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Correlation and path analysis in aromatic lines of rice (*Oryza sativa* L.)

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Abstract
The forty five aromatic rice genotypes were used to study the Correlation and path analysis for the associations between component characters and to estimate direct and indirect effect of the component characters on yield. Grain yield per plant showed highly significant positive correlation with straw yield per plant, harvest index, number of grains per panicle and productive tillers per plant. The character days to 50 percent flowering with days to maturity, productive tillers per plant and number of tillers per sq.m.; days to maturity with plant height and productive tiller per plant; productive tillers per plant with number of tillers per sq.m. and straw yield per plant and number of grains per panicle with straw yield per plant showed significant positive correlation with each other. The highest positive direct effect on grain yield per plant was exerted by straw yield per plant, harvest index number of tillers per sq.m. So, improvement in seed yield can be achieved by selecting respective characters directly. The characters *viz.*, straw yield per, number of tillers per sq.m. and days to maturity has positive indirect effect on grain yield.

Keywords: correlation, path analysis, aromatic rice, rice, *Oryza sativa* L.

Introduction
Oryza sativa L. (2n = 24) is one of the cultivated rice provides food for more than one third of the world's population. A Number of rice varieties were developed by the continuous cultivation and selection process over the years, though landraces usage in plant breeding programmes is very limited and so utilization of these diverse genotypes in breeding events may useful in improving the productivity.
Correlation and path analysis establish the extent of association between yield andits components and also bring out relative importance of their direct and indirect effects , thus giving an obvious understanding of their association with grain yield.
The association of traits provides information about the direct and indirect relationship of yield components to the yield through correlation and path analysis by which direction of selection is made. The current study was carried out to estimate Correlation and Path analysis studies among rice genotypes for selection of genotypes and identification of traits rewarding yield improvement in rice.

Material and Methods
The present investigation "Genetic diversity in Aromatic Lines of Rice (Oryza sativa L.)" was conducted at Agricultural Research Station, Vadgaon Maval, Pune during Kharif 2016. For the present study forty five genotypes of rice originating from different geographic regions and showing phenotypic variability for different agronomic and yield characters were used .Sowing of forty five genotypes of rice on nursery seed bed was completed on 16th June, 2016.and transplanting was done on 14th July 2016. The experiment was done by using randomized block design with three replications. All recommended agronomic practices such as weeding, fertilizer application were carried out as and when required. Observations on twelve quantitative characters viz, Days to 50 percent flowering (No.), Days to maturity (No.), Plant height (cm), Productive tillers per plant (No.), Number of tillers per sq. m. (No.), Panicle length (cm), Number of Grains per panicle (No.), , 1000 grain weight (g), Straw yield per plant (g), Length: Breadth ratio of grain, Harvest index (%) and Grain yield per plant (g) .The analysis of variance for the characters were studied as per procedure given by Pance and Sukhatme (1961) and path analysis was carried out by following Dewey and Lu (1959) [4] and Wright (1921) [17]

Results and Discussions

Correlation

Correlation provides a measure of genotypic association between characters and gives an indication of more useful characters. They provide basic information to the breeder in understanding the nature of the species with which they work. They also help to identify characters that have little or no importance in the selection programme. For a successful selection, it is necessary to study the nature of association of the character with grain yield.

Association of grain yield and its components

In the present study, grain yield per plant was significantly and positively correlated with straw yield per plant, harvest index and productive tillers per plant. And positively but non significantly correlated with number of tillers per square meter. It suggested that top priority should be given to these traits while making selection for yield improvement. Similar kind of association were revealed by Satyavathi *et al.* (2001) [14], Halil and Necmi (2002) [5], Bhadru *et al*. (2012) [1], Bhatia *et al.* (2012) [2] and Kumar *et al.* (2015) [8].

Among the characters days to 50 per cent flowering with days to maturity, productive tillers per plant and number of tillers per sq.m. ; days to maturity with plant height and productive tillers per plant; productive tillers per plant with number of tillers per sq.m. and straw yield per plant while number of grains per panicle with straw yield per plant showed significant positive correlation. Whereas plant height with 1000 grain weight and straw yield per plant and number of grains per panicle with 1000 grain weight and L:B ratio showed significant negative correlation.

Plant height showed negative correlation with seed yield per plant. Similar kind of result observed by Zahiad *et al.* (2006) [19]. Days to 50% flowering and days to maturity had displayed significant positive association with days to maturity and plant height respectively. These results were in conformity with the earlier findings of Halil and Necmi (2002) [5]. Similarly, productive tillers per plant had significantly positive correlation with number of tillers per square meter and straw yield per plant.

Similar kind of association observed by Satyavathi *et al.* (2001) [14] and Halil and Necmi (2002) [5]. The trait number of grains per panicle recorded significant positive association with straw yield per plant. This was in consonance with the results of Halil and Necmi (2002) [5] and Keshava *et al.* (2011) [6].

Path Coefficient Analysis

Path analysis is simply a standardized partial regression coefficient which splits the correlation coefficients into direct and indirect effects. In the present study, path analysis was carried out to estimate the magnitude and direction of direct and indirect effects of various yield and yield contributing characters. Correlation coefficients along with path effects provide more reliable information, which can be effectively used in various crop improvement programmes. If the correlation between a causal factor and direct effect is more or less of equal magnitude indicating the true and perfect relationship between the traits and direct selection between these traits will be rewarding. However, if the correlation coefficient is positive and the direct effect is negative or negligible, the indirect causal factors are to be considered in simultaneous selection. Thus path analysis provides the information about characters and their relative importance.

Path analysis of grain yield and its components

The characters *viz.*, harvest index, straw yield per plant and number of tillers per square meter, number of grains per panicle and 1000 grain weight exerted positive direct effect on grain yield which also shared significant positive correlation with grain yield. Thus direct selection for these traits will be rewarding for yield improvement. Similar kind of finding were revealed by Meenakshi *et al.* (1999) [10], Surek and Beser (2003) [16], Nayak *et al*. (2004) [11], Krishna Naik *et al.* (2005) [7], Yadavendra *et al*. (2011) [18], Bhatiya *et al*. (2012) [2], Kumar *et al.* (2015) [8] and Satyarajkumar *et al.*(2016) [13].

In direct effect of days to 50 percent flowering *via* days to maturity (0.2409) and number of tillers per sq.m. (0.1011); plant height *via* days to maturity (0.1141) and productive tillers per plant (0.1135); productive tillers per plant via days to maturity (0.1074), number of tillers per sq.m. (0.3113) and straw yield per plant (0.5326); number of tillers per sq.m. *via* straw yield per plant (0.3090) and harvest index (0.1614); 1000 grain weight *via* straw yield per plant (0.2697); straw yield per plant *via* number of tillers per sq.m. (0.1335) and L:B ratio via days to maturity (0.2005) were positive and moderate to high.

Productive tiller per plant, plant height, L: B ratio and days to 50 percent flowering had negative direct effect on seed yield. Shivani and Sree Rama Reddy (2000) [15] observed negative direct effect of plant height with grain yield.Days to 50 per cent flowering have negligible to moderate indirect effect on grain yield through days to maturity, number of tillers per sq. m and grains per panicle and showed non-significant positive correlation with grain yield. These results were in agreement with the findings of Satyavathi *et al.* (2001) [14] who observed indirect effect of days to 50 percent flowering through grains per panicle. Similarly, Chaturvedi *et al.* (2008) [3] observed the indirect effect of days to 50 percent flowering on grain yield *via* number of grains per panicle and Sankar *et al.* (2006) [12] observed the indirect effects of days to 50 percent flowering through panicle length on grain yield.

Days to maturity contributed negligible negative indirect effect through grains per panicle and showed non-significant positive correlation with grain yield. Similar kind of results were recorded by Chaturvedi *et al.* (2008) [3]. The trait panicle length displayed negligible negative indirect effect on grain yield through productive tillers per plant, plant height and days to 50 percent flowering. These result were in agreement with Arvind kumar *et al.* (2011) [9]. The trait straw yield per plant displayed high positive indirect effect on grain yield through number of tillers per square meter and negligible positive indirect effect through 1000 grain weight. . These results were in agreement with Chaturvedi *et al.* (2008) [3].

In the present study, the low residual effect (0.45) indicates that besides the characters studied, there are some other attributes which contribute for seed yield. From the foregoing discussion, it is evident that number of tillers per square meter, grains per panicle, 1000 grain weight straw yield per plant and harvest index were emerged as major components of grain yield in rice. These characters also had their indirect contribution on grain yield *via* number of tillers per square meter, grains per panicle, straw yield per plant and harvest index. Hence, these characters may also be included in formulating selection criteria for improvement of grain yield in rice.

Table 1: Genotypic correlation coefficients among grain yield and its components in rice

Character	Days to maturity (No)	Plant height (cm)	Productive tillers / plant (No.)	Number of tillers per Sq. m. (No.)	Panicle length (cm.)	No. of grains / panicle	1000 Grain Weight (g)	Straw yield/ plant (g)	L:B Ratio	Harvest Index (%)	Grain yield per plant (g)
Days to 50% flowering (No.)	0.8816**	0.2411	0.5646**	0.3184*	0.2317	0.0154	-0.1374	0.0693	0.0791	-0.0189	0.0242
Days to maturity (No)		0.4178**	0.3930**	0.2441	0.0989	-0.0054	-0.2063	-0.0742	0.0734	0.0081	-0.0881
Plant height (cm)			-0.2309**	-0.2178	0.0552	0.1397	-0.4745**	-0.3656*	-0.0745	0.0441	-0.2924
Productive tillers / plant (No.)				0.9800**	0.1822	0.2572	0.2400	0.5664**	0.0392	-0.1450	0.3732*
Number of tillers per Sq. m.(No.)					0.1076	0.2112*	0.1402	0.4202**	-0.1104	-0.1870	0.2067
Panicle length (cm)						0.0629	-0.0157	0.0513	-0.0162	-0.0778	-0.0488
No. of grains per panicle							-0.3857**	0.3286*	-0.3562*	0.2467	0.4435**
1000 Grain Weight (g)								0.2868	0.1917	-0.0122	0.1966
Straw yield per plant (g)									-0.0937	-0.1673	0.7333**
L:B Ratio										-0.2129	-0.1865
Harvest Index (%)											0.5350**

*, ** Significant at 5 % and 1 % level of significance, respectively.

Table 2: Direct and indirect effect using genotypic correlation of different characters towards yield

	Days to 50% flowering	Days to maturity	Plant height	Productive tillers per plant	Tillers per sq. m	Panicle length	Grains per panicle	1000 grain weight	Straw yield/ plant	L: B ratio	Harvest index	Genotypic correlation with grain yield
Days to 50% flowering	-0.0523	0.2409	-0.029	-0.277	0.1011	0.0005	0.0004	-0.0042	0.0652	-0.0085	-0.012	0.0242
Days to maturity	-0.0461	0.2732	-0.0503	-0.1931	0.0775	0.0002	-0.0001	-0.0063	-0.0698	-0.0786	0.0053	-0.0881
Plant height	-0.0126	0.1141	-0.1204	0.1135	-0.0692	0.0001	0.0035	-0.0145	-0.3438	0.0080	0.0288	-0.2924*
Prod. tillers / plant	-0.0295	0.1074	0.0278	-0.4914	0.3113	0.0004	0.0064	0.0073	0.5326	-0.0042	-0.0948	0.3732*
No. of tillers per sq. m	-0.0167	0.0667	0.0262	-0.4816	0.3176	0.0002	0.0053	0.0043	0.3951	0.0118	-0.1223	0.2067
Panicle length	-0.0121	0.0270	-0.0066	-0.0895	0.0342	0.0021	0.0016	-0.0005	0.0482	0.0017	-0.0509	-0.0448
No. of grains per panicle	-0.0008	-0.0015	-0.0168	-0.1264	0.0671	0.0001	0.0251	-0.0118	0.3090	0.0381	0.1614	0.4435**
1000 grain weight	0.0072	-0.0564	0.0571	-0.1179	0.0445	0.0000	-0.0097	0.0306	0.2697	-0.0205	-0.0080	0.1966
Straw yield/ plant	-0.0036	-0.0203	0.0440	-0.2784	0.1335	0.0001	0.0082	0.0088	0.9404	0.0100	-0.1094	0.7333**
L: B ratio	-0.0041	0.2005	0.0090	-0.0193	-0.0351	0.0000	-0.0089	0.0059	-0.0881	-0.1071	-0.1393	-0.1865
Harvest index	0.0010	0.0022	-0.0053	0.0713	-0.0594	-0.0002	0.0062	-0.0004	-0.1573	0.0228	0.6541	0.5350**

(R=0.45)

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