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# Genetic variability and character association in early maturing rice

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## ABSTRACT

*Genetic parameter and correlation of 12 quantitative traits including the grain yield were studied in forty four extra early and early maturing rice genotypes. High estimates of genotypic coefficient of variation were recorded for grain yield plant$^{-1}$, flag leaf area and grain L/B ratio. Estimates of heritability in broad sense were observed to be high for flag leaf area, 1000-grain weight, grain L/B ratio, days to 50 per cent flowering and grains panicle$^{-1}$. High heritability coupled with high genetic advances as per cent mean were recorded for grain yield plant$^{-1}$, flag leaf area, grain L/B ratio, spikelets panicle$^{-1}$ and days to 50 per cent flowering. Grain yield palnt$^{-1}$ exhibited highly significant and positive correlation with fertile grains panicle$^{-1}$, grains panicle$^{-1}$, 1000-grain weight, panicle length, flag leaf area and spikelets panicle$^{-1}$.*

***Key words:*** *Oryza sativa, variability, heritability, correlation coefficient*

The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme. Heritability estimates provide the information on the proportion of variation that is transmissible to the progenies in subsequent generations. Genetic advance provides information on expected genetic grain resulting from selection of superior individuals. The grain yield is a complex character, quantitative in nature and an integrated function of a number of component traits. Therefore, selection for yield *per se* may not be much rewarding unless other yield attributing traits are taken into consideration. Correlation study provides a measure of association between characters and helps to identify important characters to be considered while making elucidates selection. The present study implication in deciding desirable traits for development of high yielding variety.

## MATERIALS AND METHODS

The experiment comprised of forty four extra early and early maturing rice genotypes, (Table 1) representing a wide genetic base, was conducted in randomized complete block design with three replications at the research farm of Bihar Agricultural College, Sahbour (Bhagalpur), Bihar during wet season 2000. The plot size comprised of 7 rows, each of 4.2 meters length and 15 cm apart. The plant to plant spacing was maintained at 15 cm. the recommended agronomic package of practices were followed. The observations were recorded on five randomly selected pants in each entry and replication for twelve quantitative characters viz; days to 50 per cent flowering, productive tiller hill$^{-1}$, plant height, flag leaf area, grains panicle$^{-1}$, fertile grains panicle$^{-1}$, panicle length, spikelets panicle$^{-1}$, grain L/B ratio, 1000-grain weight and grain yield plant$^{-1}$. Correlation coefficient at the genotypes and phenotypic levels was computed from the variance and co-variance components as suggested by A1-Jibouri *et al* (1958) and Panse and Sukhatme (1967).

## RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among the various genotypes for the characters under study. This indicated that the genotypes were possessing inherent genetic variances among themselves with respect to the characters studied. A close examination of experimental results (Table 2) revealed a high estimate of phenotypic and genotypic coefficients of variation for grain yield plant$^{-1}$, flag leaf area, spikelets panicle$^{-1}$, flag leaf area, grain L/B ratio and days to 50 per cent flowering. These results indicated high degree of genetic variability a (Chauhan and Tandon 1984).

**Table 1. List of parental materials and their sources**

| Genotypes | Source | Genotypes | Source |
|---|---|---|---|
| ES 21-2-1 | B.A.C., Sabour | Boro 5-115 | R.A.U., Pusa |
| ES 29-3-31 | B.A.C., Sabour | IR 56383-77 | IRRI, Philippines |
| RAU 1344-3 | R.A.U., Pusa | IR 36 | IRRI, Philippines |
| RAU 1344-5 | R.A.U., Pusa | CR 70-2 | CRRI, Cuttack |
| RAU 1344-4 | R.A.U., Pusa | CR 876-6 | CRRI, Cuttack |
| RAU 1345-2 | R.A.U., Pusa | RR 347-166 | DRR, Hyderabad |
| RAU 1346-4 | R.A.U., Pusa | RR 347-1 | DRR, Hyderabad |
| RAU 1344-7 | R.A.U., Pusa | RR 347-167 | DRR, Hyderabad |
| RAU 1346-4-2 | R.A.U., Pusa | RR 361-1 | DRR, Hyderabad |
| RAU 1345-1-2 | R.A.U., Pusa | RR 361-783 | DRR, Hyderabad |
| RAU 1345-2-1 | R.A.U., Pusa | RR 267-1 | DRR, Hyderabad |
| RAU 1345-1-2-1 | R.A.U., Pusa | BR-Gora | BAU, Pusa |
| RAU 1440-3 | R.A.U., Pusa | Vandana | Hazaribagh |
| RAU 1406-1 | R.A.U., Pusa | Sneha | Hazaribagh |
| RAU 1406-2 | R.A.U., Pusa | CR 44-35 | CRRI, Cuttack |
| RAU 3101 | B.A.C., Sabur | Gautam | R.A.U., Pusa |
| RAU 3105 | B.A.C., Sabur | Heera | CRRI, Cuttack |
| RAU 3111 | B.A.C., Sabur | Prabhat | R.A.U., Pusa |
| RAU 3115 | B.A.C., Sabur | Turanta | R.A.U., Pusa |
| RAU 3120 | B.A.C., Sabur | Ananda | CRRI, Cuttack |
| RAU 3126 | B.A.C., Sabur | Govida | Pant Nagar |
| Boro 3-1 | R.A.U., Pusa | Richhariya | R.A.U., Pusa |

**Table 2. Estimation of populations mean, range, variances and coefficient of variation for twelve quantitative characters**

| Characters | Population mean | Range | Phenotypic variance | Genotypic variance | GCV | PCV |
|---|---|---|---|---|---|---|
| Days to 50 per cent flowering | 74.44 | 49.33-101.33 | 244.63 | 229.04 | 20.33 | 21.01 |
| Productive tillers hill$^{-1}$ | 9.46 | 7.06-12.56 | 2.73 | 2.02 | 15.05 | 17.46 |
| Plant height (cm$^2$) | 82.67 | 60.33-104.33 | 112.35 | 103.14 | 12.28 | 13.38 |
| Flag leaf area (cm$^2$) | 19.16 | 13.37-30.90 | 18.11 | 17.59 | 21.89 | 22.21 |
| Grains panicle$^{-1}$ | 72.65 | 55.80-101.50 | 179.17 | 163.89 | 17.62 | 18.43 |
| Fertile grains panicle$^{-1}$ | 63.04 | 48.40-91.66 | 166.00 | 149.90 | 19.42 | 20.44 |
| Panicle length (cm) | 18.42 | 14.53-25.43 | 11.07 | 9.72 | 16.93 | 18.07 |
| Spikelets panicle$^{-1}$ | 7.67 | 4.56-11.00 | 3.09 | 2.72 | 21.44 | 22.92 |
| Grain L/B ratio | 3.51 | 2.21-5.20 | 0.66 | 0.57 | 21.49 | 22.03 |
| 1000-grain weight (g) | 18.61 | 14.90-27.76 | 12.70 | 12.40 | 18.85 | 19.15 |
| Grain yield plant$^{-1}$ (g) | 10.86 | 5.93-16.70 | 13.19 | 12.40 | 32.84 | 33.45 |

A moderate value of phenotypic and genotypic coefficients of variation was observed for fertile grains panicle$^{-1}$, 1000-grain weight, grains panicle$^{-1}$, panicle length and productive tillers hill$^{-1}$. Similar results were reported by Awasthi and Borthakur (1986) for panicle length, 1000-grain weight, and fertile grains panicle$^{-1}$. However, Ganeshan *et al* (1984) differed with these observations and reported high genotypic coefficients of variation for these characters. A narrow magnitude of difference between phenotypic and genotypic coefficients of variation for characters, namely, 1000-grain weight and yield plant$^{-1}$ suggested a limited role of environmental variation in the expression of these characters. Thus selection based on phenotypic performance of these characters would be effective to bring about considerable improvement in these characters.

The estimates of heritability were observed to be high in magnitude for most of the characters, namely, flag leaf area, 1000-grains weight, grain yield plant$^{-1}$, grain L/B ratio, days to 50 per cent flowering, grains panicle$^{-1}$, fertile grains panicle$^{-1}$, panicle length and spikelets panicle$^{-1}$ which ranged between 87.50 per cent (days to 50 per cent flowering) and 97.17 per cent (flag leaf area) (Table 3). Similar results were reported by Panwar and Gupta (1967) for number of spikelets, grain number in main panicle, leaf area, days to 50 per cent flowering, panicle length and 500-grain weight.

A moderately high value of heritability estimates were recorded for plan height, and productive tiller hill$^{-1}$. Moderately high heritability estimates of traits indicated that these were comparatively more influenced by the environmental factors. Ragina *et al* (1994) also reported the similar result for plant height. However, Lalitha and Shreedhar (1996) differed from the present findings for this trait. These differences in results might be possible because heritability may be altered by precious selection of plant material, stage of growth, seasonal effects and specific management imposed on seed and plant population.

High genetic advances was observed for the characters, namely, days to 50 percent flowering, grains panicle$^{-1}$ and fertile grains panicle$^{-1}$ where as low estimates were recorded for grain L/B ratio, productive tillers hill$^{-1}$ and spikelets panicle$^{-1}$ (Table 3). High estimates of heritability coupled with high genetic advances were observed for the characters viz., days to 50 per cent flowering, grain panicle$^{-1}$ and fertile grains panicle$^{-1}$ indicating the predominance of additive gene action. On the other hand grain yield plant$^{-1}$, 1000-grain weight, grain L/B ratio, flag leaf area and spikelets panicle$^{-1}$ showed high heritability with low genetic advances revealing the preponderance of non-additive gene action.

In the present investigation, the genotypic correlation coefficients were generally higher than their respective correlation coefficients (Table 4). At phenotypic level, grain yield plant$^{-1}$ exhibited highly significant and positive correlations with flag leaf area, grains panicle$^{-1}$, panicle length, spikelets panicle$^{-1}$ and 1000-grain weight some workers have also reported positive and significant correlation of grains panicle$^{-1}$ and panicle length (Yolanda and Das, 1995). Kumar and Prasad (1996) also reported grain yield positively and significantly associated with 1000 grain weight.

A perusal of the correlation coefficients at phenotypic level revealed that flag leaf area, grains panicle$^{-1}$, fertile grains panicle$^{-1}$, spikelets panicle$^{-1}$ and panicle length were highly and positively correlated with each other indicating that theses characters are interdependent. Selection of any easily observable traits among these will ultimately enhance the mean performance of all the concerned interdependent characters.

The result revealed high estimates of genotypes and phonotypic coefficient of variation for grain yield plant$^{-1}$, flag leaf area and L/B ratio. Estimates of heritability in broad sense were observed to be high for leaf area, 1000-grain weight, grain L/B ratio, days to 50 percent flowering and grain panicles$^{-1}$. high

**Table 3. Estimates of heritability, genetic advance and genetic advance as percent of mean for twelve quantitative characters.**

| Characters | Heritability (%) | Genetic advance | Genetic advance as per cent of mean |
|---|---|---|---|
| Days to 50 per cent flowering | 93.63 | 30.17 | 40.53 |
| Productive tillers hill$^{-1}$ | 74.27 | 2.53 | 26.72 |
| Plant height (cm$^2$) | 84.30 | 19.21 | 23.24 |
| Flag leaf area (cm$^2$) | 97.17 | 8.52 | 44.45 |
| Grains panicle$^{-1}$ | 91.47 | 25.22 | 34.72 |
| Fertile grains panicle$^{-1}$ | 90.30 | 23.97 | 38.02 |
| Panicle length (cm) | 87.79 | 6.02 | 32.68 |
| Spikelets panicle$^{-1}$ | 87.50 | 3.07 | 41.32 |
| Grain L/B ratio | 95.19 | 1.51 | 43.20 |
| 1000-grain weight (g) | 96.89 | 7.11 | 38.22 |
| Grain yield plant$^{-1}$ (g) | 96.35 | 7.21 | 66.40 |

**Table 4. Genotypic and phenotypic correlation coefficients for twelve quantitative characters**

| Characters | | $X_2$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_{10}$ | Grain yield |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50 per cent flowering ($X_1$) | P | -0.230 | 0.070 | 0.108 | 0.296* | 0.253 | 0.366* | 0.241 | 0.01 | 0.298* | 0.061 |
| | G | -0.272 | 0.080 | 0.116 | 0.347 | 0.299 | 0.404 | 0.243 | 0.005 | 0.349 | 0.122 |
| Productive tillers hill$^{-1}$ ($X_2$) | P | | 0.014 | -0.092 | -0.118 | -0.064 | -0.167 | -0.088 | 0.346* | -0.229 | 0.179 |
| | G | | 0.015 | -0.137 | -0.159 | -0.124 | -0.219 | -0.184 | 0.407 | -0.215 | 0.273 |
| Plant height ($X_3$) | P | | | 0.409** | 0.109 | 0.089 | 0.105 | 0.084 | 0.060 | 0.066 | 0.216 |
| | G | | | 0.438 | 0.158 | 0.143 | 0.120 | 0.014 | 0.075 | 0.135 | 0.322 |
| Flag leaf area ($X_4$) | P | | | | 0.648** | 0.638** | 0.623** | 0.556** | -0.157 | 0.641** | 0.560** |
| | G | | | | 0.685 | 0.694 | 0.660 | 0.576 | -0.162 | 0.919 | 0.612 |
| Grains panicle ($X_5$) | P | | | | | 0.921** | 0.931** | 0.765** | -0.106 | 0.917** | 0.644** |
| | G | | | | | 0.986 | 0.948 | 0.822 | -0.108 | 0.919 | 0.746 |
| Fertile grains panicle$^{-1}$ ($X_6$) | P | | | | | | 0.702** | 0.765** | -0.151 | -0.900** | 0.658** |
| | G | | | | | | 0.917 | 0.821 | -0.141 | -0.920 | 0.779 |
| Panicle length ($X_7$) | P | | | | | | | 0.777** | -0.136 | 0.882** | 0.566** |
| | G | | | | | | | 0.813 | -0.164 | 0.991 | 0.676 |
| Spikelets panicle$^{-1}$ ($X_8$) | P | | | | | | | | -0.094 | 0.712** | 0.557** |
| | G | | | | | | | | -0.126 | 0.779 | 0.626 |
| Grain L/B ratio ($X_9$) | P | | | | | | | | | -0.135 | -0.099 |
| | G | | | | | | | | | -0.107 | -0.057 |
| 1000-grain weight ($X_{10}$) | P | | | | | | | | | | 0.643 |
| | G | | | | | | | | | | 0.726** |

*,** indicates significant level of probability at 5% amd 1%, respectively.

heritability coupled with high genetic advances as percent of mean were found for grain yield plant$^{-1}$, flag leaf area, grain L/B ratio, spikelets panicle$^{-1}$ and days 50 percent flowering. Grain yield plant$^{-1}$ exhibited highly significant and positive correlation with fertile grains panicle$^{-1}$, grain panicle$^{-1}$, 1000-grain weight, panicle length, flag leaf qua and panicles$^{-1}$.

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