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Research Article

GENETIC VARIABILITY, CORRELATION AND PATH ANALYSIS IN HYBRID RICE

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Abstract: Genetic variability, correlation & path analysis studies were carried out for 10 characters on 17 elite rice hybrids along with 7 different checks. The magnitude of genetic variance was high for majority of traits except for panicle length, panicle number, 100-grain weight, harvest index and grain yield per plant. The higher magnitude of genetic variance for plant height, grain number, fertility % and plot yield, which have bearing on yield may be sorted out as important selection criteria for realization of higher productivity in hybrid rice. Plot yield exhibited positive association with plant height, panicle length, panicle number, grain number, harvest index & grain yield per plant. Grain yield per plant was positively correlated with plant height, panicle length, panicle number, grain number and harvest index. Out of all the traits, plot yield and grain yield per plant have positive association with other traits like plant height, panicle length, panicle number, fertile grain number and harvest index. There is positive association between panicle number and grain yield. But the association of panicle number was observed to be low, negative and insignificant with majority of characters under study. The association between grain yield per plant & grain number was positive but the grain number exhibited negative association with 100-grain weight. Plant height exhibited maximum positive direct effect on grain yield per plant followed by panicle number, harvest index, fertility %, days to 50% flowering, fertile grain number & panicle length. Thus, indicating the importance of such traits as criteria for selection in that order for realization of higher productivity. Harvest index exerted greatest indirect effect on yield via other traits following 100-grain weight, panicle length, plant height and fertile grain number.

Keywords: Genetic Variability, Correlation, Path analysis, Rice hybrids, Genetic advance, Heritability

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Introduction

Rice (*Oryzae sativa L.*) has a special significance in Asia where about 90% of the rice is produced and consumed as a staple food. Considering the increasing demand of rice due to population increase and decreasing land and water resources available for rice cultivation, it is critical to develop and use rice technologies that will result in higher yields [1]. Hybrid rice technology is an alternative way to meet this challenge. In farmer's field, it has been experimentally proved that hybrid rice yield on an average of 1-1.5 t/ha more than semi dwarf inbred high yielding varieties [1]. Again importance of grain yield is the foremost goal in crop improvement programme. Grain yield is influenced by a number of yield components *viz*. days to flowering, panicle length, panicle number, fertile grain number, fertility %,100-grain weight, harvest index, grain yield per plant, plot yield. Knowledge of association between yield and yield components will serve to make simultaneous selection for more characters. A critical analysis and clear understanding of the genetic variability parameters, namely, Genotypic Coefficient of Variability (GCV), Phenotypic Coefficient of Variability (PCV), heritability and genetic advance for different traits of economic importance is a major pre-requisite for any plant breeder to work with crop improvement programmes [2]. Many workers have computed genotypic and phenotypic correlation coefficients. Partitioning the genotypic correlation coefficients of yield components with grain yield into direct and indirect effects will help to estimate the actual contribution of an attribute & it's influence through other characters. This knowledge of path analysis helps in making the selection more effective. Knowledge of correlation between yield and its contributing characters are basic and most important guideline for proper plant selection. In order to carried out an effective genetic improvement in crops, knowledge on the nature and magnitude of the genetic variation governing the inheritance of quantitative character like yield and its components is essential [3]. In a population, presence of high magnitude of variability provides the opportunity for selection to evolve a variety having desirable characters [4]. Yield component directly or indirectly increasing grain yield only if the components are highly heritable in nature and genetically independent or positively correlated with grain yield [5]. Therefore, the present study was undertaken with an objective to elucidate the basic genetic information on genetic correlation, heritability and path coefficients of yield components on grain yield in hybrid rice which is a major pre-requisite for crop improvement programme and make varietal selection more effective.

Materials and method

The experimental materials consisting of 17 elite rice hybrids along with 7 different checks. The test genotypes were evaluated under irrigated situations in medium lands at Rice Research Station, O.U.A.T, Bhubaneswar during 2010, and *Kharif* to study the genetic basis of yield vigour in hybrid rice. These experimental materials were evaluated in a randomised complete block designs with three replications. The hybrid rice varieties along with checks were transplanted in nine row plots of 4.35mt length with a row to row spacing of 15m.A fertiliser dose of 100:50:50 kg Nitrogen: Phosphorous: Potassium (NPK) was applied as per scheduled management practices. Observations were recorded in 8 metric traits on 5 competitive plants, selected randomly from middle rows of each plot. Whereas characters like plot yield & days to 50% flowering were recorded on plot basis. During the course of investigation, observations were recorded on 10 characters (days to flowering, plant height, panicle length, panicle number, fertile grain number, fertility %, 100-grain weight, harvest index, grain yield per plant and plot yield).

Results and discussion

The analysis of variance in respect of 10 different traits is presented in [Table-1]. From the analysis of variance it was revealed that there exists a highly significant difference among the test genotypes for all the characters. The magnitude of genetic variance was high for majority of traits except for panicle length, panicle number, 100-grain weight, harvest index and grain yield per plant. However, the higher magnitude of genetic variance for plant height, grain number, fertility % & plot yield which have bearing on yield may be sorted out as important selection criteria for realization of higher productivity in hybrid rice.

Table-1 Analysis of variance for various traits (Mean Sum of Squares)

Characters	Source of variation (df.)		
	Replication (2)	Genotype (23)	Error (46)
1. Days to 50% flowering	0.27	101.91**	5.29
2. Plant height (cm)	62.26	125.87**	10.56
3. Panicle length (cm)	1.34	5.59**	1.4
4. Panicle number	4.04	4.59**	1.81
5. No. of fertile grains / panicle	471.25	1014.31**	322.7
6. Fertility percentage	101.14	126.61**	42.33
7. 100-grain weight (g)	0.01	0.15**	0.01
8. Harvest Index	0.001	0.011*	0.006
9. Grain yield / plant (g)	14.74	20.82*	10.06
10. Plot yield (q/ ha)	135.07	174.55**	30.11

* and ** Significant at 5% and 1% level of probability respectively

Figures in parentheses indicate degrees of freedom (df.) for corresponding sources of variation

Correlation

Genotypic & phenotypic coefficient of variation-maintained correspondence for majority of traits except for panicle number, grain number, fertility %, harvest index, grain yield per plant & plot yield indicating the greater influence of the environment in the expression of these traits [Table-1]. Majority of traits except panicle number, grain number, fertility %, harvest index, grain yield per plant & plot yield showed smaller difference between GCV & PCV, indicating least influence of environment, therefore selection on the basis of phenotypic values for majority of characters is effective.

Heritability & Genetic advance

A moderate to low degree of heritability estimates were observed for most of the traits except for days to flowering, plant height & 100-grain weight, indicating high degree of influence of environment is the expression of these traits [Table-2]. High heritability with moderate to high genetic gain were observed for days to flowering, plant height ,panicle number, grain number, fertility %,100-grain weight and plot yield ,which indicate the presence of additive gene effects. So selection based on phenotypic performance would be effective [6-8]. Panicle length exhibited moderately high heritability value & low genetic gain suggested the influence of both additive & non-additive gene effects & selection of genotypes on the basis of phenotypic performance for such trait may not be effective. Low heritability estimates with moderate to low genetic gain for harvest index & grain yield per plant suggested that dominance & epistatic gene effects may be operating in the inheritance of these traits. Plot yield exhibited positive association with plant height, panicle length, panicle number, grain number, harvest index & grain yield per plant. Grain yield per plant was positively correlated with plant height, panicle length, panicle number, grain number & harvest index. Plot yield & grain yield per plant show positive association with plant height, panicle length, panicle number, fertile grain number & harvest index indicating the importance of such traits for realization of high yield in rice. The correlation of days to 50% flowering with fertility % was negative. Plant height was positively correlated with panicle length & negatively associated with fertility %.

Table-2 Mean, Range, Co-efficient of variation, Genotypic and Phenotypic co- efficient of variation, heritability and genetic advance estimates for various traits

Characters	Mean	Range	GCV	PCV	h^2	GA
			(%)	(%)	(%)	(%)
1. Days to 50% flowering	101.13	91.67-113.00	5.61	5.76	94.81	11.26
2. Plant height (cm)	86.43	73.30-100.27	7.17	7.49	91.61	14.14
3. Panicle length (cm)	24.5	22.27-27.07	4.82	5.57	74.93	8.6
4. Panicle number	10.38	8.33-13.00	9.28	11.92	60.56	14.87
5. No. of fertile grains/ panicle	113.44	78.00-146.67	13.38	16.21	68.19	22.77
6. Fertility percentage	75.95	65.43-87.03	6.98	8.55	66.56	11.73
7. 100-grain weight (g)	2.28	1.85-2.65	9.38	9.83	91.15	18.45
8. Harvest Index	0.49	0.40-0.62	8.59	12.5	47.18	12.15
9. Grain yield / plant (g)	15.6	8.53-21.35	12.15	16.89	51.71	17.99
10. Plot yield (q/ ha)	33.66	20.09-44.02	20.62	22.66	82.75	38.63

GCV:Genotypic Co-efficient of Variance, PCV:Phenotypic Co-efficient of Variance, h^2:Heritability, GA: Genetic Advance

Table-3 Path coefficient analysis of direct (underlined) and indirect effects of various characters on grain yield per plant

Traits	Day to 50% flowering	Plant height	Panicle length	Panicle no.	Fertile grain no.	Fertility%	100-grain weight	Harvest index	Correlation with grain yield
Day to 50% flowering	0.228	0.078	-0.03	-0.065	0.048	-0.108	0.003	-0.055	0.084
Plant height	0.169	0.493	0.232	-0.09	0.159	-0.219	0.106	0.044	0.498
Panicle length	-0.014	0.048	0.102	0.005	0.015	-0.049	0.031	0.016	0.266
Panicle no.	-0.122	-0.078	0.021	0.428	-0.197	0.021	0.122	0.307	0.464
Fertile grain no	0.034	0.052	0.023	-0.074	0.16	-0.018	-0.091	-0.025	0.134
Fertility%	-0.122	-0.115	-0.123	0.013	-0.029	0.026	-0.031	0.049	-0.035
100-grain weight	-0.001	-0.013	-0.018	-0.017	0.034	0.007	-0.06	-0.012	0.154
Harvest index	-0.088	0.033	0.058	0.265	-0.057	0.07	0.074	0.369	0.694

Panicle length was negatively associated with fertility %. Panicle number was positively correlated with harvest index & grain yield per plant, but it exhibited negative associations with other traits. Fertile grain number was found to be negatively correlated with 100-grain weight & harvest index exhibited positive association with both grain yield per plant & plot yield. The association of panicle number & grain yield was found to be positive [9-11]. The association of panicle number was observed to be low, negative & insignificant with majority of characters under study. The association between grain yield per plant & grain number was positive but the grain number exhibited negative association with 100-grain weight.

Path analysis

The results of path analysis indicate that plant height exhibited maximum positive direct effect on grain yield per plant followed by panicle number, harvest index, fertility %, days to flowering, fertile grain number & panicle length [Table-3]. Thus, indicating the importance of such traits as criteria for selection in that order for realization of higher productivity. Harvest index exerted greatest indirect effects on yield via other traits following 100-grain weight, panicle length, panicle number,

plant height & fertile grain number. Similar results were also reported by Choudhury & Motiramani [6]; Satish *et al*, [12]; Nayak *et al*, [13]; Santhala *et al*, [14]; Satyanarayan *et al*, [15]; Chitra *et al*, [11]; Babu *et al*, [16]; Swain & Reddy [17]; Zahid *et al*, [18]; Panwar & Ali, [19]. Grain number & panicle number exert maximum direct effect on yield. Grain number was found to exhibit high & positive indirect effect via majority of character under study. The correlation coefficient between characters like plant height, panicle number, fertile grain number, harvest index & panicle length with grain yield per plant exhibited more or less similar direct effect indicating that direct selection through these traits would be rewarding. The correlation coefficient between 100-grain weights with grain yield per plant was found to be positive & the direct effect was negative or negligible. The correlation coefficient was observed to be negative & the direct effect was positive for fertility % indicating that under such situation, a restricted simultaneous selection model to be followed to nullify the undesirable indirect effects in order to make use of the direct effects.

Conclusion

From the foregoing observation on superior yield performance of selected genotypes & their association with various quantitative traits, it is revealed that no definite trend of relationship is suggested. Still it is clearly observed that the higher magnitude of genetic variance for plant height, grain number, fertility % and plot yield, which have bearing on yield may be sorted out as important selection criteria for realization of higher productivity in hybrid rice.

Application of research: Present study was undertaken with an objective to elucidate the basic genetic information on genetic correlation, heritability and path coefficients on yield components on grain yield in hybrid rice which is a major pre-requisite for crop improvement programme & make varietal selection more effective.

Research Category: Genetic Variability

Abbreviations:
PCV: phenotypic coefficient of variation
GCV: genotypic coefficient of variation

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