SHORT COMMUNICATION

ANALYSIS OF PATH COEFFICIENT FOR YIELD AND QUALITY CHARACTERS IN AROMATIC ADVANCED BREEDING LINES OF RICE (*ORYZA SATIVA* L.)

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Abstract: The experiment was conducted at Research Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during kharif 2010 to assess the agromorphological characterization, genetic variability, association analysis and genetic divergence among the ninety eight aromatic advanced breeding lines of rice along with popular standard checks namely Indira Sugandhit Dhan-1, Pusa Basmati-1, Badsha bhog, Dubraj, Chinnor, Mahisugandha and Kalanamak. The path analysis revealed that Panicle length, Effective tillers per plant, Filled spikelets per panicle, Spikelet sterility percentage and 100 seed weight had high and positive direct effect on Grain yield per plant.

Keywords: Aromatic Rice, Path Analysis, Advanced Breeding Lines of Rice

INTRODUCTION

Rice is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planet's human population. In world, rice has occupied an area of 160.6 million hectares, with a total production of 459.74 million metric tons in 2010 (Anonymous, 2011a). In Asian countries, rice is the main staple crop covering about ninety per cent of rice grown in the world, with two countries, China and India, growing more than half of the total crop. Rice provides about two-third of the calorie intake for more than two billion people in Asia, and a third of the calorie intake of nearly one billion people in Africa and Latin America (Shastry *et al.*, 2000).

India is the second largest producer of rice after China has an area of over 43.77 million hectares with the production of 89.05 million tons in 2010 (Anonymous, 2011b). Rice being the main source of livelihood for more than 120-150 million rural household is the backbone of the Indian Agriculture. It occupies about 23.3 per cent of the food grain production and 55 percent of cereal production. The rice plays a very vital role in the national food security. Even then rice self-sufficiency in India is precarious. The country's population of more than a billion is growing at 1.8% per year, outpacing the 1.4% annual growth rate of rice production.

Chhattisgarh popularly known as "Rice Bowl of India" occupies an area around 3.61 million hectares with the production of 5.22 MT (Anonymous, 2011c). The prime causes of low productivity of rice in Chhattisgarh are unappropriate adoption of agronomical practices, limited irrigation (28.0 %) and lack of improved varieties suitable to different ecosystems.

Aromatic rice varieties are very much popular for their quality and aroma. Aroma quality of scented rice is major character, which increases the value of rice in the international market. In addition to long grain Basmati type which have high export potential, there are large number of indigenous short grained aromatic varieties cultivated in pockets of different states. Despite of low yield, they posses valuable genes for aroma, excellent cooking and eating quality traits and enjoy immense consumer preference in Chhattisgarh and in many other states. Grain quality in rice is a combination of many physico-chemical traits (Juliano, 1970). Physical quality is determined by the grain dimension, hulling, milling and head rice recovery. The quality of starch gelatinization temperature and protein content mainly constitute the chemical quality of rice. The cooking qualities are indexed by alkali spreading value, cooked kernel length, and elongation ratio. Scented varieties in general are tall, photoperiod sensitive with low yield potential. Therefore, presently much emphasis is given by the researchers on the development of high yielding varieties with good grain quality and aroma.

MATERIAL AND METHODS

The present research study on "Analysis of genetic variability for yield and quality characters in aromatic advanced breeding lines of rice (*Oryza sativa* L.)" was conducted at Research Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India. Chhattisgarh state is located between 17˚ 14′ and 24˚ 45′ N latitude and 79˚16′ and 84˚15′ E longitudes whereas, Raipur lies at 21˚16′ N and 81˚36′ E with a height of 289.60 meters above the mean sea level.

The experiment was conducted during *kharif* 2010. The maximum temperature 35.7 ˚C and minimum temperatures 15 ˚C was recorded during the crop growth season. The total rainfall during crop growth season was 1104.2 mm. highest amount of rainfall during crop growth period was received in the month of July (277.8 mm). The meteorological data depict a favorable season for crop growth but due to unevenly spread of rains, adversely affected the crop.

The experimental material was consisting of ninety eight aromatic advanced breeding lines of rice along with popular standard checks *viz.*, Indira Sugandhit Dhan-1, Pusa Basmati-1, Badsha Bhog, Dubraj, Chinnor, Mahisugandha, and Kalanamak, These breeding lines were received from rice section of department of Genetics and Plant Breeding I.G.K.V Raipur (C.G.). The experiment was laid out in randomized block design with two replications. Each breeding line was grown in a plot comprising 7 rows of 5 meter long maintaining inter and intra row spacing of 20X15 cm. Transplanting of the material was done manually when the seedlings were 21 days old nursery. A fertilizer dose of 60N:40P:20K kg/ha was applied. The entire dose of phosphorus and potassium along with half dose of nitrogen was applied as basal at the time of field preparation and the remaining nitrogen dose was applied in two splits at 20 days interval on standing crop, starting from 30 days after transplanting.

Observations recorded on various agro-morphological including qualitative and quantitative characters in each plot, on five random plants. By taking the average, the mean value for the treatment was computed. The characters studied viz., Qualitative characters : Early plant vigor (EPV), Basal leaf sheath color (BLSC), Leaf blade color (LBC), Leaf blade pubescence (LBP), Ligule color (LgC), Ligule shape (LgS), Collar color (CC), Auricle color (AC), Internode color (IC), Flag leaf angle (FLA), Panicle excertion (PE), Panicle type (PT), Stigma color (SgC), Apiculous color (ApC), Awning (An), Hull color (HC), Sterile lemma color (SLmC), Seed coat color (SCC). Quantitative characters: Days to 50 per cent flowering, Plant height, Panicle length, Total number of tillers per plant, Effective tillers per plant, Total number of spikelets per panicle, Number of filled spikelets per panicle, Number of unfilled spikelets per panicle, Spikelet sterility percentage, 100-Seed weight (g), Grain yield per plant (g). Physico-chemical quality characters, Paddy length (mm), Paddy breadth (mm), Paddy length, breadth (L/B) ratio, Brown rice length (mm), Brown rice breadth (mm), Brown rice length, breadth (L/B) ratio, Kernel length (mm), Kernel breadth (mm), Kernel length, breadth (L/B) ratio, Kernel length after cooking (KLAC) (mm), Kernel breadth after cooking (KBAC) (mm), Cooked kernel L/B ratio (KLAC: KBAC), Elongation ratio (ER), Elongation index (EI), Hulling percentage, Milling percentage, Alkali spreading value (Gelatinization temperature), Aroma.

Statistical Analysis

Path analysis was originally developed by Wright (1921) and first used for plant selection by Dewey and Lu (1959). It measures the direct and indirect contribution of independent variables on dependent variable.

The results of path coefficient analysis are interpreted as per the following scale suggested by Lenka and Mishra (1973).

Value of direct and indirect effects	Rate/ Scale
0.00 to 0.09	Negligible
0.10 to 0.19	Low
0.20 to 0.29	Moderate
0.30 to 0.99	High
>1.00	Very High

Table 1: Genotypic path showing direct and indirect effect on grain yield

Characters	DF	PH	PL	TT/P	ET/P	TS/Pa	FG/Pa	UG/Pa	SSP	SI	Correlation coefficient GY/P
	1	2	3	4	5	6	7	8	9	10	11
DF	**-0.081**	-0.006	0.005	0.004	0.035	-0.447	0.768	-0.161	0.216	-0.373	-0.062
PH	-0.009	**-0.056**	0.069	0.054	-0.037	0.233	-0.595	-0.012	0.179	0.031	-0.172
PL	-0.003	-0.024	**0.161**	0.016	-0.040	0.211	-0.523	-0.003	0.142	0.020	-0.050
TT/P	-0.001	-0.010	0.008	**0.304**	-0.102	0.122	-0.468	-0.083	0.262	-0.265	-0.230
ET/P	0.016	-0.012	0.038	0.181	**-0.171**	0.160	-0.357	0.018	0.053	-0.132	-0.154
TS/Pa	-0.038	0.014	-0.035	-0.039	0.029	**1.958**	-0.195	-0.959	0.070	-0.408	0.398**
FG/Pa	-0.030	0.016	-0.041	-0.069	0.029	2.067	**-0.079**	-0.908	-0.205	-0.233	0.557**
UG/Pa	-0.034	-0.002	0.001	0.066	0.008	0.431	-0.380	**-0.491**	0.763	-0.617	0.398**
SSP	-0.020	-0.012	0.026	0.093	-0.010	-0.078	-0.492	-0.336	**0.861**	-0.531	-0.528**
SI	0.034	-0.002	0.004	-0.090	0.025	0.438	-0.540	0.262	-0.512	**0.894**	0.521**

Residual effect –: 0.1296

1. DF: Days to 50% flowering; 2. PH: Plant Height; 3. PL: Panicle length; 4. TT/P: Total tiller per plant; 5.ET/P: Effective tiller per plant; 6. TS/Pa: Total spikelets per panicle; 7. FG/Pa: Filled spikelets per panicle; 8. UG/Pa: Unfilled spikelets per panicle; 9. SSP: Spikelet sterility percentage; 10. SI: 100 seed weight; 11. GY/P: Grain yield per plant.

*The bold data are the direct effect over grain yield.

RESULT AND DISCUSSION

The path coefficient analysis was carried out by using the correlation coefficient between different quantitative characters to obtain direct and indirect effects of different characters on grain yield per plant. The direct and indirect effects of different characters on grain yield per plant are presented in table 1.

Days to 50% flowering shown negligible negative direct effects of (- 0.081) on grain yield per plant. It had shown high positive indirect effect of (0.768) on grain yield per plant *via* filled grain per panicle, high negative indirect effect of (-0.447) *via* total spikelet per panicle, moderate positive in direct effect of (0.216) *via* spikelet sterility percentage and low negative indirect effect of (-0.161) *via* unfilled spikelet per panicle on grain yield per plant.

Plant height had shown negligible negative direct effect of (-0.056) on grain yield per plant it also shown high negative indirect effect of (-0.595) on grain yield per plant *via* filled spikelets per panicle, where as it showed moderate and low positive indirect effect on grain yield per plant *via* total spikelet per panicle (0.233) and *via* spikelet's sterility percentage (0.171).

Panicle length had expressed low positive direct effect of (0.161) on grain yield per plant. While, it showed high negative indirect effect of (-0.523) on grain yield per plant *via* filled spikelet per panicle. it had expressed moderate and low positive indirect effect on grain yield per plant *via* total spikelets per panicle (0.211), spikelet's sterility percentage (0.142) and rest of characters had showed negligible either positive or negative indirect effect on grain yield per plant.

Number tiller per plant showed a high positive direct effect of (0.304) on grain yield per plant. It had shown a high negative indirect effect of (-0.468) on grain yield per plant *via* filled grain per panicle.

Number of effective tillers per plant showed a negative but low effect of (-0.171) on grain yield per plant. It had shown a high negative indirect effect of (-0.357) on grain yield per plant *via* filled spikelets per panicle.

Total spikelet per panicle showed a high but negative direct effect of (-0.908) on grain yield per plant. Total spikelet's per panicle showed very high positive indirect effect of (2.067) on grain yield per plant *via* filled spikelets per panicle.

Filled spikelets per panicle showed a very high positive direct effect of (2.067) on grain yield per plant. It had shown a high negative indirect effect of (-0.908) on grain yield per plant *via* number of total spikelet's per plant.

Number of filled spikelets per panicle showed negligible but positive indirect effect of (0.016) and (0.029) on grain yield per plant *via* plant height and total number of effective tillers per plant.

Unfilled spikelets per panicle showed a high but negative direct effect of (-0.380) on grain yield per plant. It had shown a high positive indirect effect of (0.763) on grain yield per plant *via* spikelet sterility percentage.

Spikelet sterility percentage showed high positive direct effect of (0.861) on grain yield per plant. It had shown a high but negative indirect effect of (-0.531) on grain yield per plant *via* 100- seed weight.

Spikelet sterility percentage showed negligible but negative indirect effect of (-0.020), (-0.012), (-0.010) and (-0.078) on grain yield per plant *via* days to 50% flowering, plant height, total effective tiller per plant, total spikelets per panicle.

100-seed weight showed high positive direct effect of (0.894) on grain yield per plant. It had shown a moderate positive indirect effect of (0.262) on grain yield per plant *via* unfilled spikelets per panicle.

A high negative indirect effect of (-0.54) and (-0.512) on grain yield per plant *via* spikelet's sterility percentage and filled spikelets per panicle.

The positive direct effect of panicle length on grain yield per plant in present study was similer to the findings of Rajeshwari and Nadarajan (1995), Gopalkrishna and Ganpathy (1996), Padmavati *et al.* (1995), Chakraborty *et al.* (2001), Mishra and Verma (2002), Iftekharuddaula *et al.* (2002), Anurag *et al.* (2006) and Kumar (2008). Spikelet sterility percentage had high positive direct effect on grain yield per plant is in accordance with the findings of Khedikar *et al.* (2004) and Johnson *et al.* (2007). 100-seed weight showed high positive direct effects on grain yield per plant Similar finding have also been reported by Chakraborty *et al.* (2001), Iftekkharuddaula *et al.* (2002) and Chandra *et al.* (2009).

CONCLUSION

The path coefficient analysis was carried out by using the correlation coefficient between characters to obtain direct and indirect effects on grain yield per plant. Number of total tiller per plant, Total number of Spikelets per panicle, Spikelet sterility percentage and 100 seed weight had high positive direct effect on Grain yield per plant. On the basis of path analysis it can be concluded that the direct selection for characters *viz.* 100 seed weight will be very effective for increasing the grain yield. For improvement in grain yield however the character *viz.* days to 50 % flowering, effective tiller per plant and filled spikelets per panicle also expressed considerable indirect effects through one or more characters on grain yield per plant, hence they should be given consideration in selection criteria.

Suggestions for future works

Desirable breeding lines for yield and quality characters may be used in the improvement programme to develop superior high yielding aromatic rice varieties. For hybridization programme, the better genotypes should be taken from different clusters on the basis of yield and quality characters for hybridization programme. Morphological characterization criteria may be used for marker assisted selection.

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