Asian Journal of Plant Sciences

ISSN 1682-3974

Asian Journal of Plant Sciences 5 (4): 643-645, 2006
ISSN 1682-3974

Correlation and Path Analysis Studies of Yield and Economic Traits in Basmati Rice (*Oryza sativa* L.)

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Abstract: Phenotypic and genotypic variances, coefficient of variance, genetic advance, heritability, correlation coefficient and path coefficient analysis were conducted for yield, yield components and grain quality characteristics in 14 genotypes of Basmati rice. High heritability estimates coupled with high genetic advance were observed for plant height and 1000 grain weight. Plant height has negative correlation with yield indicating that taller Basmati plants have low yield. Grains per panicle have positive and significant genotypic and phenotypic correlation with yield. Hence, number of tillers per plant, No. of grains per panicle and 1000 grain weight contributed maximum direct effect on yield indicating these traits should be given emphasis while selecting high yielding Basmati rice cultivars for Kallar Tract. Plant height and 1000 grain weight had positive correlations with grain quality characteristics i.e. grain length and cooked grain length while tillers per plant had negative correlation with these quality traits. Grain length had positive and significant correlation with cooked grain length indicating that basmati varieties elongate length wise which is the typical basmati character.

Key words: Basmati rice, correlation, path analysis, heritability, yield components

INTRODUCTION

Basmati is predominantly cultivated rice in Pakistan and specially in Punjab and plays an important role in the economy of Pakistan as an export item and is the staple food of the people. "Kallar Tract" in Pakistan is the best region of the world for the production of best quality rice with aroma.

Yield of paddy is a complex character and is multiplicative and is the product of many factors called yield components. Development of plant breeding strategy mainly depends on the nature of association of major quantitative characters with yield, quality or any other economic trait. Number of grains per panicle and 1000 grain weight has positive genotypic and phenotypic correlation with grain yield (Yolanda and Das, 1995; Prasad *et al*., 2001; Iftikharudduala *et al*., 2002; Bhatti *et al*., 2005). Most of the genotypic correlation coefficients are higher than their phenotypic correlation coefficients indicating a fairly strong inherent interrelationship among the traits (Latif *et al*., 1994). Grain yield is negatively correlated with plant height (Amirthadevarathinam, 1983).

Tillers per plant are negatively correlated with plant height and positive correlation is found between plant height and number of grains per panicle (Khan *et al*., 1991). Grain length has positive and significance correlation with cooked grain length indicating that basmati varieties elongate lengthwise which is the typical basmati character (Khatun *et al*., 2003). Grain length is positively and significantly correlated at genotypic and phenotypic level with 1000 grain weight (Rasheed *et al*., 2002). The present study with 14 promising lines was carried out for computing the interrelationship between the eight quantitative traits for developing new genotypes with better combinations of these traits.

MATERIALS AND METHODS

The study was conducted at Rice Research Institute Kala Shah Kaku during 2003 and 2004. The nursery of fourteen uniform basmati genotypes along with standard varieties was sown on 9-6-2003 and 10-6-2004 and transplanted on 10-7-2003 and 14-7-2004, respectively. The nursery was raised by conventional method i.e., seed soaking (24 h), Incubation (48 h) and broadcasting of sprouted seed in the puddled soil/field. The seed rate was 10-12 kg ha^{-1}.

Fourteen lines were transplanted in a randomized complete block design with four replications. The plot size for each treatment during 2003 and 2004 was (1.8×6.75 m).Thirty days old nursery was transplanted with a plant spacing of 22.5×22.5 cm during both the years. All standard agronomic practices were adopted.

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Data on 10 plants from each replicate were recorded on (i) plant height (cm) (ii) number of productive tillers per plant, (iii) 1000 grain weight (g) (iv) number of grains per panicle (v) grain length (mm), (vi) cooked grain length (mm) (vii) bursting percentage (viii) paddy yield (t ha^{-1}). The data was subjected to statistical analysis of variance and covariance through the procedure advocated by Steel and Torrie (1980). Genotypic and phenotypic correlation coefficient values were calculated as outlined by Kwon and Torrie (1964).Genotypic and Phenotypic Variance and Coefficient of Variance Heritability, Genetic Advance, Genotypic correlation coefficient were estimated using the formula suggested by Sing and Chawdhury (1985) .

RESULTS AND DISCUSSION

Genotypic and phenotypic variances, Genotypic Coefficient of variation (GCV), phenotypic Coefficient of variation (PCV), heritability and genetic advance (% of mean) of eight economic characters of fourteen basmati genotypes were calculated (Table 1). GCV ranged from 4.00 to 30.64. Among the studied character the highest GCV was obtained in bursting percentage followed by number of tillers per plant, yield and no. of grains per panicles. Bursting percentage, number of tillers per plant, number of grain per panicle and yield showed more than 15% variation at phenotypic level (PCV). Hemareddy *et al.* (1994) also reported similar results while studying genetic variability for grain yield and its components in 73 genotypes of rice. Heritability estimates were relatively higher for almost all the characters studied. High heritability estimates have been found to be helpful in making selection of superior genotypes on the basses of phenotypic performance. High heritability along with high genetic advance was recorded for plant height and no. of grain per panicle.

Correlations: Most of the genotypic correlation coefficients were higher than their corresponding phenotypic correlation coefficient indicating a fairly strong inherent interrelationship among the traits (Table 2). Results of correlation coefficients at genotypic and phenotypic level showed that grain yield was positively correlated with 1000 grain weight and positively and significantly correlated with number of grains per panicles. Yolanda and Das (1995), Prasad *et al.* (2001) and Iftikharuddaula *et al.* (2002) found similar results. Grain yield was negatively correlated with plant height both at genotypic and phenotypic levels as was also reported by Amirthadevarathinam (1983). Plant height was negatively correlated with no. of tillers per plant and grain yield. Tahir *et al.* (1988) found the similar results for plant height and yield. Plant height and 1000 grain weight had positive correlations with grain quality characteristics i.e. grain length and cooked grain length while tillers per plant had negative correlation with these quality traits.

Grain length had positive and significant correlation with cooked grain length indicating that basmati varieties elongate length wise which is the typical basmati character. Similar results were reported by Khatun *et al.* (2003). Grain length is positively correlated with 1000 grain weight at genotypic and phenotypic level as reported by Rasheed *et al.* (2002).

Table 1: Estimation of genetic parameters for yield and yield components in basmati rice (*Oryza sativa* L.)

		Variance		Coefficient of Variability (CV %)			
Traits	Trait mean	Genotypic	Phenotypic	Genotypic	Phenotypic	Heritability	GA (1%)
Plant height	125.32	149.31	164.63	9.75	10.24	90.7	20.42
Tillers/Plant	I8.63	19.49	23.02	23.69	25.75	84.7	7.13
1000 grain weight	20.59	3.26	3.46	8.76	9.03	94.1	3.07
No. of grains/panicle	84.55	154.28	161.51	14.69	15.03	95.5	21.30
Grain length	7.21	0.156	0.16	5.48	5.55	97.3	0.68
Cooked grain length	13.76	0.30	0.38	4.00	4.49	79.4	0.86
Bursting percentage	6.65	4.15	4.69	30.64	32.59	88.4	3.36
Yield	3.25	0.31	0.39	17.10	19.12	80.0	0.87

Table 2: Upper diagonal genotypic correlation and lower diagonal phenotypic correlation in basmati rice (*Oryza sativa* L.)

Traits	Plant height	Tillers/plant	1000 grain weight	No. of grains /Panicle	Grain length	Cooked grain length	Bursting (%)	Yield
Plant height		-0.8754*	0.3690	0.3024	0.5621	0.5403*	-0.5129*	-0.3284
Tillers/plant	-0.7851**		-0.4763*	-0.6397*	-0.2790	-0.4338	0.4722*	-0.0419
1000 grain weight	0.3231*	-0.4423**		0.4776*	0.4725*	0.6049*	0.0174	0.0366
No. of grains/Panicle	0.2713	-0.5511**	0.4584**		-0.2457	0.0041	-0.1457	0.5562*
Grain length	0.5238**	-0.2523	0.4599**	-0.2195		0.8157*	-0.2602	-0.7062
Cooked grain length	0.4360**	-0.3612	0.4928**	0.0293	0.7277**		-0.2274	-0.5705*
Bursting percentage	-0.4816**	0.4031**	0.0220	-0.1455	-0.2493	-0.2057		0.3909
Yield	-0.3267*	0.0265	0.0421	0.5144**	-0.6159**	-0.4018**	0.3229*	

* = Significant at 5% level ($p<0.05$); ** = Highly significant at 1% level ($p<0.01$)

Table 3: Direct and indirect effects matrix

Characters	Plant height	Tillers per plant	1000 grain weight	No. of grains /panicle	Grain length	Cooked grain length	Bursting percentage	Yield
Plant height	-0.8838	0.9362	0.0393	0.0449	0.0185	-0.3086	-0.1749	-0.3284
Tillers per plant	0.7737	-1.0695	-0.0507	-0.0950	-0.0092	0.2477	0.1610	-0.0419
1000 grain weight	-0.3262	0.5094	0.1064	0.0709	0.0156	-0.3455	0.0059	0.0366
No. of grains/panicle	-0.2672	0.6842	0.0508	0.1486	-0.0081	-0.0023	-0.0497	0.5562
Grain length	-0.5968	0.2984	0.0503	-0.0365	0.0329	-0.4658	-0.0887	-0.7062
Cooked grain length	-0.4775	0.4639	0.0643	0.0006	0.0269	-0.5711	-0.0776	-0.5705
Bursting percentage	0.4533	-0.5050	0.0019	-0.0216	-0.0086	0.1299	0.3410	0.3909

Path analysis: Among yield components, path coefficient analysis showed that number of grains per panicle had the highest positive direct effect (0.1486) on grain yield followed by 1000 grain weight (0.1064) (Table 3). Yolanda and Das (1995) and Surek and Baser (2003) found the similar results. Plant height and Tillers per plant had negative direct effects (-0.8838) and (-1.0695), respectively on grain yield. These results support the findings of Prasad *et al.* (2001).Although tillers per plant had the highest negative direct effect on grain yield but its indirect effect through plant height was positive (0.7737) which consequently increased the correlation coefficient of tillers per plant with yield (-0.0419) i.e., somewhat negative. It means higher number of tiller per plant give more yield. This result indicates that for increasing effective tillers per plant, other causal factors i.e., plant height, 1000 grain weight and number of grains per panicle, must be considered.

The present study indicated that among yield components number of tillers per plant and number of grains per panicle had high genotypic and phenotypic coefficient of variability. Number of grains per panicle also had high heritability and genetic advance. Genotypic and phenotypic correlation coefficients also indicated that number of grains per panicle had the highest positive correlation with yield. Similarly this character had positive direct effect on yield. In conclusion, number of grains per panicle is the most important plant trait for yield in Basmati varieties. Thus this trait should be given due importance in making selection for high yielding better gain quality basmati rice varieties.

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