*International Journal of Plant & Soil Science*

***34(21): 98-106, 2022; Article no.IJPSS.89854***
***ISSN: 2320-7035***

# Genetic Analysis for Grain Yield and Its Attributing Characters in Rice (*Oryza sativa* L.) under Irrigated Conditions of Prayagraj, Uttar Pradesh

**Mohammad Abdul Anwar [a*φ], Maddula Sudarshan Reddy [aφ], Gaibriyal M. Lal [a#] and G. R. Lavanya [a†]**

[a] *Department of Genetics and Plant Breeding, SHUATS, Uttar Pradesh, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/IJPSS/2022/v34i2131288

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/89854

***Original Research Article***

***Received 06 May 2022***
***Accepted 10 July 2022***
***Published 11 July 2022***

## ABSTRACT

The present investigation was carried out to assess the genetic variability parameters, correlation and path analysis in 23 rice genotypes for 13 quantitative traits *viz* Days to 50% flowering, Days to Maturity, Plant height (cm), Flag Leaf Length (cm), Flag Leaf Width (cm), Number of total tillers, Number of Productive Tillers, Panicle Length (cm), Biomass (g), Harvest Index (%), Number of Grains per Panicle, Test Weight (1000 grain weight), Grain Yield per Plant per Plant (g). in Kharif 2021 season at field experimentation centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Uttar Pradesh in Randomized Block Design in three replications. Analysis of variance indicated high significant differences among the genotypes for all the traits. Genotypes SHIATS DHAN-6, KSRV-12, SHIATS DHAN-2, KSRV-140 depicted highest Grain Yield per Plant. All the characters had expressed high estimates of heritability. There is no evidence for characters expressing moderate and low heritability from the present investigation. The studies on GCV and PCV indicated that the presence of high amount of variation and role of the environment on the expression of these traits. The correlation among the yield and yield attributing characters revealed that Grain Yield per Plant

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[φ] *M.Sc. (Agriculture) Genetics and Plant Breeding;*
[#] *Assistant Professor;*
[†] *Associate Professor.*
**Corresponding author: E-mail: abdulanwar9887@gmail.com;*

per plant was positively and significantly associated at both genotypic and phenotypic levels. In Phenotypic and Genotypic path analysis a detailed analysis of diagonal values showed positive direct effect Grain Yield.

*Keywords: Genetic variability; path analysis; character association; rice.*

## 1. INTRODUCTION

Rice is the world's most widely consumed crop, directly feeding more people than any other. It is the world's most important food crop, both economically and culturally, and its production is considered the single most important economic activity on the globe. Rice is considered Asia's earliest cultivated crop. Around 3000 B.C., preserved rice grains were discovered in China. Paddy grains were uncovered during an excavation of Hastinapur, India, around 1000-750 B.C. and are the world's oldest cereal.

There are three subspecies of O. sativa: indica, japonica, and javanica. Rice grown in the tropics and subtropics, including the Philippines, India, Pakistan, and southern China, as well as several African countries, is known as indica rice. Japonica grows extensively in several parts of the world, particularly northern and eastern China, and is found in milder subtropical and temperate zones. Javanica, also known as tropical japonica, is grown in the Cordillera Mountains of northern Luzon, Philippines, on high-elevation rice terraces.

Rice is a self-pollinated crop with a short-day length. Throughout its life cycle, the crop demands a hot and humid climate with average temperatures ranging from 2 to 370 C. Rice is primarily a Kharif crop in India, and it is widely farmed in rain fed areas with high annual rainfall. It is also grown with irrigation in locations where rainfall is scarce. Rice is a staple cuisine in India's eastern and southern regions.

In India, 65 percent of the population eats rice as a staple food. It accounts for about 42% of the total production of food grains and 45% of the total production of cereals. In India, 44.78 million ha are used for growing rice, with 115.65 million tonnes produced and a productivity of about 2.7 tons/ha in 2018–19. (NRRI-2019).

The projected genetic improvement of quantitative traits in a crop species is determined by the trait's heritability pattern, as well as the nature and amount of diversity in the existing germplasm (Iraddi et al., 2013). Heritability and genetic progress are the two most essential selection criteria. Heritability estimates combined with genetic progress are usually more useful than heritability estimates alone in predicting the gain under selection.

Yield is a tough agronomic attribute to enhance, so yield component breeding to boost Grain Yield per Plant would be very beneficial. This is feasible if the components in question are highly heritable, genetically independent, or have a favourable correlation with Grain Yield per Plant. (Akin wale et al*.,* 2011).

The phenotypic correlation, which is determined by hereditary and environmental factors, quantifies the degree of relationship between two variables. The correlation coefficient between the characters, on the other hand, does not necessarily indicate a cause- and-effect link. As a result, path analysis combined with correlation in grouping would provide a better understanding of the cause-and-effect relationship between distinct pairs of characters. (Jayasudha and Sharma, 2010).

As a result, it's critical to determine the component qualities that might help boost yield. Selection would be more successful for a characteristic with a high genetic progress and a strong link to grain output. The correlation coefficient is used to determine the degree of link between yield and yield components, as well as other characteristics that have a significant impact on yield (Singh, 2009).

### 1.1 Objectives

1. To estimate genetic variability, heritability and genetic advance for yield and its related traits in rice cultivars.
2. To study the nature of character association among yield and Grain Yield per Plant attributing traits among rice genotypes.
3. To measure direct and indirect effects of yield contributing traits of rice on Grain Yield per Plant.

## 2. MATERIALS AND METHODS

The current study was conducted during the Kharif of 2021 at the Field Experimentation Center of the Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj (Allahabad), U.P. About 5 km from Prayagraj city, the university is located on the left side of the Allahabad Rewa National Highway. Prayagraj (also known as Allahabad) is a city in the Indian state of Uttar Pradesh. The experiment's site is situated 98 meters above mean sea level at 25.570N latitude and 81.560N longitude. The subtropical climate in this area features exceptionally hot and cold seasons. In the months of December and January, particularly during the Rabi season, the temperature can drop as low as 1°C to 2°C. During Zaid, the temperature can reach 46°–48°C.

Under lowland conditions, the 23 rice genotypes were grown in kharif 2021 using a Randomized Block Design with three replications for each genotype. All rice genotypes were nursery sown in kharif 2021 on June 21 and transplanted into the field 30 days later, on July 21. Three replications of each genotype were planted in a row that was 2 meters long. The crop was raised using the recommended set of practices with a 20 cm between rows and 15 cm between plants spacing. To examine the impact of various traits for heritability, correlation, path analysis, and genetic divergence on Grain yield over time, 23 genotypes were grown during Kharif 2021.

On the basis of five competitive plants selected at random from each replication, replication-specific data were collected for the following thirteen (13) quantitative traits:1) Days to 50% flowering, 2) Days to maturity, 3) Flag leaf length, 4) Flag leaf width, 5) Plant height, 6) Number of total tillers per hill 7) Number of Productive Tillers, 8) Panicle length, 9) Number of spikelets/ Grains per panicle, 10) Test weight, 11) Harvest index, 12) Biomass, 13) Grain yield per plant.

All of the recorded data for the characters under consideration were analyzed for variance using the Panse and Sukhatme (1967) formula [1]. Additionally, the genetic parameters genotypic coefficient of variance (GCV), phenotypic coefficient of variance (PCV), heritability in the broadest sense, genetic advance as percent of mean, and correlation analysis were carried out by using the appropriate statistical procedure. These additional components of variance included phenotypic, genotypic, and environmental variance.

The software called "R-Language" was used to perform the analysis mentioned above.

**Experimental material:** The experimental material for present study is obtained from the Department of Genetics and Plant Breeding, SHUATS, Prayagraj (Allahabad). The details of experimental material are as follows in Chart 1.

### 2.1 Statistical Analysis

1. Analysis of variance (Fisher, 1935).
2. Coefficient of variation [1].
   a. Genotypic coefficient of variation (GCV).
   b. Phenotypic coefficient of variation (PCV).
3. Heritability broad sense [2].
4. Genetic advance (Johnson et al*.,* 1955).
5. Correlation coefficient analysis [3].
6. Path coefficient analysis (Dewey and Lu, 1959).

**Chart 1. Experimental material**

| Sr. No | Name of Genotypes | Sr. No | Name of Genotypes | Sr. No | Name Of Genotypes |
|---|---|---|---|---|---|
| 1 | HMT | 9 | IR 64 | 17 | SHUATS DHAN 2 |
| 2 | KNM 118 | 10 | NLR | 18 | SHUATS DHAN 3 |
| 3 | MTU 1224 | 11 | RNR 1446 | 19 | SHUATS DHAN 4 |
| 4 | MTU 1156 | 12 | RNR15048 | 20 | SHUATS DHAN 5 |
| 5 | MTU 1010 | 13 | KSRV 12 | 21 | SHUATS DHAN 6 |
| 6 | JGL 24423 | 14 | KSRV 140 | 22 | SHUATS DHAN 7 |
| 7 | DURGA PADDY | 15 | NDL 7 | 23 | NDR-359 (CHECK) |
| 8 | BPT 5204 | 16 | SHUATS DHAN 1 | | |

## 3. RESULTS AND DISCUSSION

Analysis of Variance for Quantitative Characters in rice (*Oryza sativa* L.) There is a lot of room for improvement in these traits, including grain yield per plant, as long as the material is put through a careful selection process. The presence of variability may be substantial because of the variety of the materials used and the environmental factors that affect the phenotypes [4-10].

ANOVA for different characters is present in Table 1. The mean squares due to genotypes showed highly significant differences (α=0.01) for all characters indicating the presence of substantial amount of genetic variability among the rice genotypes. In Table 2. and Fig. 1 which revealed a wide range of variation for all traits studies the mean values, the coefficient of variation (C.V.), standard error of the mean (SEm+), the critical difference (C.D.) at 5% and 1%, range of 20 genotypes for 13 quantitative characters are presented [11-18].

- On the basis of Mean performance, the highest Grain Yield per Plant per hill was observed for rice genotypes Shiats Dhan-6 (62.13gm), KSRV-12 (54.73gm), Shuats Dhan-2 (51.47gm), KSRV- 140 (48.0gm), NLR (47.05gm) were found to be superior in Grain Yield per Plant.
- In the current study, the PCV was higher than the corresponding GCV for every trait, indicating that the environment had an impact. The lowest GCV (percent) value was 28.7 (Plant height, Days to Maturity), and the highest value was 36.8. (Biomass).
- A similar pattern was followed by PCV (percent), which ranged from a lowest value of 29.2 (Days to Maturity) to a highest value of 37.6. (Biomass).

**Table 1. Analysis of variance (ANOVA) among 23 rice genotypes for 13 quantitative traits**

| Trait | Mean sum of squares | | |
|---|---|---|---|
| | Treatment | Replication | Error |
| **Degree of Freedom** | **22** | **2** | **44** |
| Days to 50%Flowering | 2761.04** | 233.80 | 92.92 |
| Days to Maturity | 4771.30** | 1736.54 | 179.17 |
| Plant Height(cm) | 4462.54** | 1395.63 | 235.22 |
| Flag Leaf Length(cm) | 422.93** | 20.24 | 18.82 |
| Flag Leaf Width(cm) | 0.43 | 0.01 | 0.02 |
| Number of Total Tillers | 77.73** | 919.74 | 6.78 |
| Number of Productive Tillers | 44.11** | 0.73 | 2.19 |
| Panicle Length(cm) | 190.82** | 31.68 | 9.06 |
| Biomass(gm) | 2505.79** | 319.85 | 99.45 |
| Harvest Index | 725.76** | 33.54 | 23.96 |
| Test Weight(gm) | 144.47** | 6.14 | 3.70 |
| Number of Grains per Plant | 24297.99** | 5937.07 | 742.34 |
| Grain Yield (gm) | 653.43** | 264.23 | 38.33 |

*** Significant at P<0.01, respectively*

**Table 2. Genetic parameters for 13 quantitative characters in rice genotypes**

| Trait | GCV% | PCV% | $H^2$ | GA% of Mean |
|---|---|---|---|---|
| Days to 50%Flowering | 29.6 | 30.1 | 96.6 | 59.9 |
| Days to Maturity | 28.7 | 29.2 | 96.2 | 58.0 |
| Plant Height (cm) | 28.7 | 29.5 | 94.7 | 57.5 |
| Flag Leaf Length(cm) | 31.2 | 31.9 | 95.5 | 62.7 |
| Flag Leaf Width(cm) | 31.3 | 32.1 | 95.4 | 63.0 |
| Number of Total Tillers | 31.4 | 32.8 | 91.3 | 61.8 |
| Number of Productive Tillers | 33.7 | 34.5 | 95.0 | 67.6 |
| Panicle Length(cm) | 29.0 | 29.7 | 95.3 | 58.2 |
| Biomass(g) | 36.8 | 37.6 | 96.0 | 74.4 |
| Harvest Index (%) | 35.9 | 37.0 | 94.1 | 71.7 |
| Number of Grains per Plant | 29.5 | 29.9 | 96.7 | 59.7 |
| Test Weight(g) | 34.3 | 34.7 | 97.4 | 69.7 |
| Grain yield(g) | 35.9 | 36.5 | 96.9 | 72.9 |

*GCV: Genotypic Coefficient of Variation, PCV: Phenotypic Coefficient of Variation, $H^2$: Heritability, GA% of Mean: Genetic Advance at percent of mean*

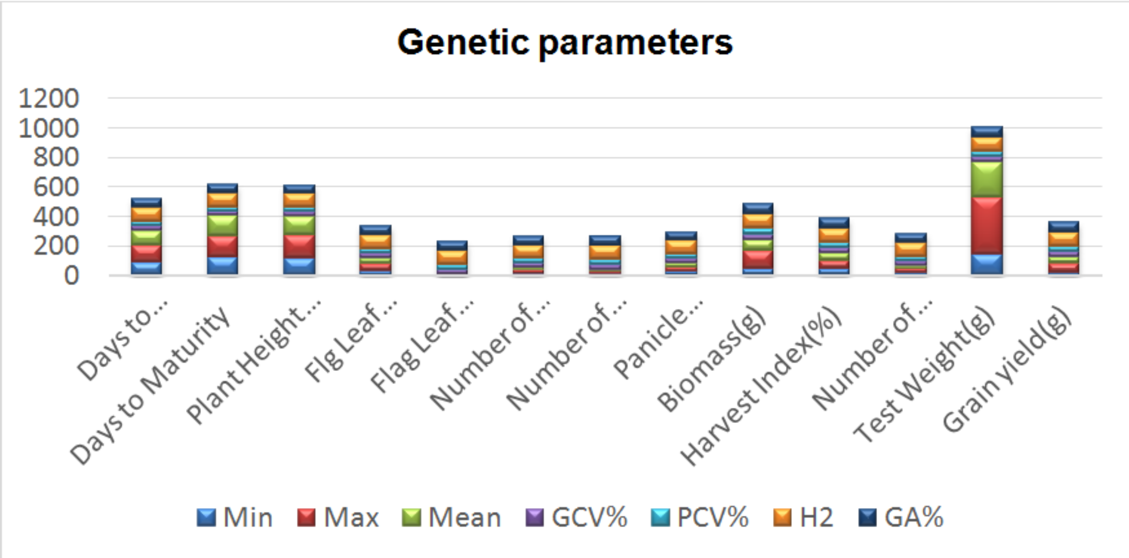


**Fig. 1. Bar diagram depicting GCV, PCV, heritability and genetic advance for 13 quantitative characters of rice**

### 3.1 Heritability

- The present investigation, all traits showed the high heritability ranging from 92.90% to 99.90%. Test weight (97.40%) showed the highest heritability among all the characters followed by Grain Yield per Plant per Plant (96.9%), Number Grains per Plant (96.7%) and Days to 50% flowering (96.6%).
- There is no evidence of low or moderate heritability in these characters. The present study's high heritability values for the traits under consideration showed that those traits were less influenced by the environment and helped in the effective selection of traits based on phenotypic expression by using a simple selection method. These high heritability values also suggested the potential for genetic improvement.

### 3.2 Genetic Advance as Percentage of Mean

- In the present investigation all the characters showed highest genetic advance as a percentage of mean except plant height, Days to Maturity, Number of Grains per Plant and Days to 50% flowering. BIOMASS (74.4) showed highest genetic advance as percentage of mean, followed by, Grain Yield per Plant per Plant (72.9), Harvest Index (71.7) and Test Weight (69.7). While moderate genetic advance as a percent of mean was observed in Number of Productive Tillers (67.6), Flag Leaf Width (63) and Flag Leaf Length (62.7).
- Except for plant height, days to maturity, and number of grains per plant, all the characters under study displayed high heritability along with high genetic advance as a percentage mean, indicating that the characters are primarily governed by additive gene action. Therefore, due to the accumulation of more additive genes leading to further improvement, direct selection of these characters based on phenotypic expression by simple selection method would be effective.

### 3.3 Phenotypic Correlation Coefficient

In the present investigation from Table 3 Grain Yield per Plant per plant showed positive significant association with Biomass (0.912**), Number of Productive Tillers (0.448**), Number of Total Tillers (0.437**) Plant Height (0.422**) and Flag Leaf Length (0.331*). While positive and non-significant association showed with Harvest Index (0.237), Number of Grains per Panicle (0.227), Panicle Length (0.215) and Test Weight (0.029). Negative and non-significant association showed with Days to 50% flowering (-0.057), Flag Leaf Width (-0.049), Days to Maturity (-0.043).

**Table 3. Correlation coefficient analysis**

| Traits | | DF50 | DM | PH | FLL | FLW | NTT | NPT | PL | BM | H.I. | NGPP | TW | GY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DF50 | P | 1 | 0.026 | 0.014 | -0.012 | -0.007 | 0.351* | 0.280* | -0.362* | 0.114 | -0.465** | 0.215 | -0.477** | -0.057 |
| | G | 1 | 0.013 | 0.012 | -0.014 | -0.017 | 0.380* | 0.306* | -0.447** | 0.122 | -0.509** | 0.23 | -0.538** | -0.058 |
| DM | P | | 1 | 0.149 | 0.320* | -0.176 | -0.172 | -0.173 | -0.131 | -0.076 | 0.116 | -0.135 | -0.04 | -0.043 |
| | G | | 1 | 0.168 | 0.354* | -0.217 | -0.244* | -0.249* | -0.132 | -0.074 | 0.121 | -0.206 | 0.011 | -0.04 |
| PH | P | | | 1 | 0.519** | 0.510** | -0.094 | -0.146 | 0.428** | 0.501** | -0.225 | 0.423** | 0.162 | 0.422** |
| | G | | | 1 | 0.562** | 0.531** | -0.121 | -0.184 | 0.500** | 0.525** | -0.262* | 0.450** | 0.192 | 0.442** |
| FLL | P | | | | 1 | 0.184 | 0.16 | 0.159 | 0.141 | 0.459** | -0.337* | 0.006 | 0.04 | 0.331* |
| | G | | | | 1 | 0.207 | 0.187 | 0.217 | 0.172 | 0.494** | -0.312* | -0.022 | 0.078 | 0.393** |
| FLW | P | | | | | 1 | 0.043 | -0.071 | 0.355* | 0.087 | -0.397** | 0.388** | 0.068 | -0.049 |
| | G | | | | | 1 | 0.04 | -0.093 | 0.424** | 0.119 | -0.473** | 0.440** | 0.07 | -0.039 |
| NTT | P | | | | | | 1 | 0.942** | -0.109 | 0.494** | -0.156 | -0.059 | -0.167 | 0.437** |
| | G | | | | | | 1 | 0.959** | -0.17 | 0.522** | -0.214 | -0.083 | -0.189 | 0.455** |
| NPT | P | | | | | | | 1 | -0.108 | 0.472** | -0.068 | -0.149 | -0.102 | 0.448** |
| | G | | | | | | | 1 | -0.193 | 0.521** | -0.093 | -0.202 | -0.133 | 0.499** |
| PL | P | | | | | | | | 1 | 0.189 | 0.051 | -0.013 | 0.600** | 0.215 |
| | G | | | | | | | | 1 | 0.216 | 0.099 | -0.001 | 0.705** | 0.258* |
| BM | P | | | | | | | | | 1 | -0.17 | 0.333* | 0.002 | 0.912** |
| | G | | | | | | | | | 1 | -0.183 | 0.337* | -0.004 | 0.919** |
| H.I. | P | | | | | | | | | | 1 | -0.235 | 0.062 | 0.237 |
| | G | | | | | | | | | | 1 | -0.284* | 0.089 | 0.212 |
| NGPP | P | | | | | | | | | | | 1 | -0.313* | 0.227 |
| | G | | | | | | | | | | | 1 | -0.309* | 0.228 |
| TW | P | | | | | | | | | | | | 1 | 0.029 |
| | G | | | | | | | | | | | | 1 | 0.018 |
| GYP | P | | | | | | | | | | | | | 1 |
| | G | | | | | | | | | | | | | 1 |

*DF50: Days to 50% Flowering, DM: Days to Maturity, PH: Plant Height, FLL: Flag Leaf Length, FLW: Flag Leaf Width, NTT: Number of Total Tillers, NPT: Number of Productive Tillers, PL: Panicle Length, BM: Biomass, H.I: Harvest Index, NGPP: Number of Grains per Panicle, TW: Test Weight, GYP: Grain Yield per Plant, P: Phenotypic, G: Genotypic*

**Table 4. Path coefficient analysis**

| Traits | | DF50 | DM | PH | FLL | FLW | NTT | NPT | PL | BM | H.I. | NGPP | TW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DF50 | P | 0.0551 | 0.0014 | 0.0008 | -0.0007 | -0.0004 | 0.0193 | 0.0154 | -0.02 | 0.0063 | -0.0256 | 0.0119 | -0.0263 |
| | G | 0.097 | 0.001 | 0.001 | -0.001 | -0.002 | 0.037 | 0.03 | -0.044 | 0.012 | -0.05 | 0.022 | -0.052 |
| DM | P | -0.0011 | -0.0413 | -0.0061 | -0.0132 | 0.0073 | 0.0071 | 0.0071 | 0.0054 | 0.0031 | -0.0048 | 0.0056 | 0.0017 |
| | G | -0.001 | -0.077 | -0.013 | -0.027 | 0.017 | 0.019 | 0.019 | 0.01 | 0.006 | -0.009 | 0.016 | -0.001 |
| PH | P | 0.0003 | 0.0036 | 0.0242 | 0.0126 | 0.0124 | -0.0023 | -0.0035 | 0.0104 | 0.0121 | -0.0055 | 0.0102 | 0.0039 |
| | G | 0 | 0.002 | 0.009 | 0.005 | 0.005 | -0.001 | -0.002 | 0.005 | 0.005 | -0.002 | 0.004 | 0.002 |
| FLL | P | -0.0006 | 0.0153 | 0.0248 | 0.0477 | 0.0088 | 0.0076 | 0.0076 | 0.0067 | 0.0219 | -0.0161 | 0.0003 | 0.0019 |
| | G | -0.002 | 0.037 | 0.058 | 0.104 | 0.022 | 0.019 | 0.023 | 0.018 | 0.051 | -0.032 | -0.002 | 0.008 |
| FLW | P | -0.0002 | -0.0055 | 0.0158 | 0.0057 | 0.031 | 0.0013 | -0.0022 | 0.011 | 0.0027 | -0.0123 | 0.012 | 0.0021 |
| | G | -0.001 | -0.014 | 0.035 | 0.014 | 0.067 | 0.003 | -0.006 | 0.028 | 0.008 | -0.031 | 0.029 | 0.005 |
| NTT | P | 0.0069 | -0.0034 | -0.0019 | 0.0031 | 0.0008 | 0.0197 | 0.0185 | -0.0021 | 0.0097 | -0.0031 | -0.0012 | -0.0033 |
| | G | 0.049 | -0.031 | -0.016 | 0.024 | 0.005 | 0.128 | 0.123 | -0.022 | 0.067 | -0.027 | -0.011 | -0.024 |
| NPT | P | -0.0029 | 0.0018 | 0.0015 | -0.0017 | 0.0007 | -0.0099 | -0.0105 | 0.0011 | -0.0049 | 0.0007 | 0.0016 | 0.0011 |
| | G | -0.046 | 0.038 | 0.028 | -0.033 | 0.014 | -0.145 | -0.152 | 0.029 | -0.079 | 0.014 | 0.031 | 0.02 |
| PL | P | 0.0046 | 0.0017 | -0.0054 | -0.0018 | -0.0045 | 0.0014 | 0.0014 | -0.0126 | -0.0024 | -0.0006 | 0.0002 | -0.0076 |
| | G | 0.032 | 0.009 | -0.035 | -0.012 | -0.03 | 0.012 | 0.014 | -0.071 | -0.015 | -0.007 | 0 | -0.05 |
| BM | P | 0.1079 | -0.0716 | 0.4742 | 0.4339 | 0.082 | 0.4675 | 0.4462 | 0.1792 | 0.946 | -0.161 | 0.3148 | 0.002 |
| | G | 0.118 | -0.072 | 0.507 | 0.478 | 0.115 | 0.505 | 0.504 | 0.209 | 0.967 | -0.177 | 0.326 | -0.004 |
| H.I. | P | -0.2142 | 0.0536 | -0.1038 | -0.1552 | -0.183 | -0.0718 | -0.0315 | 0.0234 | -0.0784 | 0.4607 | -0.1082 | 0.0285 |
| | G | -0.266 | 0.063 | -0.137 | -0.163 | -0.247 | -0.112 | -0.049 | 0.052 | -0.096 | 0.523 | -0.148 | 0.046 |
| NSPP | P | -0.0028 | 0.0018 | -0.0055 | -0.0001 | -0.0051 | 0.0008 | 0.0019 | 0.0002 | -0.0044 | 0.0031 | -0.0131 | 0.0041 |
| | G | -0.005 | 0.004 | -0.009 | 0 | -0.009 | 0.002 | 0.004 | 0 | -0.007 | 0.006 | -0.02 | 0.006 |
| TW | P | -0.0101 | -0.0008 | 0.0034 | 0.0008 | 0.0014 | -0.0035 | -0.0022 | 0.0127 | 0 | 0.0013 | -0.0066 | 0.0212 |
| | G | -0.034 | 0.001 | 0.012 | 0.005 | 0.004 | -0.012 | -0.008 | 0.044 | 0 | 0.006 | -0.019 | 0.063 |
| GYP | P | -0.0571 | -0.0434 | 0.422** | 0.331* | -0.0486 | 0.437** | 0.448** | 0.2153 | 0.912** | 0.2368 | 0.2274 | 0.0293 |
| | G | -0.058 | -0.04 | 0.442** | 0.393** | -0.039 | 0.455** | 0.499** | 0.258* | 0.919** | 0.212 | 0.228 | 0.018 |

*DF50: Days to 50% Flowering, DM: Days to Maturity, PH: Plant Height, FLL: Flag Leaf Length, FLW: Flag Leaf Width, NTT: Number of Total Tillers, NPT: Number of Productive Tillers, PL: Panicle Length, BM: Biomass, H.I: Harvest Index, NGPP: Number of Grains per Panicle, TW: Test Weight, GYP: Grain Yield per Plant, P: Phenotypic, G: Genotypic*

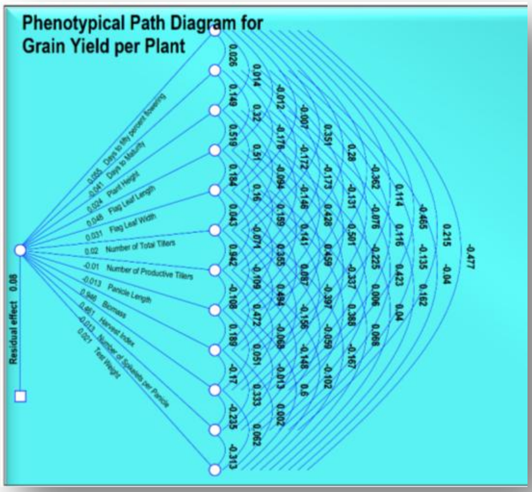


**Fig. 2. Phenotypical path diagram**

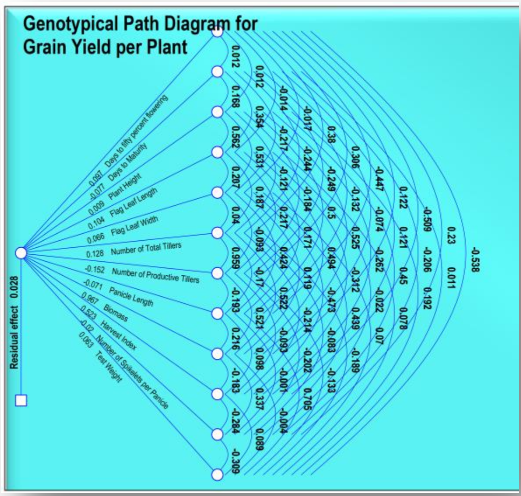


**Fig. 3. Genotypical path diagram**

### 3.4 Genotypic Correlation Coefficient

In Table 3 the correlation among the yield and yield attributing characters revealed that Grain Yield per Plant per plant was positively and significantly associated with Biomass (0.919**), Number of Productive Tillers (0.499**), Number of Total Tillers (0.455**), Plant Height (0.422**), Flag Leaf Length (0.393**), Panicle Length (0.258*). But positively and non-significant correlation was found with Harvest Index (0.212), Number of Grains per Panicle (0.228), Test Weight (0.018). Negative and non-significant associated with Days to 50% flowering (- 0.058), Days to Maturity (-0.040), Flag Leaf Width (-0.039).

### 3.5 Phenotypic Path Coefficient Analysis

Phenotypic path coefficients are calculated using the phenotypic correlation coefficient. It divides the phenotypic correlation coefficients into direct and indirect impact measurements (Dewey and Lu, 1959). A detailed analysis from Table 4 and Fig. 2 the diagonal values showed positive direct effect of Days to 50% flowering (0.0551), Plant Height (0.0242), Flag Leaf Length (0.0477), Flag Leaf Width (0.031), Number of Total Tillers (0.0197), Biomass (0.946), and Harvest Index (0.4607), and Test weight (0.0212). Negative direct effects were exhibited by Days to Maturity (-0.0413), Number of Productive Tillers (-0.0105), Panicle Length (-0.0126), and Number of Grains per Panicle (-0.0131).

### 3.6 Genotypic Path Coefficient Analysis

A perusal of the results on path coefficient for yield and yield components genotypic to be of similar direction and magnitude in general. Further the genotypic path co-efficient were observed to be of higher magnitude, compared to phenotypic path coefficient indicating the masking effect of environment. From Table 4 and Fig 3 a detailed analysis of diagonal values showed positive direct effect of Days to 50% flowering (0.097), Plant Height (0.009), Flag Leaf Length (0.104), Flag Leaf Width (0.067), Number of Total Tillers (0.128), Biomass (0.967), Harvest Index (0.523), and Test Weight (0.063). Negative direct effect was showed by Days to Maturity (-0.077), Number of Productive Tillers (-0.0152), Panicle Length (-0.071), Number of Grains per Panicle (-0.02).

## 4. CONCLUSION

For every character under study, there was a lot of genotypic variation. These genotypes had high mean values in the desired direction, i.e. According to the results of this investigation, 23 different rice genotypes were evaluated in terms of genetic variability parameters for yield and its influencing factors. To break yield stagnation and create high yielding varieties, genetic variability is the most crucial breeding tool. Plant breeders may find it useful to understand how improving one feature leads to improvements in other characters through the study of correlations and Path coefficient analysis.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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