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# Genetic Variability, Correlation and Path Coefficient Study of Indigenous Rice (*Oryza sativa* L.) Accessions for Different Yield and Quality Contributing Traits

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## ABSTRACT

In this study, eighty indigenous rice accessions were evaluated for twenty-nine quantitative and quality traits planted in Randomized Complete Block Design with three replications. The experiment was conducted during *kharif* season of 2020 at Seed Breeding Farm, Department of Plant Breeding and Genetics, College of Agriculture, JNKVV, Jabalpur (MP), India. Observations were recorded for yield and quality traits to study the genetic variability parameters, correlation coefficient and path coefficient for yield and its attributing traits. The values of PCV for all the traits were found to be more than GCV and very small difference was present in between GCV and PCV revealing little influence of environment for their expression. High heritability coupled with high genetic advance was recorded for traits viz., days of 50% flowering, flag leaf length, flag leaf width, stem length, panicle length, no. of tillers per plant, no. of productive tillers per plant, panicle weight per plant, stem thickness, no. of spikelets per panicle, fertile spikelets per panicle, sterile spikelets per panicle, thousand grain weight, plant height, plant weight, biological yield per plant, grain length, grain breadth, head rice recovery percentage and spikelet density. Based on the results from correlation and path coefficient analysis, it may be concluded that the character no. of spikelets per panicle exhibited maximum positive direct effect and positive significant association with grain yield followed by panicle weight per plant, panicle index, no. of tillers per plant, plant height, biological yield per plant and head rice recovery should be given emphasis for further selection in rice improvement program.

**Keywords** Genetic variability, Heritability, Genetic advance, Correlation and path coefficient analysis.

## INTRODUCTION

Rice (*Oryza sativa* L.) belong to the genus *Oryza* and has two cultivated and twenty-two wild species. In the wild spices, 9 species are tetraploid (2n=48) and remaining 13 wild species are diploid and two cultivated species are diploid (2n=24). The cultivated species are *Oryza sativa* (Asian cultivated rice) and *Oryza glaberrima* (African cultivated rice). Asian cultivated rice is grown world wise while African cultivated rice *Oryza glaberrima* is grown on a limited scale in West Africa. Rice is consumed by nine out of

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ten people on the planet, especially by the impoverished, where it accounts for 50-80% of daily calorie intake and is the predominant protein source. More than 90% of the world's rice is grown and consumed in Asia, which also happens to be home to 60% of the world's people.

Rice quality has attracted significant attention and it has become the most important target in rice improvement and the analysis was conducted at Rice Quality Laboratory at Indonesia Center for Rice Research (ICRR), Sukamandi. The data were analyzed using Analysis of Variance (ANOVA) and followed by Duncan's Multiple Range Test (DMRT) if differences were found (Purwaningsih and Indrasari 2019). Characteristics of quality rice mainly related to aroma, milling efficiency, grain size, shape, grain appearance and cooking characteristics, palatability, flavor and nutritional values. The Indian indigenous aromatic rice are small and medium grain types, mostly cultivated for local consumption. Few of the small and medium grained aromatic rice possess excellent aroma and other quality traits viz., kernel elongation after cooking, taste. which could be excellent source for improving quality in high yielding varieties. Amylose content strongly influences the cooking and eating characteristics of rice.

Genetic parameters such as genetic coefficient of variation (GCV), phenotypic coefficient of variance (PCV), heritability, genetic advance are biometric tools that are useful for measuring genetic variability. Data on coefficient of variety is helpful in estimating the scope of changeability present in the characters. Similarly, heritability is the measures of transmission of characters from generation to generation. The information about heritability along with genetic advance can provide a glaring picture for selection of desired traits. The relative contribution of individual traits may be accomplished by correlation studies, Path coefficient analysis utilized to find out the direct and indirect causes of association governing the traits.

## MATERIALS AND METHODS

This study was carried out at Seed Breeding Farm under Rice Improvement Project, Department of Plant Breeding and Genetics, College of Agriculture, JNKVV, Jabalpur (MP). The experimental area occupied was quite uniform in respect of topography and fertility, situated at 23.900 N latitude and 79.580 E longitudes at an altitude of 411.87 m over the mean ocean level. The experimental material comprised of 80 Indigenous rice accessions collected from different districts of Madhya Pradesh. The research material was obtained from Rice Improvement Project, Department of Plant Breeding and Genetics, College of Agriculture, JNKVV, Jabalpur. These lines were planted in Randomized Complete Block Design with three replications. To record morphological observations, five competitive plants were randomly selected and tagged each plot in three replications. Mean of large, medium and smallest panicle from each of the five randomly selected plants were used to record the observations of panicle traits. All the agro-morphological characters and their states given as per National guidelines for the conduct of tests for distinctness, uniformity and stability (Shobha *et al*. 2006, DRR) were recorded at different stages of crop growth period.

## RESULTS AND DISCUSSION

### Genetic variability parameters

In this study, the mean sum of squares owing to genotypes was highly significant for all measures, indicating that there was substantial variation among genotypes for these qualities, according to the analysis of variance results. Panicle index had the most variation, while flag leaf width had the lowest. The magnitude of GCV and PCV were recorded high for traits such as sterile spikelets per panicle, flag leaf width, panicle weight per plant, length and breadth ratio of decorticated grain, no. of spikelets per panicle, spikelet density, stem length, fertile spikelets per panicle, stem thickness, thousand grain weight, grain yield per plant, biological yield per plant, plant height, plant weight, decorticated grain breath and no. of productive tillers per plant (Table 1). Therefore, these characters should be considered during selection of desired rice lines in crop improvement program. This finding was in partial consonance with the findings of Bharath *et al*. (2018), Kencharahut *et al*. (2018), Pragnya *et al*. (2018), Kujur *et al*. (2019) and Rahangdale *et al*. (2019). PCV for all the traits were

**Table 1.** Parameters of genetic variability for yield, yield attributing and quality traits in rice genotypes.

| Sl. No. | Traits | Mean | Range | | Coefficient of variation | | h² (bs) % | Genetic advance as 5% of mean |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | GCV (%) | PCV (%) | | |
| 1 | DTF | 70.00 | 118.00 | 92.33 | 14.36 | 14.45 | 98.71 | 29.39 |
| 2 | FLL | 21.40 | 51.36 | 31.48 | 16.70 | 17.25 | 93.68 | 33.30 |
| 3 | FLW | 0.523 | 5.066 | 0.97 | 50.65 | 50.99 | 98.69 | 103.66 |
| 4 | SL | 53.13 | 135.40 | 91.97 | 22.83 | 22.89 | 99.53 | 46.93 |
| 5 | PL | 14.03 | 28.73 | 20.66 | 12.34 | 14.03 | 77.42 | 22.37 |
| 6 | TTPP | 5.866 | 12.93 | 9.98 | 16.76 | 18.24 | 84.43 | 31.72 |
| 7 | PTPP | 4.773 | 11.80 | 8.73 | 18.32 | 20.09 | 83.15 | 34.41 |
| 8 | PWPP | 3.933 | 26.66 | 16.24 | 29.09 | 29.39 | 97.99 | 59.32 |
| 9 | ST | 3.366 | 9.40 | 6.108 | 21.90 | 23.04 | 90.40 | 42.91 |
| 10 | TSPP | 94.86 | 257.60 | 152.62 | 23.74 | 24.65 | 92.77 | 47.11 |
| 11 | FSPP | 73.20 | 209.66 | 124.90 | 22.61 | 23.75 | 90.64 | 44.35 |
| 12 | SSPP | 7.80 | 69.86 | 27.715 | 50.95 | 53.07 | 92.17 | 100.76 |
| 13 | TGW | 10.70 | 32.50 | 22.07 | 21.90 | 22.02 | 98.94 | 44.88 |
| 14 | PH | 73.23 | 166.50 | 116.43 | 19.28 | 19.61 | 96.65 | 39.05 |
| 15 | PW | 14.16 | 36.60 | 22.81 | 19.26 | 23.21 | 68.88 | 32.94 |
| 16 | BYPP | 23.00 | 58.73 | 39.06 | 20.01 | 21.54 | 86.31 | 38.29 |
| 17 | SF | 63.44 | 93.44 | 82.20 | 7.56 | 8.23 | 84.33 | 14.30 |
| 18 | HI | 29.20 | 66.70 | 50.61 | 11.13 | 22.24 | 25.05 | 11.47 |
| 19 | PI | 54.98 | 308.10 | 127.36 | 21.93 | 31.58 | 48.23 | 31.37 |
| 20 | GL | 5.36 | 11.82 | 7.3260 | 14.40 | 14.51 | 98.46 | 29.44 |
| 21 | GB | 1.663 | 3.76 | 2.617 | 16.42 | 16.77 | 95.94 | 33.14 |
| 22 | DGL | 3.73 | 8.33 | 5.5471 | 14.32 | 14.36 | 99.41 | 29.42 |
| 23 | DGB | 1.167 | 2.813 | 2.0169 | 18.73 | 19.07 | 96.49 | 37.91 |
| 24 | LBR | 1.54 | 5.396 | 2.855 | 25.16 | 25.52 | 97.17 | 51.09 |
| 25 | H (%) | 74.40 | 85.20 | 79.35 | 2.64 | 2.86 | 85.38 | 5.035 |
| 26 | M (%) | 46.86 | 82.33 | 76.62 | 5.49 | 5.69 | 93.10 | 10.93 |
| 27 | HRR | 36.21 | 79.306 | 64.50 | 12.64 | 12.88 | 96.28 | 25.56 |
| 28 | SD | 4.52 | 13.480 | 7.45 | 22.92 | 24.65 | 86.41 | 43.89 |
| 29 | GYPP | 9.866 | 29.46 | 19.82 | 20.72 | 25.69 | 65.06 | 34.44 |

Notations: DTF (days to flowering), DTM (days to maturity), FLL (flag leaf length), FLW (flag leaf width), ST (stem thickness), SL (stem length), PH (plant height), NOT (number of tillers per plant), NOPT (number of productive tillers per plant), PL (panicle length), BYPP (biological yield per plant), PWPP (panicle weight per plant), NSPP (number of spikelet per panicle), FSPP (fertile spikelet per panicle), SF (spikelet fertility), SD (spikelet density), TGW (thousand grain weight), PI (panicle weight), HI (harvest index), GL (grain length), GB (grain breadth), DGL (decorticated grain length), DGB (decorticated grain breadth), DLBR (decorticated length breadth ratio), H% (hulling %), M% (milling %), HRR (head rice recovery), GYPP (grain yield per plant).

recorded more than GCV and very small difference was present in between GCV and PCV, revealing very little influence of environment for their expression.

High heritability coupled with high genetic advance was recorded for traits viz., days of 50 % flowering, flag leaf length, flag leaf width, stem length, panicle length, no. of tillers per plant, no. of productive tillers per plant, panicle weight per plant, stem thickness, no. of spikelets per panicle, fertile spikelets per panicle, sterile spikelets per panicle, thousand grain weight, plant height, plant weight, biological yield per plant, grain length, grain breadth, decorticated grain length, decorticated grain breadth, length and breadth ratio of decorticated grain, head rice recovery percentage and spikelet density (Table 1). It indicated that direct selection for these traits might be effective since the heritability is most likely due to additive gene effect. This result was in partial consonance with the finding of Srujana *et al*. (2017), Bagudam *et al*. (2018), Lal *et al*. (2018), Singh *et al*. (2018), Kumar *et al*. (2018), Kujur *et al*. (2019), Dey *et al*. (2019), Rahangdale *et al*. (2019), Gupta *et al*. (2020) and Surjaye *et al*. (2022).

## Correlation coefficient analysis

Correlation analysis reveals the interrelationships between various independent qualities and dependent traits such as grain yield/plant. In the current study, genotypic correlation coefficients were higher in magnitude in the same direction than phenotypic correlation coefficients, indicating that there is a strong inherent association between each pair of characters, which could be due to the environment's masking or modifying effect. Grain yield/plant exhibited positive and significant association between flag leaf length, flag leaf width, stem length, stem thickness, plant height, no. of productive tillers per plant, panicle length, no. of spikelets per panicle, fertile spikelets per panicle, fertile spikelets per panicle, spikelet density, grain length, decorticated grain length, biological yield per plant, panicle weight per plant (Tables 2 a - b). These traits should be given empha-

**Table 2 (a).** Estimates of phenotypic correlation coefficient for various yield and quality attributing traits.

| Char | DTF | FLL | FLW | SL | PL | TTPP | PTPP | PWPP |
|---|---|---|---|---|---|---|---|---|
| DTF | **1.0000** | 0.2754 | 0.2007 | 0.5246 | 0.4366 | -0.1561 | -0.1535 | 0.2861 |
| FLL | | **1.0000** | 0.1762 | 0.5168 | 0.3658 | -0.1822 | -0.1473 | 0.4096 |
| FLW | | | **1.0000** | 0.2492 | 0.1098 | 0.0444 | 0.0579 | 0.0671 |
| SL | | | | **1.0000** | 0.5950 | -0.1793 | -0.1593 | 0.1579 |
| PL | | | | | **1.0000** | -0.1955 | -0.2070 | 0.3414 |
| TTPP | | | | | | **1.0000** | 0.9822 | 0.0072 |
| PTPP | | | | | | | **1.0000** | 0.0328 |
| PWPP | | | | | | | | **1.0000** |
| ST | | | | | | | | |
| TSPP | | | | | | | | |
| FSPP | | | | | | | | |
| SSPP | | | | | | | | |
| TGW | | | | | | | | |
| PH | | | | | | | | |
| PW | | | | | | | | |
| BYPP | | | | | | | | |
| SF | | | | | | | | |
| HI | | | | | | | | |
| PI | | | | | | | | |
| GL | | | | | | | | |
| GB | | | | | | | | |
| DGL | | | | | | | | |
| DGB | | | | | | | | |
| LBR | | | | | | | | |
| H% | | | | | | | | |
| M% | | | | | | | | |
| HRR% | | | | | | | | |
| SD | | | | | | | | |
| GYPP | 0.3415 | 0.4858 | 0.0255 | 0.1538 | 0.3106 | 0.0447 | 0.0584 | 0.9029 |

**Table 2 (a).** Continued.

| Char | ST | TSPP | FSPP | SSPP | TGW | PH | PW |
|---|---|---|---|---|---|---|---|
| DTF | 0.4287 | 0.1515 | 0.0966 | 0.1957 | 0.0090 | 0.5302 | 0.5024 |
| FLL | 0.3656 | 0.4002 | 0.3346 | 0.3577 | 0.0360 | 0.5133 | 0.4698 |
| FLW | 0.1508 | 0.0634 | 0.1234 | -0.0841 | 0.1803 | 0.2355 | 0.1428 |
| SL | 0.4279 | 0.2872 | 0.2052 | 0.3266 | -0.0451 | 0.9939 | 0.5787 |
| PL | 0.4708 | 0.3535 | 0.3178 | 0.2715 | -0.1067 | 0.6915 | 0.4079 |
| TTPP | -0.3012 | -0.0474 | -0.0411 | -0.0396 | 0.0065 | -0.1903 | 0.0322 |
| PTPP | -0.2978 | -0.0387 | -0.0604 | 0.0215 | 0.0121 | -0.1751 | 0.0331 |
| PWPP | 0.3363 | 0.3124 | 0.3206 | 0.1606 | -0.0929 | 0.1844 | 0.4675 |
| ST | **1.0000** | 0.3904 | 0.3526 | 0.2968 | -0.1134 | 0.4586 | 0.3611 |

**Table 2 (a).** Continued.

| Char | ST | TSPP | FSPP | SSPP | TGW | PH | PW |
|---|---|---|---|---|---|---|---|
| TSPP | | **1.0000** | 0.9338 | 0.6986 | -0.5291 | 0.3145 | 0.4467 |
| FSPP | | | **1.0000** | 0.3964 | -0.4935 | 0.2307 | 0.3714 |
| SSPP | | | | **1.0000** | -0.3709 | 0.3457 | 0.4036 |
| TGW | | | | | **1.0000** | -0.0587 | -0.1152 |
| PH | | | | | | **1.0000** | 0.5757 |
| PW | | | | | | | **1.0000** |
| BYPP | | | | | | | |
| SF | | | | | | | |
| HI | | | | | | | |
| PI | | | | | | | |
| GL | | | | | | | |
| GB | | | | | | | |
| DGL | | | | | | | |
| DGB | | | | | | | |
| LBR | | | | | | | |
| H% | | | | | | | |
| M% | | | | | | | |
| HRR% | | | | | | | |
| SD | | | | | | | |
| GYPP | 0.2434 | 0.2233 | 0.2113 | 0.1504 | 0.0048 | 0.1723 | 0.5551 |

sis for further selection since strong association of these traits with grain yield/plant was recorded. This result was in confirmation with Jambulkar and Bose (2014), Bhati *et al*. (2015), Konate *et al*. (2016), Pal

**Table 2 (b).** Estimates of phenotypic correlation coefficient for various yield and quality attributing traits (Cont.).

| Char | BYPP | SF | HI | PI | GL | GB | DGL |
|---|---|---|---|---|---|---|---|
| DTF | 0.4556 | -0.1377 | -0.1492 | -0.0652 | 0.1079 | -0.1143 | 0.1540 |
| FLL | 0.5119 | -0.1531 | 0.0104 | -0.1385 | 0.0341 | 0.0814 | 0.2035 |
| FLW | 0.1209 | 0.1493 | -0.1845 | -0.1083 | 0.0105 | 0.0354 | 0.0423 |
| SL | 0.4210 | -0.2289 | -0.4038 | -0.0985 | -0.1571 | -0.0148 | -0.0515 |
| PL | 0.4359 | -0.1032 | -0.2501 | -0.2330 | -0.0686 | -0.1904 | -0.0179 |
| TTPP | 0.0225 | -0.0229 | 0.0937 | -0.0257 | -0.0882 | -0.0472 | -0.0784 |
| PTPP | 0.0384 | -0.0933 | 0.0948 | -0.0370 | -0.0703 | -0.0495 | -0.0335 |
| PWPP | 0.8676 | 0.0173 | 0.0717 | -0.7072 | 0.2589 | -0.1101 | 0.2350 |
| ST | 0.4065 | -0.1224 | -0.2034 | -0.2283 | -0.0698 | -0.1712 | -0.0434 |
| TSPP | 0.4402 | -0.2615 | -0.3265 | -0.2278 | -0.1229 | -0.2317 | -0.0824 |
| FSPP | 0.4027 | 0.0925 | -0.2871 | -0.3030 | -0.1279 | -0.1937 | -0.1085 |
| SSPP | 0.3241 | -0.8563 | -0.2637 | 0.0215 | -0.0597 | -0.2071 | 0.0054 |
| TGW | -0.1209 | 0.1818 | 0.1897 | 0.0814 | 0.2347 | 0.4114 | 0.2866 |
| PH | 0.4353 | -0.2328 | -0.3938 | -0.1230 | -0.1421 | -0.0423 | -0.0417 |
| PW | 0.8451 | -0.2117 | -0.3706 | 0.0251 | 0.1006 | 0.0113 | 0.1274 |
| BYPP | **1.0000** | -0.1086 | -0.1650 | -0.4135 | 0.2131 | -0.0602 | 0.2137 |
| SF | | **1.0000** | 0.1608 | -0.1856 | 0.0043 | 0.1538 | -0.0604 |
| HI | | | **1.0000** | 0.0963 | 0.1011 | 0.0875 | 0.1666 |
| PI | | | | **1.0000** | -0.0766 | 0.0905 | 0.0264 |
| GL | | | | | **1.0000** | 0.1444 | 0.8650 |
| GB | | | | | | **1.0000** | 0.1624 |
| DGL | | | | | | | **1.0000** |
| DGB | | | | | | | |
| LBR | | | | | | | |
| H% | | | | | | | |
| M% | | | | | | | |
| HHR% | | | | | | | |
| SD | | | | | | | |
| GYPP | 0.8582 | -0.0172 | 0.3530 | -0.3855 | 0.2835 | -0.0482 | 0.3191 |

**Table 2 (b).** Continued.

| Char | DGB | LBR | H% | M% | HRR% | SD% |
|---|---|---|---|---|---|---|
| DTF | -0.0848 | 0.1337 | -0.0467 | -0.0853 | -0.1115 | -0.0909 |
| FLL | 0.0541 | 0.0281 | -0.1665 | -0.1003 | -0.0993 | 0.2146 |
| FLW | 0.0942 | -0.0676 | 0.0399 | 0.0241 | 0.0012 | 0.0066 |
| SL | -0.0448 | -0.0671 | 0.0885 | 0.0680 | 0.0692 | -0.0536 |
| PL | -0.1899 | 0.1378 | 0.0589 | -0.0189 | 0.1066 | -0.1851 |
| TTPP | -0.0700 | 0.0328 | -0.0345 | -0.1670 | -0.1201 | 0.0761 |
| PTPP | -0.0749 | 0.0615 | 0.0105 | -0.1411 | -0.0628 | 0.0880 |
| PWPP | -0.1866 | 0.3366 | 0.0546 | 0.0471 | -0.0319 | 0.1632 |
| ST | -0.1879 | 0.1322 | -0.0805 | -0.0586 | 0.0061 | 0.1352 |
| TSPP | -0.2743 | 0.2306 | -0.1048 | 0.1045 | 0.1308 | 0.8470 |
| FSPP | -0.2624 | 0.2095 | -0.1268 | 0.0980 | 0.0997 | 0.8110 |
| SSPP | -0.1791 | 0.1728 | -0.0153 | 0.0721 | 0.1364 | 0.5515 |
| TGW | 0.3976 | -0.2229 | 0.0988 | -0.1322 | -0.2388 | -0.5103 |
| PH | -0.0711 | -0.0326 | 0.0859 | 0.0680 | 0.1008 | -0.0796 |
| PW | -0.0602 | 0.1192 | 0.0245 | -0.1441 | -0.0866 | 0.2278 |
| BYPP | -0.1467 | 0.2706 | 0.0468 | -0.0525 | -0.0680 | 0.2268 |
| SF | 0.0825 | -0.1100 | -0.0648 | -0.0511 | -0.1299 | -0.1873 |
| HI | 0.0940 | 0.0479 | -0.0455 | -0.0939 | -0.2396 | -0.1578 |
| PI | 0.1362 | -0.1180 | -0.0549 | -0.1232 | -0.1281 | -0.1143 |
| GL | 0.1357 | 0.4409 | 0.0839 | -0.0200 | -0.0485 | -0.0872 |
| GB | 0.7954 | -0.5608 | 0.1079 | 0.0456 | -0.2289 | -0.1541 |
| DGL | 0.1179 | 0.5111 | 0.0925 | -0.0179 | 0.0257 | -0.0719 |
| DGB | **1.0000** | -0.7613 | -0.0126 | -0.0594 | -0.2432 | -0.1915 |
| LBR | | **1.0000** | 0.1177 | 0.0730 | 0.2464 | 0.1803 |
| H% | | | **1.0000** | 0.5199 | 0.4161 | -0.1405 |
| M% | | | | **1.0000** | 0.6276 | 0.1115 |
| HHR% | | | | | **1.0000** | 0.0640 |
| SD | | | | | | **1.0000** |
| GYPP | -0.1121 | 0.3169 | 0.0660 | -0.0710 | -0.1451 | 0.0975 |

*et al*. (2016), Karande *et al*. (2017), Archana *et al*. (2018), Meena *et al*. (2018), Mukesh *et al*. (2018), Pratap *et al*. (2018), Nanda *et al*. (2019), Rahangdale *et al*. (2019) and Sahu *et al*. (2019) for different traits.

## Path coefficient analysis

Path analysis results revealed that the highest positive direct effect on seed production per plant was observed for no. spikelets per panicle exhibited maximum positive direct effect followed by panicle weight per plant, panicle index, no. of tillers per plant, plant height, biological yield per plant, head rice recovery, grain length, hulling percentage, grain breath, days of 50 % flowering, thousand grain weight, flag leaf width (Tables 3 a - b). This result was in consonance with findings of Sharma (2014), Ekka *et al*. (2015), Guru *et al*. (2017), Gour *et al*. (2017), Mukesh *et al*. (2018), Venkatesan (2017) and Singh *et al*. (2019).

**Table 3 (a).** Genotypic path analysis showing direct and indirect effect of various components on grain yield/plant.

| Char | DTF | FLL | FLW | SL | PL | TTPP | PTPP |
|---|---|---|---|---|---|---|---|
| DTF | **0.5044** | 0.1389 | 0.1012 | 0.2646 | 0.2202 | -0.0787 | -0.0774 |
| FLL | -0.1231 | **-0.4470** | -0.0788 | -0.2310 | -0.1635 | 0.0814 | 0.0658 |
| FLW | 0.0050 | 0.0044 | **0.0251** | 0.0062 | 0.0028 | 0.0011 | 0.0015 |
| SL | -0.5068 | -0.4992 | -0.2407 | **-0.9660** | -0.5748 | 0.1732 | 0.1539 |
| PL | -2.1871 | -1.8323 | -0.5503 | -2.9806 | **-5.0096** | 0.9791 | 1.0371 |
| TTPP | -0.7166 | -0.8364 | 0.2036 | -0.8231 | -0.8971 | **4.5899** | 4.5082 |
| PTPP | 0.6258 | 0.6005 | -0.2362 | 0.6494 | 0.8440 | -4.0041 | **-4.0768** |
| PWPP | 1.5282 | 2.1880 | 0.3584 | 0.8436 | 1.8235 | 0.0383 | 0.1750 |
| ST | -0.1572 | -0.1340 | -0.0553 | -0.1569 | -0.1726 | 0.1104 | 0.1092 |

**Table 3 (a).** Continued.

| Char | DTF | FLL | FLW | SL | PL | TTPP | PTPP |
|---|---|---|---|---|---|---|---|
| TSPP | 1.7329 | 4.5764 | 0.7253 | 3.2842 | 4.0428 | -0.5427 | -0.4422 |
| FSPP | -0.1785 | -0.6185 | -0.2281 | -0.3793 | -0.5875 | 0.0760 | 0.1116 |
| SSPP | -0.3655 | -0.6681 | 0.1570 | -0.6100 | -0.5071 | 0.0739 | -0.0401 |
| TGW | 0.0020 | 0.0080 | 0.0400 | -0.0100 | -0.0236 | 0.0014 | 0.0027 |
| PH | 1.8672 | 1.8075 | 0.8292 | 3.5000 | 2.4353 | -0.6700 | -0.6166 |
| PW | -3.2114 | -3.0027 | -0.9128 | -3.6991 | -2.6074 | -0.2059 | -0.2116 |
| BYPP | 1.2953 | 1.4554 | 0.3437 | 1.1969 | 1.2392 | 0.0638 | 0.1093 |
| SF | 0.0181 | 0.0201 | -0.0196 | 0.0301 | 0.0136 | 0.0030 | 0.0123 |
| HI | 0.1102 | -0.0077 | 0.1362 | 0.2981 | 0.1846 | -0.0692 | -0.0700 |
| PI | -0.3315 | -0.7042 | -0.5507 | -0.5007 | -1.1847 | -0.1308 | -0.1880 |
| GL | 0.1275 | 0.0403 | 0.0124 | -0.1856 | -0.0810 | -0.1042 | -0.0831 |
| GB | -0.0670 | 0.0477 | 0.0207 | -0.0087 | -0.1115 | -0.0276 | -0.0290 |
| DGL | -0.0116 | -0.0154 | -0.0032 | 0.0039 | 0.0014 | 0.0059 | 0.0025 |
| DGB | 0.1478 | -0.0944 | -0.1643 | 0.0780 | 0.3312 | 0.1220 | 0.1305 |
| LBR | -0.3352 | -0.0705 | 0.1695 | 0.1682 | -0.3457 | -0.0822 | -0.1542 |
| H% | -0.0375 | -0.1337 | 0.0320 | 0.0710 | 0.0473 | -0.0277 | 0.0085 |
| M% | 0.1689 | 0.1987 | -0.0478 | -0.1348 | 0.0374 | 0.3308 | 0.2795 |
| HRR% | -0.1546 | -0.1376 | 0.0016 | 0.0959 | 0.1478 | -0.1665 | -0.0871 |
| SD | 0.5919 | -1.3983 | -0.0429 | 0.3493 | 1.2058 | -0.4960 | -0.5730 |
| GYPP | 0.3415 | 0.4858 | 0.0255 | 0.1538 | 0.3106 | 0.0447 | 0.0584 |

R square= 1.1556
Residual effect = (1-1.1556)

**Table 3 (a).** Continued.

| Char | PWPP | ST | TSPP | FSPP | SSPP | TGW | PH |
|---|---|---|---|---|---|---|---|
| DTF | 0.1443 | 0.2162 | 0.0764 | 0.0487 | 0.0987 | 0.0045 | 0.2674 |
| FLL | -0.1831 | -0.1634 | -0.1788 | -0.1495 | -0.1599 | -0.0161 | -0.2294 |
| FLW | 0.0017 | 0.0038 | 0.0016 | 0.0031 | -0.0021 | 0.0045 | 0.0059 |
| SL | -0.1526 | -0.4134 | -0.2774 | -0.1982 | -0.3155 | 0.0436 | -0.9601 |
| PL | -1.7101 | -2.3587 | -1.7709 | -1.5921 | -1.3603 | 0.5344 | -3.4643 |
| TTPP | 0.0329 | -1.3824 | -0.2178 | -0.1886 | -0.1817 | 0.0298 | -0.8733 |
| PTPP | -0.1336 | 1.2142 | 0.1576 | 0.2461 | -0.0876 | -0.0493 | 0.7138 |
| PWPP | **5.3416** | 1.7965 | 1.6689 | 1.7125 | 0.8577 | -0.4960 | 0.9851 |
| ST | -0.1233 | **-0.3666** | -0.1431 | -0.1293 | -0.1088 | 0.0416 | -0.1681 |
| TSPP | 3.5732 | 4.4649 | **11.4368** | 10.6800 | 7.9898 | -6.0515 | 3.5968 |
| FSPP | -0.5927 | -0.6518 | -1.7264 | **-1.8487** | -0.7329 | 0.9123 | -0.4265 |
| SSPP | -0.2999 | -0.5542 | -1.3047 | -0.7404 | **-1.8676** | 0.6927 | -0.6456 |
| TGW | -0.0206 | -0.0251 | -0.1173 | -0.1094 | -0.0822 | **0.2217** | -0.0130 |
| PH | 0.6495 | 1.6150 | 1.1075 | 0.8124 | 1.2173 | -0.2067 | **3.5215** |
| PW | -2.9880 | -2.3082 | -2.8553 | -2.3738 | -2.5801 | 0.7361 | -3.6799 |
| BYPP | 2.4668 | 1.1557 | 1.2515 | 1.1450 | 0.9215 | -0.3438 | 1.2377 |
| SF | -0.0023 | 0.0161 | 0.0344 | -0.0122 | 0.1126 | -0.0239 | 0.0306 |
| HI | -0.0530 | 0.1501 | 0.2410 | 0.2119 | 0.1947 | -0.1401 | 0.2907 |
| PI | -3.5956 | -1.1606 | -1.1581 | -1.5406 | 0.1092 | 0.4137 | -0.6256 |
| GL | 0.3059 | -0.0825 | -0.1453 | -0.1511 | -0.0705 | 0.2773 | -0.1679 |
| GB | -0.0645 | -0.1003 | -0.1357 | -0.1135 | -0.1213 | 0.2410 | -0.0248 |
| DGL | -0.0178 | 0.0033 | 0.0062 | 0.0082 | -0.0004 | -0.0217 | 0.0032 |
| DGB | 0.3253 | 0.3276 | 0.4783 | 0.4576 | 0.3122 | -0.6933 | 0.1240 |
| LBR | -0.8442 | -0.3315 | -0.5784 | -0.5255 | -0.4333 | 0.5591 | 0.0818 |
| H% | 0.0438 | -0.0646 | -0.0842 | -0.1019 | -0.0123 | 0.0794 | 0.0690 |
| M% | -0.0933 | 0.1161 | -0.2070 | -0.1941 | -0.1429 | 0.2619 | -0.1348 |
| HRR% | -0.0442 | 0.0085 | 0.1814 | 0.1383 | 0.1891 | -0.3312 | 0.1398 |
| SD | -1.0634 | -0.8811 | -5.5179 | -5.2837 | -3.5931 | 3.3245 | 0.5184 |
| GYPP | 0.9029 | 0.2434 | 0.2233 | 0.2113 | 0.1504 | 0.0048 | 0.1723 |

**Table 3 (b).** Genotypic path analysis showing direct and indirect effect of various components on grain yield/plant (cont.).

| | PW | BYPP | SF | HI | PI | GL | GB |
|---|---|---|---|---|---|---|---|
| DTF | 0.2534 | 0.2298 | -0.0695 | -0.0753 | -0.0329 | 0.0544 | -0.0577 |
| FLL | -0.2100 | -0.2288 | 0.0684 | -0.0047 | 0.0619 | -0.0152 | -0.0364 |
| FLW | 0.0036 | 0.0030 | 0.0037 | -0.0046 | -0.0027 | 0.0003 | 0.0009 |
| SL | -0.5590 | -0.4067 | 0.2212 | 0.3901 | 0.0951 | 0.1518 | 0.0143 |
| PL | -2.0435 | -2.1835 | 0.5169 | 1.2528 | 1.1673 | 0.3436 | 0.9537 |
| TTPP | 0.1479 | 0.1031 | -0.1051 | 0.4302 | -0.1181 | -0.4048 | -0.2165 |
| PTPP | -0.1350 | -0.1567 | 0.3803 | -0.3863 | 0.1507 | 0.2868 | 0.2019 |
| PWPP | 2.4970 | 4.6345 | 0.0923 | 0.3832 | -3.7775 | 1.3830 | -0.5878 |
| ST | -0.1324 | -0.1490 | 0.0449 | 0.0746 | 0.0837 | 0.0256 | 0.0627 |
| TSPP | 5.1089 | 5.0342 | -2.9910 | -3.7343 | -2.6051 | -1.4061 | -2.6497 |
| FSPP | -0.6866 | -0.7446 | -0.1710 | 0.5308 | 0.5602 | 0.2365 | 0.3582 |
| SSPP | -0.7538 | -0.6053 | 1.5992 | 0.4925 | -0.0401 | 0.1115 | 0.3867 |
| TGW | -0.0255 | -0.0268 | 0.0403 | 0.0421 | 0.0180 | 0.0520 | 0.0912 |
| PH | 2.0273 | 1.5330 | -0.8197 | -1.3868 | -0.4333 | -0.5005 | -0.1490 |
| PW | **-6.3920** | -5.4021 | 1.3530 | 2.3686 | -0.1606 | -0.6430 | -0.0721 |
| BYPP | 2.4028 | **2.8431** | -0.3088 | -0.4692 | -1.1756 | 0.6060 | -0.1712 |
| SF | 0.0278 | 0.0143 | **-0.1315** | -0.0211 | 0.0244 | -0.0006 | -0.0202 |
| HI | 0.2735 | 0.1218 | -0.1187 | **-0.7382** | -0.0711 | -0.0746 | -0.0646 |
| PI | 0.1278 | -2.1023 | -0.9437 | 0.4894 | **5.0843** | -0.3892 | 0.4603 |
| GL | 0.1189 | 0.2518 | 0.0051 | 0.1195 | -0.0904 | **1.1815** | 0.1706 |
| GB | 0.0066 | -0.0353 | 0.0901 | 0.0513 | 0.0530 | 0.0846 | **0.5858** |
| DGL | -0.0096 | -0.0162 | 0.0046 | -0.0126 | -0.0020 | -0.0654 | -0.0123 |
| DGB | 0.1049 | 0.2557 | -0.1438 | -0.1638 | -0.2375 | -0.2367 | -1.3867 |
| LBR | -0.2989 | -0.6786 | 0.2759 | -0.1202 | 0.2960 | -1.1058 | 1.4066 |
| H% | 0.0197 | 0.0376 | -0.0521 | -0.0365 | -0.0441 | 0.0674 | 0.0867 |
| M% | 0.2854 | 0.1041 | 0.1013 | 0.1861 | 0.2441 | 0.0396 | -0.0904 |
| HRR% | -0.1201 | -0.0943 | -0.1801 | -0.3323 | -0.1777 | -0.0673 | -0.3174 |
| SD | -1.4839 | -1.4777 | 1.2205 | 1.0279 | 0.7446 | 0.5682 | 1.0042 |
| GYPP | 0.5551 | 0.8582 | -0.0172 | 0.3532 | -0.3855 | 0.2835 | -0.0482 |
| R square= 1.1556 | | | | | | | |
| Residual effect = (1-1.1556) | | | | | | | |

**Table 3 (b).** Continued.

| | DGL | DGB | LBR | H% | M% | HRR | SD |
|---|---|---|---|---|---|---|---|
| DTF | 0.0777 | -0.0428 | 0.0674 | -0.0235 | -0.0430 | -0.0562 | -0.0458 |
| FLL | -0.0910 | -0.0242 | -0.0126 | 0.0744 | 0.0448 | 0.0444 | -0.0959 |
| FLW | 0.0011 | 0.0024 | -0.0017 | 0.0010 | 0.0006 | 0.0000 | 0.0002 |
| SL | 0.0497 | 0.0432 | 0.0648 | -0.0855 | -0.0657 | -0.0668 | 0.0518 |
| PL | 0.0895 | 0.9515 | -0.6905 | -0.2952 | 0.0946 | -0.5339 | 0.9272 |
| TTPP | -0.3600 | -0.3211 | 0.1505 | -0.1585 | -0.7664 | -0.5512 | 0.3494 |
| PTPP | 0.1364 | 0.3052 | -0.2506 | -0.0430 | 0.5751 | 0.2560 | -0.3586 |
| PWPP | 1.2552 | -0.9965 | 1.7979 | 0.2915 | 0.2516 | -0.1703 | 0.8719 |
| ST | 0.0159 | 0.0689 | -0.0485 | 0.0295 | 0.0215 | -0.0022 | -0.0496 |
| TSPP | -0.9428 | -3.1373 | 2.6375 | -1.1986 | 1.1948 | 1.4964 | 9.6865 |
| FSPP | 0.2005 | 0.4852 | -0.3874 | 0.2344 | -0.1811 | -0.1843 | -1.4993 |
| SSPP | -0.0101 | 0.3345 | -0.3226 | 0.0286 | -0.1347 | -0.2547 | -1.0300 |
| TGW | 0.0635 | 0.0881 | -0.0494 | 0.0219 | -0.0293 | -0.0529 | -0.1131 |
| PH | -0.1470 | -0.2505 | -0.1148 | 0.3024 | 0.2396 | 0.3550 | -0.2802 |
| PW | -0.8142 | 0.3846 | -0.7617 | -0.1568 | 0.9209 | 0.5538 | -1.4559 |
| BYPP | 0.6077 | -0.4170 | 0.7692 | 0.1330 | -0.1494 | -0.1934 | 0.6448 |
| SF | 0.0079 | -0.0108 | 0.0145 | 0.0085 | 0.0067 | 0.0171 | 0.0246 |
| HI | -0.1230 | -0.0694 | -0.0354 | 0.0336 | 0.0693 | 0.1769 | 0.1165 |
| PI | 0.1340 | 0.6925 | -0.6000 | -0.2792 | -0.6265 | -0.6515 | -0.5811 |
| GL | 1.0220 | 0.1604 | 0.5210 | 0.0991 | -0.0236 | -0.0573 | -0.1030 |

**Table 3 (b).** Continued.

| | DGL | DGB | LBR | H% | M% | HRR | SD |
|---|---|---|---|---|---|---|---|
| GB | 0.0951 | 0.4660 | -0.3286 | 0.0632 | 0.0267 | -0.1341 | -0.0903 |
| DGL | **-0.0756** | -0.0089 | -0.0386 | -0.0070 | 0.0014 | -0.0019 | 0.0054 |
| DGB | -0.2056 | **-1.7435** | 1.3272 | 0.0219 | 0.1036 | 0.4241 | 0.3339 |
| LBR | -1.2818 | 1.9092 | **-2.5080** | -0.2953 | -0.1830 | -0.6180 | -0.4521 |
| H% | 0.0743 | -0.0101 | 0.0946 | **0.8032** | 0.4175 | 0.3342 | -0.1128 |
| M% | 0.0355 | 0.1178 | -0.1445 | -1.0299 | **-1.9811** | -1.2433 | -0.2208 |
| HRR% | 0.0356 | -0.3373 | 0.3416 | 0.5770 | 0.8702 | **1.3866** | 0.0888 |
| SD | 0.4685 | 1.2476 | -1.1745 | 0.9153 | -0.7262 | -0.4173 | **-6.5149** |
| GYPP | 0.3191 | -0.1121 | 0.3169 | 0.0660 | -0.0710 | -0.1451 | 0.0975 |

Based on the results of correlation and path coefficient analysis, it is concluded that the characters no. spikelets per panicle exhibited maximum positive direct effect followed by panicle weight per plant, panicle index, no. of tillers per plant, plant height, biological yield per plant, head rice recovery, grain length, hulling percentage, grain breath, days of 50 % flowering, thousand grain weight and flag leaf width showing high positive direct effect and significant association with grain yield/plant. These traits should be given emphasis for further selection.

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