendranagar.	
26	RNR 10269		

Table 1: Rice varieties developed from different research station of Andhra Pradesh

Results and Discussion

Effective selection depends on identifying key characters and knowledge on the magnitude and direction of association between yield and its attributing characters aid in effective selections and yield improvement. The analysis of variance for grain yield and yield attributing characters is presented in Table 2. A perusal of these results revealed the presence of significant differences among the genotypes studied indicating the effectiveness of selection for improvement of these traits. The data recorded on estimates of variability and genetic parameters for yield and yield attributing characters presented in Table 3. An analysis of these results revealed wide range of variability for grain yield/ ha followed by effective tillers /plant. The phenotypic coefficient of variation (PCV) was observed to be higher than the genotypic coefficient of variation (GCV) for all traits studied in the present investigation, indicating the influence of environment. The extent of environmental influence (Environmental Coefficient of Variation: ECV) is explained by the amount of the difference between GCV and PCV and it ranged from 0.11 (Days to 50% flowering) to 1.93 (Effective tillers/plant) in the present study. Further high phenotypic and genotypic coefficient of variation was observed for number of seeds per panicle (>20%). Therefore the characters, effective tiller per plant, 1000 seed weight and grain yield recorded moderate (10-20%) estimates of genotypic and phenotypic estimates of variation. Low (<10%) estimates of GCV and PCV were however observed for days to 50 per cent flowering, plant height and panicle length.

Source of variance	Degrees of freedom	Days to 50% flowering	Plant height	Effective tillers for Plant	Panicle length	No. of seed/ Panicle	1000 SW	Seed yield/ha
Replication	2	2.09	4.13	3.96	2.61	8.42	3.77**	866576.81
Varieties	25	60.46**	129.85**	10.81**	4.94**	9307.31**	26.94**	1698480.99**
Error	50	3.08	10.70	3.11	1.67	131.89	0.53	404894.03

**Significant at P=0.05 and P=0.01 levels respectively

Table 2: ANOVA table for yield and yield attributing characters of medium duration rice varieties

Characters	Mean	Range		Coefficient variation		Heritability In broad sense	Genetic advance as percent mean
		Min.	Max.	Genotypic (GCV)	Phenotypic (PCV)		
Days to 50% flowering	108.53	96.00	114.33	4.03	4.14	0.95	8.09
Plant height	108.81	97.10	118.30	5.79	6.05	0.92	11.43
Effective tillers/plant	15.35	12.00	18.67	10.44	12.37	0.71	18.16
Panicle length	23.06	20.63	25.70	4.53	5.57	0.66	7.59
No. of seed/Panicle	246.81	176.33	367.33	22.41	22.57	0.99	45.83
1000 SW (g)	18.10	13.52	24.03	16.39	16.56	0.98	33.44
Seed yield/ha	6266.23	4622	7822	10.48	12.01	0.76	18.84

Table 3: Estimates the variability and genetic parameters for yield and yield attributing characters in medium duration rice

High heritability (>0.60) was recorded for days to 50% flowering, plant height, number of effective tillers per plant, panicle length, number of seeds per panicle, 1000 seed weight and grain yield. The findings are in accordance with the results [13] who reported moderate PCV and GCV for productive tillers per plant and high heritability with moderate genetic advance with respect to days to maturity. The results on genetic advance as percent mean revealed high estimates ($>20\%$) for number of seeds per panicle and 1000 seed weight. The findings are in agreement with the reports [14] who recorded higher PCV, GCV with high heritability and high genetic advance with respect to filled grains per panicle. However moderate estimates (10-20%) were recorded for plant height and productive tillers per plant with moderate heritability and high genetic advance [15] and with high GCV and PCV coupled with high heritability and genetic advance with effective tillers per plant and grain yield [16] while low estimates ($<10\%$) were recorded for days to 50 per cent flowering and panicle length with low PCV and GCV coupled with high heritability and moderate genetic advance [13].

High heritability coupled with high genetic advance as percent mean was recorded for number of filled grains per panicle and 1000 seed weight in the present study indicating that these characters are governed by additive gene action and therefore simple selection would be effective for improvement of these characters. These findings are in agreement with the reports of moderate PCV and GCV coupled with high heritability and genetic advance with respect to 1000 seed weight [14,17]. High heritability with moderate genetic advance as percent mean was recorded for plant height, effective tillers per plant and grain yield indicating that heritability for these traits was due to both additive and non additive gene effects and hence simple selection may not be effective for improvement of these characters. The results are in agreement with the reports for plant height [14] and for effective tillers per plant and grain yield [16]. Further the characters namely days to 50% flowering and panicle length had recorded high heritability coupled with low genetic advance as percent mean indicating the predominant role of non additive gene effects such as epistasis and dominance. Similar results were reported earlier [8,18] who reported that information on genetic variation along with heritability and genetic advance estimates would give better idea about the efficacy of selection. In the present study high GCV and PCV coupled with high heritability and high genetic advance as percent mean was observed for number of seeds per panicle indicating the preponderance of additive gene action and a scope for improvement of the trait through simple selection. These results are in conformity with reports [10].

Phenotypic and genotypic correlation between yield and yield components are presented in Table 4. The results revealed that higher estimates of genotypic coefficients, compared to phenotypic coefficients for most of the characters studied indicating the masking modifying effects of environments and similar results were reported [8]. Further effective tillers per plant had recorded negative and significant correlation with panicle length probably due to competition for a common possibility such as nutrient supply indicating the need for balanced selection while effecting improvement for these traits. These findings are in conformity with the reports [2,19] who recorded positive and significant correlation with respect to filled grains per panicle and plant height whereas days to 50 per cent flowering had recorded positive and significant correlation with plant height, 1000 seed weight and panicle length [20]. Further 1000 seed weight, panicle length and plant height had also recorded positive and significant correlation with grain yield indicating an increase in yield with an increase in these characters. Therefore, priority should be given to these traits, while making selection for yield improvement. These findings are in agreement with the reports [6] which recorded positive and significant correlation with respect to filled grains per panicle and 1000 seed weight.

Character	Effective tillers for Plant	Days to 50% flowering	1000 SW	Panicle length	Plant height	No. of seed /Panicle	Seed yield /ha
Effective tillers for Plant	1.000 (1.000)	-0.0504 (-0.0795)	-0.5582 (-0.6580)	-0.3163** (-0.5765)	-0.0211 (-0.0103)	-0.0122 (-0.0179)	-0.1434 (-0.1566)
Days to 50% flowering		1.000 (1.000)	0.0916 (0.0946)	-0.0658 (-0.1139)	0.2880* (0.3131)	-0.1835 (-0.1927)	-0.1311 (-0.1550)
1000 SW			1.000 (1.000)	0.0752 (0.1069)	0.0082 (0.0022)	-0.4107 (-0.4168)	0.3261** (0.3926)
Panicle length				1.000 (1.000)	0.2529* (0.2791)	0.1737 (0.2200)	0.2382* (0.3395)
Plant height					1.000 (1.000)	0.2933** (0.3025)	0.2355* (0.2901)
No. of seed/Panicle						1.000 (1.000)	0.1810 (0.2060)
Seed yield/ha							1.000 (1.000)

**Significant at 1 percent level * Significant at 5 percent level

Figures in parenthesis are genotypic correlation coefficients

Table 4: Estimates of phenotypic and genotypic correlation coefficient between yield and yield component characters of medium duration rice varieties

Among all the characters 1000 seed weight had the maximum positive effect on grain yield followed by panicle length [4].

Path co-efficient analysis provides an efficient means of finding out the direct and indirect causes of association and presents a critical examination of the specific forces acting to produce a given correlation and also measures the relative importance of each casual factor, hence the study of direct and indirect effects of yield components on grain yield was undertaken in the present investigation and the results obtained are presented in Table 5.

Character	Effective tillers for Plant	Days to 50% flowering	1000 SW	Panicle length	Plant height	No. of seed /Panicle
Effective tillers for Plant	0.2445 (1.3051)	-0.0123 (-0.1038)	-0.1365 (-0.8587)	-0.0773 (-0.7524)	-0.0052 (-0.0135)	-0.0030 (-0.0234)
Days to 50% flowering	0.0070 (-0.0084)	-0.1399 (0.1058)	-0.0128 (0.0100)	0.0092 (-0.0120)	-0.0403 (0.0331)	0.0257 (-0.0204)
1000 SW	-0.3346 (-0.9576)	0.0549 (0.1376)	0.5994 (1.4554)	0.0451 (0.1555)	0.0049 (0.0032)	0.2462 (-0.6065)
Panicle length	-0.0534 (-0.4845)	-0.0111 (-0.0957)	0.0127 (0.0898)	0.1688 (0.8405)	0.0427 (0.2346)	0.0293 (0.1850)
Plant height	-0.0029 (0.0019)	0.0389 (-0.0587)	0.0011 (-0.0004)	0.0341 (-0.0523)	0.1353 (-0.1875)	0.0396 (-0.0567)
No. of seed/Panicle	-0.0041 (-0.0131)	-0.0616 (-0.1403)	-0.1378 (-0.3034)	0.0583 (0.1602)	0.0984 (0.2203)	0.3356 (0.7281)
Seed yield/ha	-0.1434 (-0.1566)	-0.1311 (-0.1550)	0.3261 (0.3926)	0.2382 (0.3395)	0.2355 (0.2901)	0.1810 (0.2060)
Partial R ²	-0.0351 (-0.2044)	0.0183 (-0.0164)	0.1955 (0.5714)	0.0402 (0.2853)	0.0318 (-0.0544)	0.0607 (0.1500)

Residual Effect (Phenotypic) = 0.8298

Residual Effect (Genotypic) = 0.5181

Figures in parenthesis are genotypic effects

Table 5: Estimates direct and indirect effects between yield and yield components

Conclusion

Studies on correlation and path analysis in medium duration rice varieties showed that some of the characters could not produce significant correlation with single plant yield which might be due to high negative direct effects. Critical analysis of results obtained from character association and path analysis indicated that days to 50% flowering recorded positive and significant correlation with plant height, 1000 seed weight and panicle length. 1000 seed weight had maximum positive effect on grain yield followed by panicle length. Hence selection for the traits with high heritability coupled with high genetic advance like days to 50% flowering, plant height, number of effective tiller per plant, panicle length, number of filled grains per panicle, 1000 seed weight and yield could bring improvement in yield and yield components of medium duration rice varieties.

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