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Path Co-Efficient Analysis of Indigenous Rice Varieties of eastern Uttar Pradesh for Grain Quality Traits

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ABSTRACT

Forty-five indigenous genotypes of rice (Oryza sativa L.) were used for path co-efficient analysis. The genotypic correlations were subjected to path co-efficient analysis to partition the correlation co-efficient of all the eight physical characters with three quality characters viz, water uptake, volume expansion and amylose content into direct and indirect effects. The L/B ratio showed direct positive effect on amylase content while kernel density had direct and negative effect on amylose content and this was enhanced by indirect effects of kernel breadth, hulling % and head rice recovery.

Key Words: *Path co-efficient, indigenous, volume expansion ratio, water uptake, amylose*

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INTRODUCTION

Rice is the world's most important staple cereal crop and is the primary source of energy for more than half of the world's population. More than 80% of total rice production is produced and consumed in Asia and South East Asia. India is the 2nd largest producer of rice after china with an annual production of 104 millions tons. India is the home of thousands of rice cultivars, traditional varieties, landraces and many lesser known varieties that have been under cultivation since ages by the farmers. These cultivars were developed through selections, based on desirable characters such as grain yield, aroma, kernel length, cooking quality and adaptation to various abiotic stresses. Such process of selection resulted in a wide range of rice varieties adapted to a wide range of agro-ecological conditions. In India in almost all the rice growing regions have their own well adapted rice cultivars suitable for specific agro-climatic conditions (Singh et al., 2003). Many of these varieties are highly valued in the domestic market and were also patronized by many erstwhile royal families (Pachauri et al., 2010). Consumer preference is a strong factor in deciding the varietal composition of different rice growing region. Uttar Pradesh has been a home for growing large number of high quality indigenous rice varieties. International rice breeding programs emphasizing on the improvement of crop productivity by selecting yield attributing traits (Huang *et al.* 2009). Rice productivity was greatly enhanced by the development of semi-dwarf cultivars in the 1960s (Peng *et al.* 1999). Further exploitation of heterosis in hybrid rice boosted rice yields to even higher levels beginning in the 1970s (Virmani *et al.* 1982, Yuan 1998). In recent years, scientists and breeders have focused on improving the quality of rice for higher market value and consumer preference. Milling properties, nutritional value, appearance and cooking quality are the major traits which determine the grain quality of rice (Yu et.al.). Both the molecular genetic background and environment significantly affect the quality of rice (Hakata *et al.* 2012, Li 2014, Li *et al.* 2014 and Lyman *et al.* 2013). At global level considerable emphasis is being made an improving nutritional quality of rice along with texture of rice grain. Association between different physical and cooking quality characters could be possibly, useful in breeding selection parameters in breeding programme. Large numbers of rice varieties have so far developed through hybridization. For success of any hybridization program the choice of parent is of paramount importance. Diverse parents are expected to yield the best recombinations. A qualitative estimation of genetic diversity in any gene pool guides the breeders to make crosses between desirable but diverse genotypes to genetic material for a selection program.

In view of the above observations present study was undertaken to select suitable lines on the basis of physical and quality characters.

METHODOLOGY

The experimental materials comprised of 45 indigenous rice varieties, were collected from different agro-climatic zones of eastern Uttar Pradesh. All the collected rice varieties were grown at Crop Research Station, Masodha, Faizabad during kharif 2013. Twenty days old seedlings were transplanted using 2-3 seedlings/hill in 2 rows of 5 m length at spacing of 20 cm between row and 15 cm between plants with three replications in alpha lattice design. Harvested grain from each plots were cleaned, processed and sun dried. These grain samples were utilized in quantitative estimation of grain quality parameters viz. Test weight , Kernel Length, Kernel breadth, L/b ratio, Kernel density, Hulling %, Milling %, Head Rice, Water Uptake, Volume Expansion ratio and Amylose content. Grain quality traits were quantifies with help of method described in Standard Evaluation System (SES) IRRI, Manila, Philippines. Path co-efficients were worked out according to the procedure suggested by Wright (1921) as elaborated by Dewary and Lu (1959), Eight physical characters; test weight, kernel length. kernel breadth, L/B ratio, Kernel density, hulling per cent, milling per cent and head rice recovery were subjected to path coefficient analysis to find out their direct and indirect effects upon water uptake, volume expansion ratio and amylose content.

RESULTS AND DISCUSSION:

Path co-efficient analysis for water uptake:

All the physical parameters showed positive and direct effect on water uptake except test weight and kernel length which showed negative effect. The maximum direct effect was recorded for L/B ratio followed by kernel breadth. Test weight showed negative direct effect on water uptake. L/B ratio, kernel density, hulling % and milling % recorded pcsitive indirect effect. However, L/B ratio and kernel density indirectly influenced water uptake in positive direction but the effect was negated by the indirect effects generated by test weight, kernel breadth, hulling % and head rice recovery.

The direct as well as indirect effects through test weight, kernel length, kernel density, hulling %, milling % and head rice recovery towards water uptake were positive. L/B ratio had direct positive contribution on water uptake but this was negated by test weight, kernel length, kernel breadth, hulling %, milling % and head rice recovery. Effect of ker density on water uptake may be explained on the bass of indirect positive effect caused by kernel breadth, L/B ratio, hulling %, milling %0 and head rice recovery.

The direct contribution of milling % on water uptake was also positive and had positive support with other characters. However indirect effects through test weight, kernel length, L/B ratio and head rice recovery were negative but were not able to nullify the positive contribution of milling %. The association between head rice recovery and water uptake were positive due to positive direct and indirect contribution of all the physical traits, except L/B ratio and milling % (Table 1). The results are in agreement with the work of earlier workers viz. Quan et. al. (2015), Wright (1921); Chang (1967), Chauhan (1981) and Singh et. al. (1982).

Path coefficient analysis for volume expansion ratio:

Kernel length, Kernel breadth and head rice recovery via test weight had negative indirect effect on volume expansion ratio. Indirect effect of kernel breadth on volume expansion via test weight, kernel length, kernel density, hulling %, milling% and head rice recovery was positive. Hulling % had positive direct contribution on volume expansion ratio and indirect positive effect via. kernel length, kernel breadth, kernel density, milling % and head rice recovery. Test weight, kernel length, L/B ratio and head rice recovery exhibited negative indirect influence on volume expansion through milling % however, kernel breadth, kernel density and hulling % exhibited positive indirect influence. Head rice recovery exhibited positive direct and indirect effects via test weight, kernel length, kernel breadth, kernel density arid hulling per cent. L/B ratio and milling per cent showed negative and indirect effect on volume expansion ration via head rice recovery (Table 2). The results have been in agreement with the earlier workers; Wu and Shen (1971). Singh (1973), Rangel (1979); Yadav and Singh (1979) and Zaman, et. a!. (1987).

Path co-efficient analysis for amylose content:

The direct contribution of test weight, kernel length, L/B ratio and milling per cent and amylose content was positive. The L/B ratio showed direct positive effect and support the trait by indirect positive effects through test weight, kernel length, kernel breadth, hulling per cent and head rice recovery. The kernel density had direct and negative effect on amylose content and this was enhanced by indirect effects of kernel breadth, hulling per cent and head rice recovery. The milling per cent had positive direct and indirect effect on amylose content through test weight, groin length and head rice recovery. The negative direct and indirect effects of test weight, kernel length kernel breadth, L/B ratio, kernel density, hulling per cent and milling per cent through' head rice recovery were observed on amylose content. (Table I c). The results are in agreement with the work of the earlier workers; Quan et.al. (2015), Nanda et. al. (1971) ; Wu and Shen (1971); Rangel (1979); Chauhan (1981) and Singh et. al, (1982).

CONCLUSION

Development of new high yielding varieties having superior cooking quality is a vital requirement of rice breeding. Breeding for high yield has been quite successful over the years but improvement of the quality parameter along with yield has been lagging due to lack of potential genotypes which can be utilized as parents in hybridization programs. For successful breeding a genetically diverse germplasm population is required. Present study provided a basic idea about correlation of physical grain parameters with grain quality traits which can be helpful in alternate selection of characters for development of new lines.

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Table 1: Direct and indirect effects of different physical parameters on water uptake

Character	Test Weight	Kernel Length	Kernel breadth	L/B ratio	Kernel density	Hulling %	Milling %	Head Rice Recovery
Test Weight	-0.338	-0.169	-0.011	0.148	0.400	0.022	0.009	-0.002
Kernel Length	-0.145	-0.396	-0.317	0.579	0.230	-0.046	0.000	-0.002
Kernel breadth	0.006	0.186	0.675	-0.701	0.006	0.064	0.008	0.004
L/B ratio	-0.064	-0.292	-0.603	0.786	0.075	-0.067	-0.003	-0.002
Kernel density	-0.267	-0.180	0.008	0.116	0.506	0.046	0.005	0.003
Hulling %	-0.033	0.079	0.186	-0.229	0.100	0.231	0.018	0.001
Milling %	-0.055	-0.003	0.088	0.039	0.042	0.071	0.058	-0.003
Head Rice Recovery	0.320	0.030	0.131	-0.084	0.053	0.007	-0.007	0.022

Residual= 0.7348

Table 2: Direct and indirect effects of different physical parameters on volume expansion ration

Character	Test Weight	Kernel Length	Kernel breadth	L/B ratio	Kernel density	Hulling %	Milling %	Head Rice Recovery
Test Weight	-0.331	-0.264	-0.011	0.161	0.368	0.030	0.008	-0.017
Kernel Length	-0.141	-0.618	-0.304	0.629	0.212	-0.062	0.000	-0.013
Kernel breadth	0.005	0.290	0.648	-0.762	0.005	0.086	0.007	0.034
L/B ratio	-0.062	-0.455	-0.578	0.854	0.069	-0.091	-0.003	-0.019
Kernel density	-0.262	-0.281	0.008	0.126	0.466	0.062	0.004	0.018
Hulling %	-0.032	0.124	0.179	-0.249	0.092	0.311	0.016	0.005
Milling %	-0.051	-0.005	0.085	-0.042	0.639	0.096	0.052	-0.022
Head Rice Recovery	0.032	0.047	0.126	-0.092	0.049	0.009	0.007	0.173

Residual= 0.5676

Table 3: Direct and indirect effects of different physical parameters on Amylose content

Character	Test Weight	Kernel Length	Kernel breadth	L/B ratio	Kernel density	Hulling %	Milling %	Head Rice Recovery
Test Weight	0.417	0.042	0.001	0.031	-0.172	-0.021	0.022	0.028
Kernel Length	0.178	0.097	0.038	0.123	-0.099	0.043	0.001	0.022
Kernel breadth	-0.007	-0.046	-0.081	-0.149	-0.003	-0.060	0.018	-0.056
L/B ratio	0.078	0.072	0.072	0.167	0.032	0.063	-0.007	0.031
Kernel density	0.330	0.044	-0.001	0.025	-0.218	-0.043	0.011	-0.031
Hulling %	0.041	-0.019	-0.022	-0.049	-0.043	-0.217	0.043	-0.009
Milling %	0.068	0.001	-0.011	-0.008	-0.018	-0.670	0.014	0.037
Head Rice Recovery	-0.040	-0.007	-0.016	-0.018	-0.023	-0.007	-0.017	-0.290

Residual= 0..5350

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