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Correlation and Path Analysis Studies in Popular Rice Hybrids of India

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***Abstract*-** The present investigation is carried out to study the correlation and path analysis in twenty one popular hybrids of rice (*Oryza sativa* L.). Character association of the yield attributing traits revealed significantly positive association of grain yield per plant with number of productive tillers per plant. Hence, selection for these traits can improve yield. Path coefficient analysis revealed that panicle length and number of productive tillers per plant exhibited positive direct effect on yield. Among these characters, number of productive tillers per plant possessed both positive association and high direct effects. Hence, selection for this character could bring improvement in yield and yield components.

***Index Terms*-** Correlation, Path Analysis, Rice and Yield

I. INTRODUCTION

Rice (Oryza sativa L.) is one of the pivotal staple cereal crops feeding more than half of the world population. In view of the growing population, the basic objective of the plant breeders would always be towards yield improvement in staple food crops. It has been estimated that the world will have to produce 60% more rice by 2030 than what it produced in 1995. Therefore, to increase 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 rice yield, such as building of irrigation works, improvement of soil conditions, cultural techniques and breeding of high yielding varieties. Among them, it seems at present that the most effective and economic way available is to develop "hybrid varieties".

Hybrid rice technology has proved to be one of the most feasible and readily adoptable approaches to break the yield barrier, as they yield about 15-20 per cent more than the best of the improved or High Yielding Varieties. China ranks first in Hybrid rice production in terms of area and production i.e. about 55 per cent of total rice area and 66 per cent of the total rice output is through hybrid rice. Being convinced of the potential of hybrid rice technology in enhancing the production, India adopted this technique and has released 43 hybrids till date for commercial cultivation. The estimated area under hybrid rice in India is about 1.32 m ha. Hybrid technology has been widely acclaimed and accepted. High magnitude of variability in a population provides the opportunity for selection to evolve a variety having desirable characters.

Information on association of characters, direct and indirect effects contributed by each character towards yield will be an added advantage in aiding the selection process. Correlation and path analysis establish the extent of association between yield and its components and also bring out relative importance of their direct and indirect effects, thus giving an obvious understanding of their association with grain yield. Ultimately, this kind of analysis could help the breeder to design his selection strategies to improve grain yield. In the light of the above scenario, the present investigation is carried out with the objective of studying the character associations in rice hybrids for yield improvement.

II. MATERIALS AND METHODS

Twenty one rice hybrids were obtained from Plant Breeding Section, Crop Improvement Division, Directorate of Rice Research, Rajendranagar, Hyderabad. The present experiment was carried out at Directorate of Rice Research Farm, ICRISAT, Patancheru, Hyderabad, Andhra Pradesh, India, situated at 17.5°N latitude, 78.27°E longitude and altitude of 545 m above mean sea level. The details of hybrids are furnished in the Table 1. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The experimental material was planted in three blocks. Each block consisted of twenty one genotypes randomized and replicated within each block. Twenty seven days old seedlings were transplanted 20cm apart between rows and 15cm within the row. All necessary precautions were taken to maintain uniform plant population in each treatment per replication. All the recommended package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded and the data was subjected to statistical analysis. Statistical analyses for the above characters were done following Singh and Chaudhary (1995) for correlation coefficient and Dewey and Lu (1959) for path analysis.

III. RESULTS AND DISCUSSION

Selection based on the detailed knowledge of magnitude and direction of association between yield and its attributes is very important in identifying the key characters, which can be exploited for crop improvement through suitable breeding programme. Phenotypic and genotypic correlations between yield and yield components viz., days to 50 per cent flowering, plant height, panicle length, number of productive tillers per plant , number of filled grains per panicle, number of chaffy grains per panicle and 1000 grains weight were computed separately for rice genotypes. The results are presented in Table 2. The results revealed that the estimates of genotypic coefficients were higher than phenotypic correlation coefficients for most of the characters under study which indicated strong

inherent association between the characters which might be due to masking or modifying effects of environment.

Days to 50 per cent flowering registered positive and significant correlation with plant height, panicle length and number of filled grains per panicle, while negative and significant association with number of productive tillers per plant and grain yield per plant. Plant height exhibited positive and significant correlation with panicle length, number of filled grains per panicle, number of chaffy grains per panicle while negative and significant association with number of productive tillers per plant and grain yield per plant. Panicle length exhibited positive and significant association with number of filled grains per panicle, number of chaffy grains per panicle and 1000 grain weight while negative and significant association with number of productive tillers per plant and grain yield per plant. These results for number of filled grains per panicle were in accordance with Lalitha and Sreedhar (1996), Ganesan et al. (1997), Janardhanam et al. (2001), Kavitha and Reddi (2001), Yogameenakshi et al. (2004) and Sharma and Sharma (2007). The results for the trait 1000 grain weight are in unison with Gopinath et al. (1984) and Yogameenakshi et al. (2004).

Number of productive tillers per plant had positive and significant association with grain yield per plant while negative and non-significant association with 1000 grain weight. The results were in unison with Reddy et al. (1995), Roy et al. (1995) and Reddy et al. (1997). It indicated that grain yield can be increased whenever there is an increase in characters that showed positive and significant association with grain yield. Hence, these characters can be considered as criteria for selection for higher yield as these were mutually and directly associated with yield. Number of filled grains per panicle had positive and significant correlation with number of chaffy grains per panicle and negative and significant correlation with grain yield per plant. Number of chaffy grains per panicle had negative and significant correlation with grain yield per plant. The results were in unison with Krishnaveni et al. (2006). 1000 Grain weight had negative and non-significant correlation with grain yield per plant. Character association revealed significantly positive association of grain yield per plant with number of productive tillers per plant. Hence, selection for these traits can improve yield.

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. It allows separating the direct effect and their indirect effects through other attributes by apportioning the correlations (Wright, 1921) for better interpretation of cause and effect relationship. The estimates of path coefficient analysis are furnished for yield and yield component characters in Table 3. Among all the characters, the number of productive tillers per plant had the maximum positive effect on grain yield followed by panicle length. These findings were also corroborated by Meenakshi et al. (1999), Nayak et al. (2001), Madhavilatha (2002), Satish et al. (2003) and Khedikar et al. (2004).On the other hand, negative direct effect on grain yield were recorded by number of chaffy grains per panicle, number of filled grains per panicle, 1000 grain weight, days to 50 per cent flowering and plant height as suggested by Ganesan et al. (1997), Nayak et al. (2001) and Madhavilatha (2002). Phenotypic path diagram for yield per plant is shown in Fig. 1.

Table 1: Details of twenty one popular rice hybrids of India

S.No.	Name	Nominating Agency
1	DRRH – 2	Directorate of Rice Research, Hyderabad
2	PA 6129	Bayer Bio-Science
3	Sahyadri – 2	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
4	Sahyadri –4	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
5	Pusa RH -10	Indian Agricultural Research Institute, New Delhi
6	Indirasona	Indira Gandhi Krishi Vishwa Vidyalaya, Raipur
7	GK 5003	Ganga Kaveri Seeds
8	PSD-3	G. B. Pant University of Agriculture and Technology, Pantnagar
9	Sahyadri – 3	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
10	PA 6201	Bayer Bio-Science
11	HSD-1(HKRH-1)	Chaudhary Charan Singh Haryana Agricultural University, Karnal
12	PA 6444	Bayer Bio-science
13	Suruchi (MPH 5401)	Mahyco seeds, Hyderabad
14	JKRH- 2000	JK Agri. Genetics
15	US - 312	US Agri Seeds
16	CORH- 3	Tamil Nadu Agricultural University, Coimbatore
17	KRH-2	University of Agricultural Sciences, Mandya
18	Sahyadri -1	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
19	PHB – 71	Pioneer Overseas Corporation
20	CRHR - 5	Central Rice Research Institute, Cuttack
21	CRHR - 7	Central Rice Research Institute, Cuttack

Table 2: Estimates of phenotypic and genotypic correlation coefficients between yield and yield component characters

Character	Days to 50 % flowering	Plant height (cm)	Panicle length (cm)	No. of productive tillers plant^{-1}	No. of filled grains panicle^{-1}	No. of chaffy grains panicle^{-1}	1000-grain weight (g)	Grain yield plant^{-1}
Days to 50 % flowering	1.000 (1.000)	0.4576** (0.5284)**	0.3580** (0.4346)**	-0.1483 (-0.2790)*	0.3627** (0.3689)**	0.1888 (0.1928)	0.1776 (0.1789)	-0.2212 (-0.4540)**
Plant height (cm)		1.000 (1.000)	0.4470** (0.5641)**	-0.1870 (-1.0133)**	0.4883** (0.4587)**	0.3178* (0.2539)*	0.0476 (-0.0049)	-0.2586* (-1.1903)**
Panicle length (cm)			1.000 (1.000)	-0.2210 (-0.4341)**	0.2752* (0.3245)**	0.4759** (0.5683)**	0.2577* (0.2982)*	-0.1963 (-0.6386)**
No. of productive tillers plant^{-1}				1.000 (1.000)	0.0218 (-0.1951)	0.0280 (-0.1605)	0.0395 (-0.0033)	0.7125** (0.9473)**
No. of filled grains panicle^{-1}					1.000 (1.000)	0.4088** (0.3836)**	-0.0375 (-0.0613)	-0.2173 (-0.6229)**
No. of chaffy grains panicle^{-1}						1.000 (1.000)	0.2414 (0.2322)	-0.2250 (-0.6479)**
1000-grain weight (g)							1.000 (1.000)	-0.0675 (-0.2357)
Grain yield plant^{-1} (g)								1.000 (1.000)

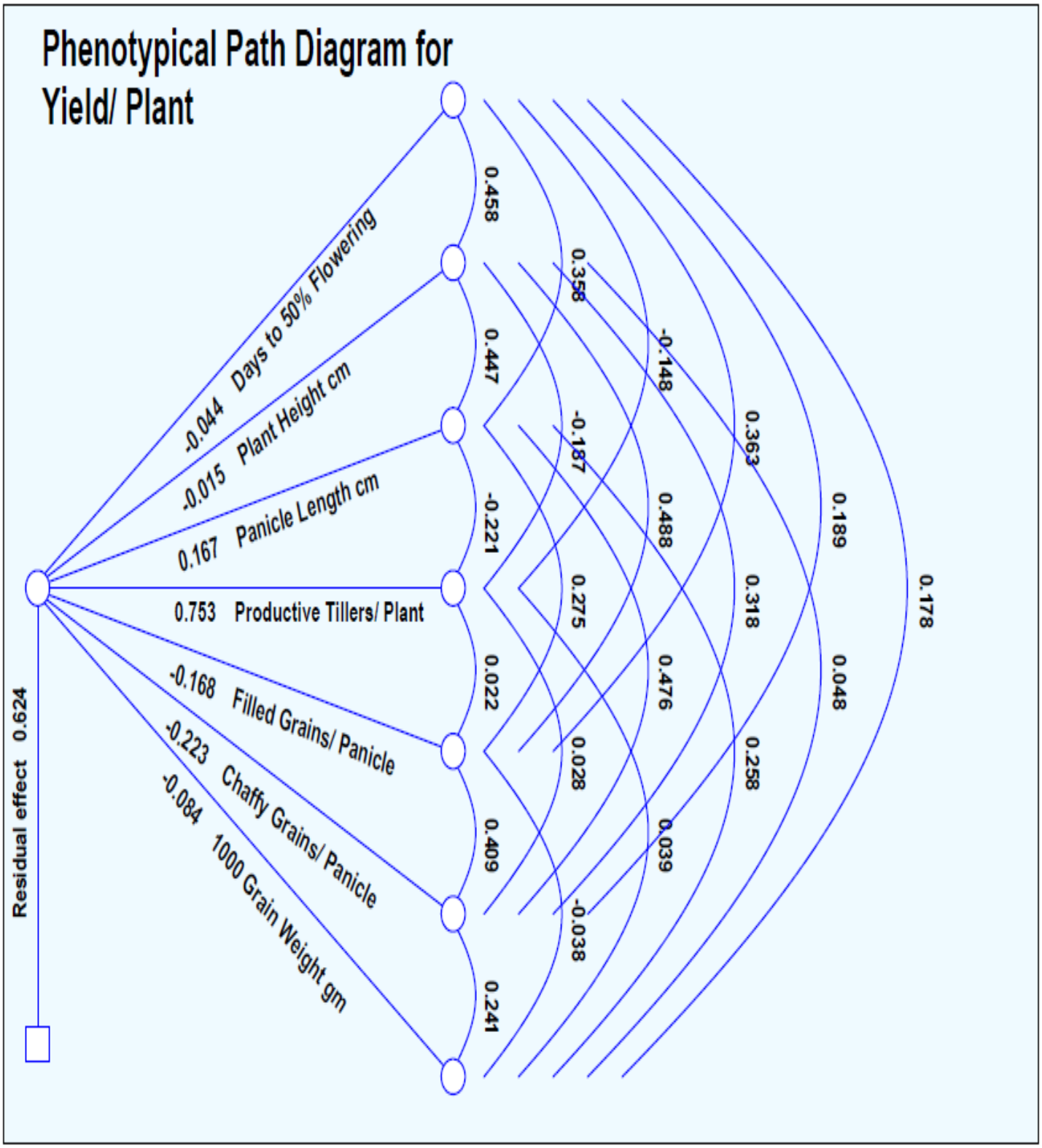
** Significant at 1 per cent level * Significant at 5 per cent level
Figures in parenthesis are genotypic correlation coefficients

Table 3: Estimates of direct and indirect effects between yield and yield components

Character	Days to 50 per cent flowering	Plant height (cm)	Panicle length (cm)	No. of productive tillers plant^{-1}	No. of filled grains panicle^{-1}	No. of chaffy grains panicle^{-1}	1000-grain weight (g)	Grain yield plant^{-1}
Days to 50 per cent flowering	**-0.0442 (-0.2080)**	-0.0202 (-0.1099)	-0.0158 (-0.0904)	0.0066 (0.0580)	-0.0160 (-0.0767)	-0.0083 (-0.0401)	-0.0078 (-0.0372)	-0.2212 (-0.4540)
Plant height (cm)	-0.0069 (0.4643)	**-0.0150 (0.8786)**	-0.0067 (0.4956)	0.0028 (-0.8903)	-0.0073 (0.4030)	-0.0048 (0.2231)	-0.0007 (-0.0043)	-0.2586 (-1.1903)
Panicle length (cm)	0.0598 (0.0535)	0.0746 (0.0694)	**0.1669 (0.1230)**	-0.0369 (-0.0534)	0.0459 (0.0399)	0.0794 (0.0699)	0.0430 (0.0367)	-0.1963 (-0.6386)
No. of productive tillers plant^{-1}	-0.1117 (-0.4652)	-0.1409 (-1.6893)	-0.1665 (-0.7237)	**0.7533 (1.6671)**	0.0164 (-0.3252)	0.0211 (-0.2675)	0.0297 (-0.0055)	0.7125 (0.9473)
No. of filled grains panicle^{-1}	-0.0610 (-0.1929)	-0.0821 (-0.2398)	-0.0463 (-0.1697)	-0.0037 (0.1020)	**-0.1682 (-0.5228)**	-0.0688 (-0.2006)	0.0063 (0.3020)	-0.2173 (-06229)
No. of chaffy grains panicle^{-1}	-0.0422 (-0.0760)	-0.0710 (-0.1001)	-0.1063 (-0.2241)	-0.0063 (0.0633)	-0.0913 (-0.1512)	**-0.2233 (-0.3943)**	-0.0539 (-0.0915)	-0.2250 (-0.6479)
1000-grain weight (g)	-0.0149 (-0.0297)	-0.0040 (0.0008)	-0.0217 (-0.0495)	-0.0033 (-0.0006)	0.0032 (0.0102)	-0.0203 (-0.0385)	**-0.0841 (-0.1658)**	-0.0675 (-0.2357)

Residual effect (Phenotypic) = 0.6244
Residual effect (Genotypic) = -0.833
Figures in parenthesis are genotypic effects

Fig. 1: Phenotypic Path Diagram for yield per plant



IV. CONCLUSION

Partitioning of correlation values showed that some of the characters could not produce significant correlation with single plant yield which might be either due to very high negative direct effects. Critical analysis of results obtained from character association and path analysis indicated that the number of productive tillers per plant possessed both positive association and high positive direct effects. Hence, selection for these traits could bring improvement in yield and yield components.

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