**VARIABILITY IN SIMILAR NAMED JIRASAIL GROUP OF RICE GERMPLASM OF BANGLADESH**

**M S Ahmed\*1 and Shahnaz Parveen2**

1Genetic Resources and Seed Division (GRSD), Bangladesh Rice Research Institute (BRRI), Gazipur-1701, Bangladesh, E-mail: sharfuddin.brri@gmail.com, Mobile: 01792383994.

2Training Division (TD), Bangladesh Rice Research Institute (BRRI), Gazipur-1701, Bangladesh

**ABSTRACT**

Fifteen duplicate and similar named Jirasail group of rice germplasms were studied to evaluate the variations for 14 yield and yield contributing characters at Bangladesh Rice Research Institute during Boro 2019-20 season. The height leaf length (50 cm) was observed in Jira Bhog (Bolder) (acc. no. 4828) with a range of 25.6-50. The height culm diameter (4.7 mm) was recorded from JS15 (NC). The highest panicle length (32.8 cm) was observed in acc. 1984 (Jira Buti) with a range of 20.8-32.8. Jira Dhan (acc. 5313) had the longest plant height (124.8 cm) with a range of 84.8-124.8. Jira Dhan (acc. 5313) had the highest number of filled grains per panicle (251) with range 76-251. The longest dehulled grain (6.8 mm) and the highest LB ration (3.82) were found in acc. 6718 (Jirasail). The highest 1000-grain weight (21.8 g) was observed in Jirasail (Indian)(acc. 8056) and the lowest (8.9) in Jira Bhog (Finer)(acc. 4831). The highest grain yield (35.4 g/hill) was observed in Jirasail (Indian)(acc. 8056). Grain yield had highly significant positive correlation with leaf width, grain length, decorticated grain(s)length breadth ratio and 1000-grain weight, but highly significant negative correlation with panicle length and un-filled grain per panicle. Considerable genetic variations were observed among the Jirasails though have the similar or duplicate name. The best genotypes are acc. no. 1984, 4828, 4831, 5313, 6694, 6718, 8056 and NC (JS15). Finally, the potential genotypes with valuable gene(s) need to be conserved and utilized for Jirasail rice improvement.

**Key word:** Agronomic traits, Bangladesh, D2-statistics, Jirasail, rice, similar named.

**1. INTRODUCTION**

Rice yield per unit area as well as total rice production are required to increase along with the less land to meet the food demand of the increasing population of the country. Consequently, there is a necessity for developing AEZ (Agro Ecological Zone) based more high yielding climate smart varieties along with higher biomass production, good grain quality, high nutrition, medicinal values etc.Because, to feed the growing population, the global food supply will need to increase by nearly 70% by 2050 (Tian *et al.*, 2006). Moreover, climate change is expected to have an impact on ensuring long-term food security, particularly in South Asia, where cereal yields are expected to drop by up to 30% by 2050 (IPCC, 2007).On the other hand, agro-morphological characterization of the germplasms is fundamental in order to provide information for plant breeding programmes (Das and Ghosh*,* 2011).

The plant genetic resources are reservoirs of natural genetic variation and provide raw material for crop improvement programs (Sharma*et al.*, 2013). It is a rich reservoir of valuable genes that plant breeders can harness for crop improvement (Yadav *et al.*, 2013). To assess phenotypic variation, morphological and yield related features have been used as criteria as well as sources of enhancing the rice yield potential (Ali *et al.*, 2024). Moreover, identifying germplasm accessions for different agronomical characters in phenotypically divergent sources would help in pre-breeding and breeding programs (Pachauri *et al.*,2017). Moreover, landraces and wild species possess immense potential of most valuable genes which can be effectively utilized in the present day breeding programmes to evolve miracle varieties in rice that possess not high yield potential and quality, but also resistant to biotic and abiotic stresses (Saxena *et al.,* 1988) and the breeding programme requires much genetic variation for crop improvement (Rao *et al.*, 2021).Therefore, characterization of rice germplasms increases its utilization.

Only a small proportion of the world rice germplasm collections have been used in breeding programmes though with abundance of genetic variability and diversity. Lack of access to phenotype information is still seen as a limiting factor for the use of plant genetic resources (Emi*et al.*, 2021). Information generated from phenotyping the germplasms can be used as baseline information for utilization in rice breeding programmes (Rabara *et al.*, 2014). Some of these genotypes are being gradually eroded from their respective places of origin and are on the verge of becoming extinct due to competition from high yielding varieties (Maxted and Kell, 2009). Therefore, characterization of rice germplasm is important both for crop protection aspects and as well as its improvement.However, Hamid *et al.* (1982) reported that duplicate(s) named as well as with many slightly deviated names rice germplasm given by the farmers,were cultivated all over Bangladesh-which need to be studied. Pachauri *et al.* (2017) also characterized 124 rice germplasm accessions including 119 germplasm received from NBPGR New Delhi on the basis of 19qualitative agro-morphological and 11 agronomical traits. Singh*et al.* (2021) evaluated 50 indigenous rice germplasm to estimate the Agro-morphological characterization of indigenous germplasm accessions of rice (*Oryza sativa* L.) in yield and yield contributing characters at Research cum Instructional Farm, Genetics and Plant Breeding Department, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, during *Kharif* 2018.Sarif *et al.* (2020) evaluated the genetic variability and diversity of 32 coloured rice accessions using 13 yield and yield contributing characteristics. Islam *et al.* (2018) studied 36 similar named aromatic rice landraces of Bangladesh on 14 quantitative characters. Consequently, more detailed studies on similar named groups of rice germplasm of Bangladesh need to be done for its more effective utilization.

**2. OBJECTIVES OF THE STUDY**

The present study was undertaken to characterize the duplicate and similar named Jirasail group of rice germplasm of Bangladesh through quantitative characters. The purpose of this study includes, the assessment of the variability of the quantitative traits.The determination of the extent of variability of the quantitative traits. The evaluation of the correlation among the quantitative traits. The identification of the potential genotypes of the duplicate and similar named Jirasail group of rice germplasm of Bangladesh. Finally, the study will facilitate the use of diverse germplasm in future breeding programmes.

**3. MATERIALS AND METHODS**

**3.1 Materials of the study**

A total of eleven accessions and four new collections (NC) of duplicate and similar named Jirasail group of rice germplasms received from Bangladesh Rice Research Institute (BRRI) Genebank (Table 1) were grown during Boro 2019-20 season for studying their quantitative and qualitative Agro-morphological diversity.

**Table 1: List of similar and duplicate named Jirasail group of rice germplasms**

**grown in Boro 2019-20 season**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Code** | **Acc. no.\*** | **Name** | **Upazila** | **District** | **Collection year** | **Season** |
| 1 | JS1 | 7591 | Jira Sail | Sadar | Dinajpur | - | B. Amon |
| 2 | JS2 | 5061 | Jira Shail | -- | Dinajpur | 2001 | Aman |
| 3 | JS3 | 6694 | Jirasail | Fulbari | Dinajpur | - | T. Aman |
| 4 | JS4 | 6718 | Jirasail | Mahadevpur | Naogaon | - | T. Aman |
| 5 | JS5 | 8056 | Jirasail (Indian) | Mohadevpur | Naogaon | 2014 | Boro |
| 6 | JS6 | 4828 | Jira Bhog (Bolder) | Chirrbanoar | Dinajpur | 1997 | T. Amon |
| 7 | JS7 | 4831 | Jira Bhog (Finer) | Chirrbanoar | Dinajpur | 1997 | T. Amon |
| 8 | JS8 | 1984 | Jira Buti | Sribordi | Mymensingh | 1977 | T. Amon |
| 9 | JS9 | 5313 | Jira Dhan | Dumuria | Khulna | 2004 | T. Aman |
| 10 | JS10 | 5045 | Jira Katari | -- | Dinajpur | 2001 | Aman |
| 11 | JS11 | 5975 | Gira Katari | Dinajpur | Dinajpur | 2005 | T. Aman |
| 12 | JS12 | NC\*\* | Jira | -- | Bogura | 2018 | T. Aman |
| 13 | JS13 | NC | Jirasail | -- | Jashore | 2018 | T. Aman |
| 14 | JS14 | NC | Jirasail | -- | Rajshahi | 2018 | T. Aman |
| 15 | JS15 | NC | Jirasail | Modhupur (BADC) | Tangail | 2018 | T. Aman |

\*BRRI Genebank accession number, \*\*New collection.

**3.2 Plot layout and seedling transplanting of the experiment**

The unit plot comprised with three rows of each 5.4 m long. The thirty-days-old single seedling was transplanted with a spacing of 20 × 20 cm between rows and plants, respectively.

**3.3 Cultural management of the experiment**

Fertilizers were applied @ 80:20:40:12 kg N, P, K and S per hectare respectively. Crop management such as weeding, irrigation etc. were done in time. Appropriate control measures were taken for insect pests, diseases and weeds when necessary.

**3.4 Data recording and data analysis of the experiment**

The germplasms were characterized through 14 quantitative characters at Genetic Resources and Seed Division of BRRI in Gazipur.The observed 14 quantitative Agronomical characters were seedling height (cm), leaf length (cm), leaf width (cm), culm diameter (mm), effective tiller number, panicle length (cm), plant height (cm), days to maturity, filled grains per panicle, un-filled grains per panicle, grain length (mm), decorticated grain length breadth ratio, 1000-grain weight (g) and grain yield per hill (g). The data were analyses by MSTATE-C programme.

**4. RESULTS AND DISCUSSION**

The 14 qualitative agro-morphological characters of 15 genotypes of duplicate and similar named Jirasail group of rice germplasms from BRRI Rice Genebank were studied during Boro 2019-21 season. The results of the assessment of variability of qualitative agro-morphological characters are described as follows:

**4.1 Assessment of the Variability of the Quantitative Traits**

The highest seedling height (12.8 cm) was observed in Jirasail (Indian) (acc. no. 8056) among the fifteen similar and duplicate named group of Jirasail germplasms (Table 2). The height leaf length (50 cm) was observed in Jira Bhog (Bolder) (acc. no. 4828) and the height leaf width (1.3 cm) was found in Jirasail (Acc. no..6694). The height culm diameter (4.7 mm) was recorded from Jirasail (NC). The highestnumber of effective tiller per hill (12) was observed in acc. no. 6694 (Jirasail). The highest panicle length (32.8 cm) was observed in acc. 1984 (Jira Buti) and the shortest panicle length (20.8) in acc. 4831 of Jira Bhog (Finer). Jira Dhan (acc. 5313) had the longest plant height (124.8 cm), while the shortest plant (84.8) was observed in NC (Jira). Jira Dhan (acc. 5313) had the highest number of filled grains per panicle (251) and the lowest (76) from Jirasail (acc. 6694) and Jira Katari (acc. 5045) had the highest number of un-filled grains per panicle (33) and the lowest (7) in Jirasail (acc. 6694) among the studied Jirasail germplasms. Besides, the longest dehulled grain (6.8 mm) and the highest LB ration (3.82) were found in acc. 6718 (Jirasail)(Figure 1). The highest 1000 grain weight (21.8 g) was observed in acc. 8056 of Jirasail (Indian) and the lowest (8.9) in acc. 4831 of Jira Bhog (Finer). Finally, the highest grain yield (35.4 g/hill) was observed in acc. 8056 of Jirasail (Indian) and the lowest (4.6 g/hill) in acc. 5061 (Jira Shail).

**Table 2: Variability of 15 similar and duplicate named Jirasail group of rice germplasm for 14 important morphological characters during Boro 2019-20**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name** | **Acc. No.** | **SH**  **(cm)** | **LL**  **(cm)** | **LW**  **(cm)** | **CD**  **(mm)** | **ETN** | **PL**  **(cm)** | **PH**  **(cm)** | **DM (Days)** | **FGPP** | **UFGPP** | **GL**  **(mm)** | **DG LBR** | **TGW**  **(g)** | **GY**  **(g/hill)** |
| Jira Sail | 7591 | 11.4 | 37.2 | 1.1 | 3.4 | 10 | 23.4 | 90.6 | 148 | 157 | 10 | 6.8 | 3.67 | 17.8 | 16.2 |
| Jira Shail | 5061 | 9.0 | 47.6 | 1.1 | 3.2 | 8 | 28.6 | 96.0 | 146 | 200 | 13 | 3.9 | 1.97 | 10.8 | 4.6 |
| Jirasail | 6694 | 12.0 | 35.6 | 1.3 | 3.5 | 12 | 23.6 | 106.0 | 151 | 76 | 7 | 5.7 | 2.33 | 19.8 | 18.6 |
| Jirasail | 6718 | 12.4 | 44.4 | 1.1 | 4.4 | 11 | 26.6 | 92.8 | 147 | 131 | 12 | 6.8 | 3.82 | 18.7 | 11.8 |
| Jirasail (Indian) | 8056 | 12.8 | 25.6 | 1.1 | 4.1 | 8 | 23.0 | 87.2 | 147 | 137 | 13 | 5.7 | 2.10 | 21.8 | 35.4 |
| Jira Bhog (Bolder) | 4828 | 9.8 | 50.0 | 1.0 | 3.6 | 9 | 24.0 | 117.0 | 149 | 83 | 10 | 4.4 | 2.25 | 14.7 | 12.9 |
| Jira Bhog (Finer) | 4831 | 10.0 | 40.4 | 1.0 | 4.0 | 8 | 20.8 | 104.4 | 146 | 120 | 9 | 3.7 | 1.70 | 8.9 | 10.7 |
| Jira Buti | 1984 | 10.6 | 44.0 | 0.7 | 4.3 | 9 | 32.8 | 120.4 | 147 | 91 | 13 | 4.7 | 2.34 | 12.9 | 5.9 |
| Jira Dhan | 5313 | 11.6 | 43.2 | 0.8 | 3.7 | 8 | 27.2 | 124.8 | 148 | 251 | 18 | 4.6 | 2.30 | 8.9 | 10.0 |
| Jira Katari | 5045 | 12.0 | 35.4 | 1.1 | 4.2 | 11 | 25.4 | 111.8 | 149 | 142 | 33 | 4.1 | 2.02 | 10.7 | 10.6 |
| Gira Katari | 5975 | 10.4 | 41.8 | 0.7 | 4.4 | 8 | 24.0 | 116.6 | 149 | 190 | 13 | 3.7 | 1.83 | 9.9 | 22.7 |
| Jira | NC | 12.0 | 35.6 | 0.8 | 4.2 | 8 | 23.0 | 91.2 | 146 | 142 | 15 | 5.8 | 3.05 | 13.9 | 11.7 |
| Jirasail | NC | 10.0 | 34.8 | 1.0 | 4.6 | 9 | 28.2 | 113.2 | 148 | 112 | 12 | 4.4 | 2.39 | 11.0 | 18.0 |
| Jirasail | NC | 10.0 | 39.0 | 1.2 | 3.8 | 8 | 23.4 | 90.2 | 146 | 193 | 11 | 6.4 | 3.51 | 18.6 | 20.5 |
| Jirasail | NC | 9.4 | 32.0 | 1.0 | 4.7 | 10 | 22.4 | 84.8 | 148 | 151 | 21 | 6.7 | 3.81 | 15.9 | 30.7 |
| Min |  | 9.0 | 25.6 | 0.7 | 3.2 | 8 | 20.8 | 84.8 | 146 | 76 | 7 | 3.7 | 1.70 | 8.9 | 4.6 |
| Max |  | 12.8 | 50.0 | 1.3 | 4.7 | 12 | 32.8 | 124.8 | 151 | 251 | 33 | 6.8 | 3.82 | 21.8 | 35.4 |
| Mean |  | 10.9 | 39.1 | 1.0 | 4.0 | 9 | 25.1 | 103.1 | 148 | 145 | 14 | 5.2 | 2.61 | 14.3 | 16.0 |
| SE |  | 0.31 | 1.63 | 0.05 | 0.13 | 0.36 | 0.80 | 3.49 | 0.36 | 12.39 | 1.63 | 0.31 | 0.21 | 1.11 | 2.22 |
| CV |  | 11.0 | 16.2 | 17.3 | 11.6 | 15.9 | 12.3 | 13.1 | 1.0 | 33.1 | 45.3 | 22.5 | 28.8 | 29.9 | 53.7 |
| LSD |  | 3.4 | 18.0 | 0.5 | 1.3 | 4.1 | 8.8 | 38.3 | 4.1 | 136.3 | 18.0 | 0.41 | 2.1 | 12.1 | 24.5 |

Legend: SH=Seedling height, LL=Leaf length, LW=Leaf width, CD=Culm diameter, ETN=Effective tiller number, PL=Panicle length, PH=Plant height, DM=Days to maturity, FGPP=Filled grain per panicle, UFGPP=Un-filled grain per panicle, GL=Grain length, DGLBR=Decorticated grain length breadth ratio, GB=Grain breadth, TGW=Thousand grain weight and GY=Grain yield.

****

Legend: All from left to right; 1st row contains JS1 to JS5, 2nd row contains JS6 to JS10 and 3rd row contains JS11 to JS15.

**Figure 1: Variation in grain morphology of similar and duplicate named Jirasail rice germplasm**

**4.2Determination of the Extent of Variability of the Quantitative Traits**

The mean value of seedling height (cm) was 10.9 with a range of 9-12.8 (Table 2 and Figure 2). The range of leaf length was 25.6-50 cm with a mean value of 39.1 cm and the mean value of leaf width (cm) was 1.0 with a range of 0.7-1.3. Similarly, the range of culm diameter was 3.2-4.7 mm with a mean value of 4.0 mm. The mean value of effective tiller number was 9 with a range of 8-12. Similarly, the mean of panicle length was 25.1 cm with a range of 20.8-32.8 and the mean of plant height was 103.1 cm with a range of 84.8-124.8 cm. The mean of days to maturity was 148 days with a range of 146-151. The range of filled grain per panicle was 76-251 with a mean of 145 and the mean value of un-filled grain per panicle was 14 with a range of 7-33. Similarly, the range of grain length was 3.7-6.8 mm with a mean of 5.2 mm and the mean value of decorticated grain length breadth ratio was 2.61 with a range of 1.70-3.82. Again, the mean of thousand grain weight was 14.3 g with a range of 8.9-21.8 g. Finally, the range of grain yield (g/hill) was 4.6-35.4 g with a mean value of 16 g. Therefore, similar and duplicate named Jirasail rice germplasms are not duplicated and need to be conserved in Genebank.

Ahmed *et al.* (2008), Rahman *et al.* (2015), Ahmed *et al.* (2018), Pachauri *et al.* (2017), Chowdhury *et al.* (2018), Emi*et al.* (2021), Gupta*et al.* (2023) and Ali *et al.* (2024) also found valuable and highly significant variability among their studied rice germplasms.

**4.3Evaluation of Simple Correlation among the Quantitative Traits**

Simple correlation analysis among yield and yield contributing characters revealed that the yield had highly significant positive correlation with leaf width, grain length, decorticated grain length breadth ratio and 1000-grain weight, but highly significant negative correlation with panicle length and un-filled grain per panicle (Table 3). However, the 1000-grain weight had highly significant positive correlation with grain length and grain length breadth ratio, but negatively related with leaf length. The grain length breadth ratio had highly significant

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |

**Figure 2: Variations of important agro-morphological characters among 15 similar or duplicate named Jirasail rice germplasm**

**Table 3: Correlation matrix of yield and yield contributing characters of 15 similar and or duplicate named Jirasail group of rice germplasm**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Characters | SH | LL | LW | CD | ETN | PL | PH | DM | FGPP | UFGPP | GL | DG LBR | TGW | GY |
| SH | 1.000 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LL | -0.268\* | 1.000 |  |  |  |  |  |  |  |  |  |  |  |  |
| LW | -0.008 | -0.237 | 1.000 |  |  |  |  |  |  |  |  |  |  |  |
| CD | 0.013 | -0.380\*\* | -0.257 | 1.000 |  |  |  |  |  |  |  |  |  |  |
| ETN | 0.263\* | -0.112 | 0.431\*\* | 0.076 | 1.000 |  |  |  |  |  |  |  |  |  |
| PL | -0.033 | 0.395\*\* | -0.374\*\* | 0.018 | -0.020 | 1.000 |  |  |  |  |  |  |  |  |
| PH | 0.256 | -0.185 | 0.331\* | 0.320\* | 0.959\*\* | 0.011 | 1.000 |  |  |  |  |  |  |  |
| DM | 0.169 | -0.040 | 0.261\* | -0.038 | 0.605\*\* | -0.054 | 0.562\*\* | 1.000 |  |  |  |  |  |  |
| FGPP | -0.067 | 0.084 | -0.287\* | -0.173 | -0.424\*\* | 0.012 | -0.423\*\* | -0.264\* | 1.000 |  |  |  |  |  |
| UFGPP | 0.093 | -0.232 | -0.158 | 0.309\* | 0.119 | 0.071 | 0.200 | 0.038 | 0.258 | 1.000 |  |  |  |  |
| GL | 0.234 | -0.380\*\* | 0.351\* | 0.148 | 0.354\* | -0.298\* | 0.369\* | -0.086 | -0.145 | -0.120 | 1.000 |  |  |  |
| DG LBR | 0.104\* | -0.135\*\* | 0.171\*\* | 0.107 | 0.291\* | -0.164\* | 0.291\* | -0.156 | 0.067\* | -0.031\* | 0.875\*\* | 1.000 |  |  |
| TGW | 0.327 | -0.386 | 0.517 | -0.129 | 0.313\* | -0.289 | 0.269\* | 0.085 | -0.314 | -0.323 | 0.817\*\* | 0.545\*\* | 1.000 |  |
| GY | 0.060 | -0.199 | 0.418\*\* | -0.118 | 0.206 | -0.430\*\* | 0.155 | -0.163 | -0.016 | -0.357\* | 0.900\*\* | 0.834\*\* | 0.732\*\* | 1.000 |

\*, \*\* significant at 5%, 1% levels

positive correlation with leaf width, grain length, 1000-grain weight and grain yield,but highly significant negatively related with leaf length. The filled grain per panicle had highly significant negative correlation with effective tiller number and plant height, but un-filled grain per panicle had significant positive correlation with culm diameter. The days to maturity had highly significant positive correlation with effective tiller number and plant height, but negatively related with leaf length, culm diameter and panicle length. The plant height had highly significant positive correlation with effective tiller number, days to maturity, but highly significant negative relation with filled grain per panicle. The effective tiller number effective tiller number had highly significant positive correlation with leaf width, plant height and days to maturity,but highly significant negatively related with filled grain per panicle.Earlier Haque *et. al.* (1988),Das *et. al.* (1992), Iftekharuddaula *et. al.* (2001), Ahmed *et al.* (2008), Shrestha*et al.* (2018), Chowdhury*et al.* (2018), Kayastha *et al.* (2022) and Saran *et al.* (2023) reported similar or comparable trend of results in rice.

**5. CONCLUSION**

Characterization is an important prerequisite to evaluate phenotypic diversity within the conserved germplasm. Evaluation of rice germplasm based on agronomicalcharacters revealed presence of substantial variability within the germplasm.Considerable ranges of genetic variations were observed among the studied 15 Jirasail germplasm for the 14 quantitative agronomical characters though have the similar or duplicate named.Based on yield performance and other relevant features, the best genotypes are JS3 (acc. no.6694), JS4 (6718), JS5 (8056), JS6 (4828), JS7 (4831),JS8 (1984), JS9 (5313) and JS15 (NC).Therefore, it can be said that studied Jirasail group of germplasm proposes a valuable gene pool, which needs to conserve in Genebank. However, the germplasm need to be further evaluated through SSR markers or SNP genotyping to generated more information for the selection, classification, conservation, identification of parental source and utilization for breeding programmes, such as marker-assisted selection (MAS) in Jirasail rice improvement. Finally, the identified core germplasm with potential gene(s) need to utilize in breeding programs, if possible. This study would be useful for breeders to choose and identify the revival and beneficial genes for rice improvement.

**6. REFERENCES**

1. Ahmed MS, Rashid ESMH, Akter N & Khalequzzaman M. Morphological characterization and diversity of T. Aman rice germplasm of Bangladesh. Bangladesh Rice J. Vol.22(2), pp.13-22, 2018.
2. Ahmed MS, Khalequzzaman M, Akter K, Rashid ESMH & Islam MZ. Variation, character association and path analysis in rice (*Oryza sativa* L.) accessions having duplicate name. Intl. J. BioRes. Vol. 4(2), pp. 28-33, 2008.
3. Ali Z, Naeem M, Ahmed HGMD, Hafeez A, Ali B, Sarfraz MH, Iqbal R, Ditta A, AbidI & Mustafa AEZMA. Diversity and association analysis of physiological and yield indices in rice germplasm. ACS Agric. Sci. Technol. Vol. 4(3), pp. 317-329, 2024. https://doi.org/10.1021/acsagscitech.3c00284.
4. Chowdhury A, Akter A, Hossain MS & Rahman J. Characters association analysis of morphophysiological traits in spring wheat (*Triticum aestivum*) under drought stress. Journal of Science and Technology. Vol. 16, pp. 37-47, 2018.
5. Das S & Ghosh A. Characterization of rice germplasm of West Bengal. Oryza.Vol. 47(3), pp. 201-205, 2011.
6. Das RK, Islam MA, Howlader M, Ibrahim SM, Ahmed HU & Miah NM. Variability and genetic association in upland rice (*Oryza sativa* L.). Bangladesh J. Pl. Breed. Genet. Vol. 5(1&2), pp. 51-56, 1992.
7. Emi FR, Khatun H, Yasmine F, Hasan AK & Hossain MA. Morphological variability and genetic diversity of Aman rice germplasm of Bangladesh cultivated in Mymensingh region. Plant Science Today. Vol. 8(4), pp. 972–985, 2021.
8. Gupta P, Parikh M, Bhat S & Tandekar K. Morphological characterization of rice accessions (*Oryza sativa* L.) using morphological descriptors and quality parameters. The Pharma Innovation Journal. Vol. 12(3), pp. 4773-4780, 2023.
9. Hamid A, Uddin N, Haque M & Haque E. Deshi Dhaner Jat (Bangla). Publication no.59, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh, 1982.
10. Haque ME, Basset MA, Zeenat Z & Miah NM. Variabilty and correlation in three groups of rice (*Oryza sativa* L.). Bangladesh J. Pl. Breed. Genet. Vol. 1(1&2), pp. 104-109, 1988.
11. Iftekharuddaula KM, Badshah MA, Hassan MS, Bashar MK & Akter K. Genetic variability, character association and path analysis of yield components in irrigated rice (*Oryza sativa* L.). Bangladesh J. Pl. Breed. Genet. Vol. 14(2), pp. 43-49, 2001.
12. IPCC. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Eds. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ & Hanson CE, Cambridge University Press, Cambridge, UK,p. 976, 2007.
13. Islam MZ, Akter N, Chakrabarty T, Bhuiya A, Siddique MA & Khalequzzaman M. Agro-morphological characterization and genetic diversity of similar named aromatic rice (*Oryza sativa* L.) landraces of Bangladesh. Bangladesh Rice J. Vol. 22(1), pp. 45-56, 2018.
14. Kayastha P, Chand H, Barsha KC, Pandey B, Roka Magar B, Bhandari J, Lamichhane P, Baduwal P & Poudel MR. Correlation coefficient and path analysis of yield and yield attributing characters of rice (*Oryza sativa* L.) genotypes under reproductive drought stress in the Terai region of Nepal. Archives of Agriculture and Environmental Science. Vol. 7(4), pp. 564-570, 2022.
15. Maxted N & Kell SP. Establishment of a global network for the insitu conservation of crop wild relatives: status and needs. FAO Commission on Genetic Resources for Food and Agriculture, Rome, Italy, p. 266, 2009.
16. Pachauri AK, Sarawgi AK, Bhandarkar S & Ojha GC. Agro-morphological characterization and morphological based genetic diversity analysis of rice (*Oryza sativa* L.) germplasm. Journal of Pharmacognosy and Phytochemistry. Vil. 6(6), pp. 75-80, 2017.
17. Rabara RC, Ferrer MC, Diaz CL, Newingham MCV & Romero GO. Phenotypic diversity of farmers’ traditional rice varieties in the Philippines. Agronomy.Vol. 4, pp. 217-241, 2014.
18. Rahman MM, Naher MS, Sikdar MSI, Azam MG & Hasan MA. Genetic characterization of red pericarp trait in rice. Journal of Science and Technology.Vol. 13,pp. 118-121, 2015.
19. Rao NND, Roja V, Tushara M, Rao VS & Rao VS. 2021. Characterization and diversity analysis of rice germplasm. Biological Forum-An International Journal. Vol. 13(3a),pp. 170-179, 2015.
20. Saran D, Gauraha D, Sao A, Sandilya VK & Kumar R. Correlation and path coefficient analysis for yield and yield attributing traits in rice (*Oryza sativa* L.). International Journal of Plant and Soil Science. Vol. 35(18), pp. 94-101, 2023.
21. Sarif HM, Yusof MR, Ramli A, Oladosu Y, Musa HM, Rahim HA, Zuki ZM & Chukwu SC. Genetic diversity and variability among pigmented rice germplasm using molecular marker and morphological traits. Biotechnology and Biotechnological Equipment. Vol. 34(1), pp.747-762, 2020.
22. Saxena RK, Chang TT, Sapra RL & Paroda RS. Evaluation studies in indigenous rice *(Oryza sativa* L.) germaplasm at IRRI. Philippines. Published in NBPGR manual, pp. 1-3, 1988.
23. Sharma [S](http://www.frontiersin.org/Community/WhosWhoActivity.aspx?sname=ShivaliSharma&UID=97009), Upadhyaya HD, [Varshney](http://www.frontiersin.org/Community/WhosWhoActivity.aspx?sname=RajeevVarshney&UID=25772)RK &Gowda CLL. Pre-breeding for diversification of primary gene pool and genetic enhancement of grain legumes. Plant Sci. Vol. 4,pp. 309 (1-14), 2013.
24. Shrestha N, Poudel A, Sharma Acharya S, Parajuli A, Budhathoki S & Shrestha K. Correlation coefficient and path analysis of advance rice genotypes in Central Mid-hills of Nepal. International Journal of Research in Agricultural Sciences. Vol. 5(3),pp. 2348-3997, 2018.
25. Singh M, Chouhan P & Chaudhari P. Agro-morphological characterization of indigenous germplasm accessions of rice (*Oryza sativa* L.). Journal of Pharmacognosy and Phytochemistry. Vol. 10(2), pp. 1378-1385, 2021.
26. Tian F, Li DJ, Fu Q, Zhu ZF, Fu YC, Wang XK & Sun CQ. Construction of introgression lines carrying wild rice (*Oryza rufipogon*Griff.) segments in cultivated rice (*Oryza sativa* L.) background and characterization of introgressed segments associated with Yield-Related Traits. Theor. Appl. Genet.Vol. 112(3), pp. 570−580, 2006.
27. Yadav S, Singh A, Singh MR, Goel N, Vinod KK, Mohapatra T & Singh AK. Assessment of genetic diversity in Indian rice germplasm (*Oryza sativa* L.): use of random versus trait-linked microsatellite markers. Journal of Genetics. Vol. 92(3),pp. 545-57, 2013.