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CORRELATION BETWEEN DIFFERENT TRAITS OF AROMATIC RICE (*Oryza sativa* L.) AND THEIR CAUSE-EFFECT RELATIONSHIP

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ABSTRACT

The present study was undertaken with the objective to study the correlation between different traits of aromatic rice and cause-effect relationship. Thirty aromatic rice genotypes were grown at Rice Research field, RAU, Pusa, Bihar, India in four environments (2 dates of sowing for 2 years i.e. *kharif* 2008 and 2009). Observations on 21 morphophysiological and quality traits were recorded. Grain yield showed significant but positive association with effective tillers plant^{-1}, filled grains panicle^{-1}, grain weight panicle^{-1}, leaf area index and harvest index. The genotypic and phenotypic correlation showed similar trend of association, except for a few combinations. The component traits of grain yield in aromatic rice genotypes were harvest index, grain weight panicle^{-1}, effective tillers plants^{-1}, filled-grain panicle^{-1} and leaf area index. The selection based on these component traits may increase the grain yield in aromatic rice. Leaf area index may be a preferable selection criterion due to its high positive indirect effects via kernel length towards yields along with other component characters with high direct effects towards yield.

Keywords: Aromatic rice, correlation, path coefficient analysis

INTRODUCTION

Grain quality, along with crop yield is an important criterion in most rice breeding programme especially for rice variety selection and development (Singh *et al.*, 2000). As per the growing demand of aromatic rice, the emphasis should be given to the development of superfine grain aromatic rice for their outstanding quality traits such as aroma, kernel elongation after cooking and taste. The quality of aromatic rice has long been well known in national and international markets. The quality of rice is mainly defined as long and slender. Breeding selection has incorporated grain quality into varietal improvement with other agronomic characters. Rice with long, slender and translucent grain is preferable. The correlation study between characters is expected to help in further evaluation and development of improved aromatic rice varieties. Correlation coefficient is a statistical tool to determine the degree to which two related varieties can vary together. Direction of correlation can often be altered by selection and hybridization.

Wright (1921) conceptualized path coefficient analysis to understand the cause-effect relationship which has been extensively used to analyze the real contribution of individual traits towards an end product like yield. The path coefficient is a standardized partial regression coefficient which measures the direct influence of one variable on other and permits the separation of correlation coefficient into components of direct and indirect effects. The success of a breeding programme depends upon the knowledge regarding direct or indirect influence of these components on polygenic traits like yield. In the development of improved breeding lines having superior quality, the correlation between the grain quality characters is useful in the choice of parents, screening and selection procedures for the segregation population. Hence, an attempt was made to unravel the correlation of qualitative and quantitative characters of aromatic rice varieties from different aromatic rice genotypes.

MATERIALS AND METHODS

The present investigation was undertaken during *kharif* 2008 and 2009 with two dates of sowing in Rice Research field at RAU, Pusa, Samastipur. Geographically Pusa is located at 25.29°N latitude and 85.40°E longitude and 51.8 m masl. The experiment was laid in a randomized block design with each treatment replicated thrice. The plot size was 0.6 x 3 m and plant spacing 20 x 15 cm. The experimental material consisted of 30 aromatic rice genotypes obtained from different parts of the country i.e. 6 genotypes namely HUR-ASG-GN, Kasturi, Pusa Sugandh 3, Birsamati, Jasmaine and PAU 3025-50-1-2 from BAU, Ranchi; 14 genotypes namely Jeerakasala, Gandhasala, Narendra Lalmati, NDR 6235, NDR 8018, NDR 6242, CR 2603, HUR-ASG-KN, KJT 4-4-36, RNR 2465-1, Kalanamak, Badsahbhog NDR 9542 and JGL -15336 from Directorate of Rice Research, Hyderabad; 6 genotypes namely Basmati 370, Basmati 385, Ranvir Basmati, Sanwal Basmati, RR564 and Tarori Basmati from SKUAST-J, Jammu and 4 genotypes namely RAU 3055, RAU 3036, Rajendra Kasturi and Rajendra Suwasini from RAU, Pusa. The recommended package of practice was followed. The relative humidity during crop seasons ranged from 83 to 94%.

The observations were recorded for yield attributing characters and quality character of aromatic rice. The correlation co-efficient of yield with various quantitative and qualitative characters on pooled over environments basis were partitioned into measures of direct effect with the help of path coefficient analysis as suggested by Dewey and Lu (1959). The required simultaneous equations were formed and solved for estimating the various direct and indirect effects.

RESULTS AND DISCUSSION

The genotypes showed significant variation among themselves, irrespective of the effect of environments on the characters studied. Grain yield showed significant positive correlation with plant height, effective tillers plant^{-1}, filled-grain panicle^{-1}, grain weight panicle^{-1} and harvest index. However, it exhibited significant negative correlation with days to 50% flowering and days to maturity at genotypic level.

The magnitude of genetic correlation, in general, was greater than phenotypic correlation for almost all the traits, except in a few combinations like leaf area index and filled grain panicle^{-1}, and even change in sign was observed in a few cases like between days to 50% flowering and elongation ratio due to environmental interaction. Hence, the significant phenotypic association between characters was primarily due to the genetic cause, perhaps owing to the pleiotropic effect rather than linkage between the genes affecting different characters. Thus correlation study revealed that the genotypes having high effective tillers plant^{-1}, filled-grain panicle^{-1}, grain weight panicle^{-1}, leaf area index and harvest index are desirable. High value for specific leaf weight, kernel L/B ratio, gelatinization temperature, days to 50% flowering, days to maturity, cooked-kernel length and elongation ratio cannot be taken as criteria for selection of genotypes as these are negatively correlated with grain yield. High values of these characters may cause low productivity for grain yield. As such the careful strategy of optimization of these characters may be a good choice to improve the aromatic rice alongwith important quality and physiological characters.

The positive correlations between yield and its component characters were in accordance with Sadhukhan and Chattopadhyay (2000) for test weight, Choudhary and Motiramani (2003) for effective number of tillers plant^{-1}, spikelets panicle^{-1} and biological yield, De *et al.* (2005) for number of panicles plant^{-1} and Patil and Sarawgi (2005) for days to 50% flowering, plant height and filled grain panicle^{-1}.

Table 1: Analysis of variance for different morphophysiological and quality traits of aromatic rice

Characters	Analysis of variance		
	Replication MSS (2df)	Treatment MSS (29 df)	Error MSS (58 df)
Plant height (cm)	9.07	8031.40**	47.96
Panicle length (cm)	14.46	98.46**	3.11
Effective tillers plant^{-1}	4.28	312.04**	5.45
Spiklets panicle^{-1}	727.22	34766.4**	416.66
Filled grain panicle^{-1}	483.81	30999.7**	320.30
Grain weight (g panicle^{-1})	0.07	3.61**	0.07
Leaf area index (cm^2)	2.43	96.70**	0.62
SLW(g cm^{-2})	0.00	0.0001**	0.00
Grain length (mm)	0.13	43.20**	0.06
L/B ratio (mm)	0.001	10.69**	0.02
Harvest index (%)	1.18	244.15**	2.16
Gelatinization temperature (^{0}C)	2.21	36.32**	0.26
Grain yield (g plot^{-1})	2019.63	162602**	11561.2
Grain yield (g plant^{-1})	3.44	676.24**	19.20
Test weight (g)	0.013	1.30**	0.02
Days to 50% flowering	82.58	753.40**	19.56
Days to maturity	87.10	726.35**	22.89
Head rice recovery (%)	0.19	104.38**	1.36
Kernel length (mm)	0.014	21.89**	0.01
Cooked-kernel (mm)	0.013	17.45**	0.09
Elongation ratio	0.0006	0.18**	0.004

SLW: Specific leaf weight, L/B: Length/Breath ratio; ** Significant at P = 0.01

In present study most of the quality characters were found negatively correlated with yield. It, in general, was in agreement with Kibria *et al.* (2008) who found highly significant negative association of grain quality with yield. Considering the association among the quality traits, the grain length had significant negative association with head rice recovery and elongation ratio whereas it was significantly and positively associated with kernel length, L/B ratio and cooked kernel length. This, in general, is in agreement with the findings of Khatun *et al.* (2003). Gelatinization temperature was significantly but negatively correlated with cooked kernel length. L/B ratio was significantly but negatively correlated with head rice recovery and elongation ratio. However, it depicted high positive significant association with kernel length and cooked-kernel length. The findings are in tune with Singh *et al.* (1997), Sadhukhan and Chattopadhayay (2001) and Ghosh *et al.* (2004).

In present study, a few component traits were observed to directly contribute towards yield over pooled environments. These component traits, with high positive direct-effects towards yield, were effective tillers plant^{-1}, filled grain panicle^{-1}, grain weight panicle^{-1}, leaf area index and harvest index; whereas days to maturity and cooked kernel length exhibited significant negative direct-effect on yield. The genotypic association of these traits with yield was found in the same direction as observed in direct effect. However, days to 50% flowering, head rice recovery, kernel length and elongation ratio showed very high positive direct-effect on yield but their genotypic association with yield was negative. Based on these observations, the aforesaid component traits with maximum direct contribution (high direct effects, positive or negative) may be utilized, and grain yield may be increased owing to increase in component traits having high positive direct-effect.

Yield attributing components based on their high direct effects reportedly contributed towards increased yield (Choudhary *et al.*, 2004, Patil *et al.*, 2003, De *et al.*, 2005, Kishore *et al.*, 2007). Hence,

Table 2: Estimate of genotypic and phenotypic correlation coefficient for yield and yield component in aromatic rice

Character		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Plant height	G	1.00	0.27	-0.16	0.16	0.15	0.30	-0.06	0.20	-0.45	-0.47	0.05	-0.19	0.05	-0.03	0.27	0.30	0.46	-0.45	-0.54	0.11
	P	1.00	0.22#	-0.13*	0.15*	0.14*	0.26#	-0.04	0.17*	-0.43#	-0.45#	0.03	-0.18*	0.04	-0.01	0.21#	0.23#	0.43#	-0.43#	-0.51#	0.08
2. Panicle length	G		1.00	-0.11	-0.26	-0.44	0.10	-0.11	-0.08	0.37	0.39	-0.14	0.13	-0.09	0.62	0.09	0.08	-0.28	0.24	0.11	-0.46
	P		1.00	-0.08	-0.18*	-0.36*	0.07	-0.08	-0.05	0.32#	0.33#	-0.13*	0.11*	-0.07	0.48#	0.06	0.07	-0.22#	0.21#	0.07	-0.37#
3. Effective tiller plant^{-1}	G			1.00	-0.15	-0.04	-0.42	0.14	-0.28	0.12	0.08	0.19	-0.30	0.54	-0.08	-0.44	-0.44	-0.12	0.33	0.31	-0.17
	P			1.00	-0.12*	-0.03	-0.38#	0.16*	-0.21#	0.11*	0.08	0.17*	-0.27#	0.50#	-0.05	-0.36#	-0.36#	-0.10	0.30#	0.27#	-0.13*
4. Spiklets panicle^{-1}	G				1.00	0.82	0.32	0.07	-0.04	-0.78	-0.63	0.34	0.05	0.28	-0.73	0.49	0.49	0.73	-0.74	-0.70	0.56
	P				1.00	0.76*	0.29#	0.06	-0.02	-0.72#	-0.58#	0.29#	0.04	0.22#	-0.62#	0.40#	0.39#	0.26#	-0.69#	-0.65#	0.44#
5. Filled grain panicle^{-1}	G					1.00	0.44	0.02	-0.02	-0.68	-0.61	0.40	-0.05	0.49	-0.71	0.27	0.23	0.59	-0.62	-0.59	0.50
	P					1.00	0.44#	0.03	-0.01	-0.63#	-0.56#	0.31#	-0.04	0.43#	-0.61#	0.23#	0.19*	0.51#	-0.58#	-0.53#	0.43#
6. Grain wt. panicle^{-1}	G						1.00	0.03	0.17	-0.32	-0.40	0.50	-0.01	0.45	-0.10	0.31	0.27	0.28	-0.46	-0.56	0.05
	P						1.00	0.02	0.15*	-0.28#	-0.34#	0.42#	-0.01	0.44#	-0.06	0.25#	0.21#	0.22#	-0.41#	-0.47#	0.06
7. Leaf area index	G							1.00	-0.59	0.11	0.12	0.14	0.25	0.14	-0.07	0.23	0.20	-0.25	0.04	-0.05	-0.10
	P							1.00	-0.51*	0.11*	0.12*	0.13*	0.23#	0.14*	-0.05	0.19*	0.16*	-0.22#	0.04	-0.05	-0.08
8. Specific leaf wt.	G								1.00	-0.23	-0.23	0.14	-0.25	-0.11	-0.02	0.04	0.06	0.27	-0.15	-0.12	0.08
	P								1.00	-0.22#	-0.22#	0.13*	-0.22#	-0.07	-0.02	0.05	0.07	0.23#	-0.14*	-0.11*	0.07
9. Grain length	G									1.00	0.94	-0.38	0.05	-0.25	0.73	-0.38	-0.44	-0.96	0.81	0.76	-0.60
	P									1.00	0.92#	-0.35#	0.05	-0.22#	0.66#	-0.34#	-0.37#	-0.89#	0.80#	0.73#	-0.53#
10. L/B ratio	G										1.00	-0.39	0.06	-0.35	0.60	-0.29	-0.35	-0.92	0.79	0.74	-0.55
	P										1.00	-0.37#	0.06	-0.28#	0.55#	-0.26#	-0.30#	-0.83#	0.78#	0.72#	-0.47#
11. Harvest index	G											1.00	-0.13	0.73	-0.51	0.08	0.07	0.28	-0.26	-0.30	0.08
	P											1.00	-0.12*	0.60#	-0.45#	0.06	0.04	0.24#	-0.25#	-0.28#	0.08
12. Gel. Tem.	G												1.00	-0.22	0.03	0.48	0.46	-0.10	-0.09	-0.14	-0.02
	P												1.00	-0.18*	0.03	0.40#	0.37#	-0.09	-0.09	-0.13*	-0.02
13. Grain yield plant^{-1}	G													1.00	-0.28	-0.15	-0.18	0.20	-0.17	-0.24	-0.01
	P													1.00	-0.23#	-0.11*	-0.14*	0.16*	-0.15*	-0.19*	0.04
14. Test weight	G														1.00	-0.23	-0.24	-0.64	0.50	0.44	-0.47
	P														1.00	-0.20*	-0.21#	-0.52#	0.45#	0.39#	-0.38#
15. Days 50% flower	G															1.00	0.98	0.32	-0.46	-0.64	0.02
	P															1.00	0.95#	0.23#	-0.40#	-0.56#	-0.01
16. Days maturity	G																1.00	0.38	-0.52	-0.66	0.09
	P																1.00	0.27#	-0.43#	-0.57#	0.02
17. Head rice recover	G																	1.00	-0.79	-0.71	0.58
	P																	1.00	-0.73#	-0.63#	0.49#
18. Kernel length	G																		1.00	0.91	-0.73
	P																		1.00	0.87#	-0.66#
19. Kernel l. cooked	G																			1.00	-0.40
	P																			1.00	-0.24#
20. Elongation ratio	G																				1.00
	P																				1.00
Grain yield plot^{-1}		0.1	0.09	0.45	0.06	0.28	0.56	0.25	-0.16	-0.09	-0.22	0.68	-0.21	0.90	-0.03	-0.11	-0.16	0.05	-0.02	-0.13	-0.18
		0.1	0.06	0.38#	0.05	0.22#	0.43#	0.20*	-0.07	-0.06	-0.14*	0.48#	-0.15*	0.79#	-0.02	-0.07	-0.10*	0.03	-0.01	-0.10*	0.11*

*Significant at $P_{0.05}$; **Significant at $P_{0.01}$; Significance if correlation 'r' for $P_{0.05}$ is 0.1034 and for $P_{0.01}$ is 0.1356

Table 3: Genotypic cause-effect relationship between grain yield and its morpho-physiological and quality characters in aromatic rice

Characters		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Plant height	G	-0.17#	-0.04	0.02	-0.02	-0.02	-0.05	0.01	-0.03	0.07	0.08	-0.009	0.03	0.005	-0.04	-0.05	-0.08	0.07	0.09	-0.01
	P	-0.01	-0.003	0.002	-0.002	-0.002	-0.004	0.0007	-0.002	0.006	0.006	-0.0006	0.002	0.0001	-0.003	-0.003	-0.006	0.006	0.007	-0.001
2. Panicle length	G	0.05	0.18#	-0.02	-0.04	-0.08	0.01	-0.02	-0.01	0.07	0.07	-0.02	0.02	0.11*	0.01	0.01	-0.05	0.04	0.02	-0.08
	P	0.02	0.09	-0.007	-0.01	-0.03	0.006	-0.007	-0.005	0.03	0.03	-0.01	0.01	0.04	0.006	0.006	-0.02	0.01	0.007	-0.03
3. Effective tillers plant^{-1}	G	-0.08	-0.05	0.50#	-0.07	-0.02	-0.21#	0.07	-0.14#	0.06	0.04	0.09	-0.15#	-0.04	-0.22#	-0.22#	-0.06	0.16#	0.15#	-0.08
	P	-0.07	-0.04	0.51#	-0.06	-0.01	-0.19#	0.08	-0.10*	0.05	0.04	0.09	-0.13#	-0.03	-0.18#	-0.18#	-0.05	0.15#	0.13#	-0.06
4. Spiklets panicle^{-1}	G	-0.08	0.13#	0.08	-0.53#	-0.43#	-0.17#	-0.03	0.02	0.41#	0.33#	-0.18#	-0.02	0.38#	-0.26#	-0.26#	-0.38#	0.39#	0.37#	-0.30#
	P	-0.01*	0.01	0.01	-0.08	-0.06	-0.02	-0.005	0.002	0.06	0.05	-0.02	-0.004	0.05	-0.03	-0.03	-0.05	0.06	0.05	-0.03
5. Filled grain panicle^{-1}	G	0.03	-0.09	-0.009	0.18#	0.22#	0.09	0.006	-0.005	-0.15#	-0.13#	0.08	-0.01	-0.15#	0.06	0.05	0.13*	-0.14#	-0.13*	0.11*
	P	0.01	-0.03	-0.003	0.07	0.09	0.04	0.003	-0.001	-0.05	-0.05	0.03	-0.004	-0.05	0.02	0.01	0.04	-0.05	-0.05	0.04
6. Grain wt. panicle^{-1}	G	0.20#	0.06	-0.27#	0.21#	0.29#	0.65#	0.01	0.11*	-0.21#	-0.26#	0.33#	-0.008	-0.06	0.20#	0.18#	0.18#	-0.30#	-0.36#	0.03
	P	0.14#	0.04	-0.20#	0.15#	0.24#	0.53#	0.01	0.08	-0.15#	-0.18#	0.23#	-0.002	-0.03	0.13#	0.11*	0.12*	-0.22#	-0.25#	0.03
7. Leaf area index	G	-0.01	-0.02	0.03	0.01	0.007	0.007	0.25	-0.15	0.03	0.03	0.03	0.06	-0.02	0.06	0.05	-0.06	0.01	-0.01	-0.02
	P	-0.004	-0.008	0.01	0.006	0.003	0.002	0.09	-0.05	0.01	0.01	0.01	0.02	-0.005	0.01	0.01	-0.02	0.004	-0.005	-0.008
8. Specific leaf wt.	G	-0.01	0.006	0.02	0.003	0.001	-0.01	0.04	-0.07	0.01	0.01	-0.01	0.01	0.001	-0.002	-0.004	-0.01	0.01	0.009	-0.006
	P	-0.004	0.001	0.005	0.0007	0.0003	-0.003	0.01	-0.02	0.005	0.005	-0.003	0.005	0.0005	-0.001	-0.001	-0.005	0.003	0.002	-0.001
9. Grain length	G	-0.52#	0.43#	0.14#	-0.91#	-0.79#	-0.37#	0.13#	-0.27#	1.16#	1.09#	-0.44#	0.06	0.85#	-0.45#	-0.51#	-1.12#	0.95#	0.88#	-0.70#
	P	-0.01	0.007	0.002	-0.01	-0.01	-0.006	0.002	-0.005	0.02	0.02	-0.008	0.001	0.01	-0.008	-0.009	-0.02	0.01	0.01	-0.01
10. L/B ratio	G	0.09	-0.08	-0.01	0.13*	0.12*	0.08	-0.02	0.05	-0.19#	-0.20#	0.08	-0.01	-0.12*	0.06	0.07	0.19#	-0.16#	-0.15#	0.11*
	P	0.05	-0.03	-0.009	0.06	0.06	0.03	-0.01	0.02	-0.10*	-0.11*	0.04	-0.007	-0.06	0.03	0.03	0.09	-0.09	-0.08	0.05
11. Harvest Index	G	0.02	-0.06	0.08	0.15#	0.17**	0.22#	0.06	0.06	-0.16#	-0.17#	0.44#	-0.06	-0.22#	0.03	0.03	0.12*	-0.11*	-0.13#	0.03
	P	0.007	-0.02	0.03	0.05	0.06	0.08	0.02	0.02	-0.06	-0.07	0.18#	-0.02	-0.08	0.01	0.009	0.04	-0.04	-0.05	0.01
12. Gel. Tem.	G	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0001	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	P	0.001	-0.001	0.001	-0.001	0.001	0.00	-0.001	0.001	-0.001	-0.001	0.001	-0.002	-0.001	-0.001	-0.001	0.001	0.001	0.001	0.001
13. Test weight	G	-0.01	0.22#	-0.02	-0.26#	-0.25#	-0.03	-0.02	-0.009	0.26#	0.21#	-0.18#	0.01	0.36#	-0.08	-0.09	-0.23#	0.18#	0.16#	-0.17#
	P	-0.001	0.05	-0.006	-0.07	-0.06	-0.007	-0.006	-0.002	0.07	0.06	-0.05	0.003	0.11*	-0.02	-0.02	-0.05	0.05	0.04	-0.04
14. Days to 50% flower	G	0.32#	0.11*	-0.53#	0.59#	0.32#	0.37#	0.28#	0.04	-0.46#	-0.35#	0.10#	0.58#	-0.28#	1.19#	1.18#	0.38#	-0.56#	-0.76#	0.02
	P	0.007	0.002	-0.01	0.01	0.008	0.009	0.006	0.001	-0.01	-0.009	0.002	0.01	-0.007	0.03	0.03	0.008	-0.01	-0.02	-0.0004
15. Days maturity	G	-0.37#	-0.10	0.54#	-0.60#	-0.29#	-0.33#	-0.25#	-0.08	0.53#	0.43#	-0.09	-0.56#	0.30#	-1.20#	-1.22#	-0.47#	0.63#	0.81#	-0.11*
	P	-0.01	-0.003	0.01	-0.01	-0.009	-0.01	-0.008	-0.003	0.01	0.01	-0.002	-0.01	0.01	-0.04	-0.04	-0.01	0.02	0.02	-0.001
16. Head rice recovery	G	0.71#	-0.44#	-0.19#	1.13#	0.92#	0.43#	-0.39#	0.42#	-1.50#	-1.42#	0.44#	-0.15#	-0.99#	0.49#	0.60#	1.55#	-1.22#	-1.10#	0.91#
	P	0.01	-0.009	-0.004	0.02	0.02	0.009	-0.009	0.01	-0.03	-0.03	0.01	-0.003	-0.02	0.009	0.01	0.04	-0.03	-0.02	0.02
17. Kernel length	G	-1.68#	0.92#	1.23#	-2.76#	-2.33#	-1.72#	0.15#	-0.58#	3.03#	2.96#	-0.98#	-0.36#	1.85#	-1.74#	-1.93#	-2.93#	3.71#	3.39#	-2.71#
	P	-0.05	0.02	0.04	-0.09	-0.07	-0.05	0.005	-0.02	0.10*	0.10*	-0.03	-0.01	0.06	-0.05	-0.05	-0.09	0.13*	0.11*	-0.08
18. Cooked kernel length	G	1.46#	-0.29#	-0.83#	1.89#	1.58#	1.50#	0.14#	0.33#	-2.04#	-2.00#	0.83#	0.39#	-1.19#	1.72#	1.78#	1.90#	-2.44#	-2.67#	1.08#
	P	0.01	-0.001	-0.006	0.01	0.01	0.01	0.001	0.002	-0.01	-0.01	0.006	0.003	-0.008	0.01	0.01	0.01	-0.01	-0.02	0.005
19. Elongation ratio	G	0.19#	-0.78#	-0.29#	0.96#	0.86#	0.08	-0.18#	0.14#	-1.03#	-0.95#	0.15#	-0.04	-0.80#	0.03	0.15#	1.007#	-1.25#	-0.69#	1.70#
	P	0.001	-0.006	-0.002	0.008	0.007	0.001	-0.001	0.001	-0.009	-0.008	0.001	-0.0004	-0.007	-0.001	0.0005	0.009	-0.01	-0.004	0.01
Grain yield plot^{-1}	G	0.12*	0.09	0.45#	0.06	0.28#	0.56#	0.25#	-0.16#	-0.09	-0.22#	0.68#	-0.21#	-0.03	-0.11*	-0.16#	0.05	-0.02	-0.13#	-0.18#
Partial R^2		-0.02	0.01	0.22#	-0.03	0.06	0.36#	0.06	0.01	-0.10*	0.04	0.30#	0.00	-0.01	-0.14#	0.19#	0.07	-0.09	0.37#	-0.32#
Grain yield plot^{-1}	P	0.08	0.06	0.38#	0.05	0.22#	0.43#	0.20#	-0.07	-0.06	-0.14#	0.48#	-0.15#	-0.02	-0.07	-0.10*	0.03	-0.01	-0.10	-0.11*
Partial R^2		-0.001	0.006	0.19#	-0.004	0.02	0.23#	0.01	0.001	-0.001	0.01	0.09	0.0004	-0.002	-0.002	0.005	0.001	-0.002	0.002	-0.002

R square = 1.0121; Residual effect = 0.11

weightage must be given to the component characters like grain weight panicle^{-1}, effective tillers plant^{-1}, harvest index, leaf area index and filled-grain panicle^{-1} during selection for future breeding programme. It is noteworthy that cooked kernel length and kernel length contributed indirectly in building up the association of leaf area index with yield; whereas the association of filled grain panicle^{-1} and cooked-kernel length contributed indirectly in positive direction. The cooked-kernel length and kernel length contributed indirectly in positive and negative (opposite) direction for building up association between grain weight panicle^{-1} and yield, harvest index and yield; whereas in vice-versa direction (i.e. positive of kernel length and negative of cooked-kernel length) for building up association between effective tillers plant^{-1}. Thus, it is suggested to use leaf area index as selection criterion since it reflected high positive direct effect on yield, association in the same direction and chances to improve both kernel length and cooked-kernel length. Careful consideration of these two important quality traits is essentially required while utilizing them for their high direct-effect towards yield.

Conclusion: On the basis of path analysis study the component traits of grain yield for aromatic rice were identified on the basis of their high direct effect and genotypic association with yield. The characters like harvest index, grain weight panicle^{-1}, effective tillers plants^{-1}, filled grain panicle^{-1} and leaf area index. Hence, selection based on such component traits may increase grain yield in aromatic rice. The other characters although show high positive direct effect and positive correlation with yield in the same direction, reflected opposite indirect contribution of kernel length and cooked-kernel length. So, careful consideration is essentially required when these traits are to be used for yield improvements.

REFERENCES

Chaudhary, M., Sarawgi, A.K. and Motiramani, N.K. 2004. Genetic variability of quality, yield and yield attributing traits in aromatic rice (*Oryza sativa*). *Advances in Plant Sciences*, **17**: 485-490.

Chaudhary, M and Motiramani, N.K. 2003. Variability and association among yield attributes and grain quality in traditional aromatic rice accessions. *Crop Improvement*, **30**: 84-90.

Dewey, D.R. and Lu, K.H. 1959. A Correlation and path coefficient analysis of components of crested wheat grass for seed production. *Agronomy Journal*, **51**: 515-518.

De, D.K., Pal, S.K., Ghosh, M. and Pal, A.K. 2005. Correlation and path analysis in aromatic rice. *Annals of Agricultural Research*, **26**: 398-401.

Fisher, R.A. 1918. The correlation between relatives on the supposition of mendelian inheritance. *Trans. Roy. Soc. Edn.*, **52**: 399-433.

Ghosh, M., Mandal, B.K., Mandal, B.B., Lodh, S.B. and Dash, A.K. 2004. The effect of planting date and nitrogen management on yield and quality of aromatic rice (*Oryza sativa*). *Journal of Agricultural Science*, **142**: 183-191.

Khatun, M., Mahmuda, M., Hazrat Ali and Quirino D. Dela Cruz 2003. Correlation studies on grain physicochemical characteristics of aromatic rice. *Pakistan Journal of Biological Sciences*, **6**: 511-513.

Kibria, K., Islam M.M. and Begum, S.N. 2008. Screening of aromatic rice lines by phenotypic and molecular markers. *Bangladesh Journal of Botany*. **37**: 141-147.

Kishore, N.S., Ansari, N.A., Babu, V.R., Rani, N.S., Rao, L.V.S. and Ravichandran 2007. Correlation and path analysis in aromatic and non-aromatic rice genotypes. *Agricultural Science Digest*, **27**: 122-124.

Patil, P.V. and Sarawgi, A.K. 2005. Studies on genetic variability, correlation and path analysis in traditional aromatic rice accessions. *Annals of Plant Physiology*, **19**: 92-95.

Patil, P.V., Sarawgi, A.K. and Shrivastava, M.N. 2003. Genetic analysis of yield and quality traits in traditional aromatic accessions of rice. *Journal of Maharashtra Agricultural Universities*. **28**: 255-258.

Sadhukhan, R.N. and Chattopadhyay, P. 2000. Variability and character association between yield attributes and grain quality in aromatic rice. *Journal of Interacademicia,* **4**: 494-497.

Sadhukhan, R.N. and Chattopadhyay, P. 2001. Some agromorphic and grain quality characters in aromatic rice genotypes under West Bengal condition. *Journal of Interacademicia,* **5**: 19-24.

Sindhu, J.S. 1973. Correlation in paddy. *Indian Journal of Genetics,* **33:** 314-318.

Singh, R.K., Singh, U.S., Khush, G.S. and Rohilla, R., 2000. Genetics and biotechnology of quality traits in aromatic rices. pp: 47-69. **In**: *Aromatic Rices* (eds. R.K. Singh, U.S. Singh and G.S. Khush), Oxford & IBH Publ., New Delhi, India.

Singh, V.P., Khush, G.S. and Cruz, N. dela. 1997. Variability and quality indices in aromatic rice germplasm. *International Rice Research Notes,* **22**: 22-23.

Wright, S. 1921. Correlation and causation. *Journal of Agriculture Research,* **20**: 557-587.