**Study of genetic erosion, variation and correlation among morpho-physiological traits of ahu rice of Assam, India**

**ABSTRACT**

The conservation of traditional rice landraces, along with their associated farming practices and indigenous knowledge, plays a vital role in ensuring long-term food security. However, the progressive disappearance of these landraces from cultivation has not been adequately addressed by researchers. This study examines genetic erosion, variability, and trait relationships among 12 traditional ahu rice varieties cultivated by Mising tribal farmers in Assam's Jorhat and Golaghat districts. The results demonstrate a concerning decline in landrace diversity, highlighting the risk of genetic erosion.

Statistical analysis revealed significant differences among the varieties for most measured traits, with the exception of radicle length, leaf area index, photosynthetic rate, and stomatal conductance. The recently introduced Kolong variety achieved the highest grain yield, along with superior performance in filled grains per panicle and total spikelets per panicle. Genetic analysis showed considerable heritable variation in chlorophyll stability index, while days to 50% flowering exhibited strong genetic control. Grain yield displayed significant positive correlations with tiller density, panicle density, spikelet number per panicle, filled grain count, and spikelet fertility at both genetic and observable levels.

These findings underscore the critical need to preserve traditional ahu rice varieties to mitigate genetic erosion while incorporating high-performing cultivars into farming systems. Coordinated efforts involving farmers, policymakers, and researchers are necessary to maintain agricultural biodiversity and secure future food production.

***Key words***: Rice Landraces, ahu rice, genotypic coefficient of variation, phenotypic coefficient of variation, genetic analysis, genetic parameters

**INTRODUCTION**

Rice (*Oryza sativa* L.) constitutes the principal dietary staple for over half of the global population, serving as the most critical food security crop worldwide (Elert, 2014). As the second largest producer after China, India plays a pivotal role in global rice supply, with the northeastern region - particularly Assam - recognized as a vital center of genetic diversity for this essential cereal crop (Singh et al., 2021). Recent studies have emphasized that Assam's agricultural landscape is dominated by rice cultivation, which occupies approximately 60% of the gross cropped area and accounts for an overwhelming 96% of the state's total food grain production (Das et al., 2020). The region's exceptional agro-biodiversity is evidenced by the conservation of more than 4,000 traditional rice landraces at Assam Agricultural University (AAU) alone, many of which continue to be cultivated by smallholder farmers, particularly in ecologically vulnerable areas and regions predominantly inhabited by tribal communities (Bora et al., 2022; Chhaya et al., 2023).

The preservation of these traditional landraces, along with their associated indigenous knowledge systems and cultivation practices, has gained increasing recognition as a crucial component of long-term food security and climate resilience strategies (Dwivedi et al., 2023). However, contemporary agricultural transitions have precipitated the gradual disappearance of these genetic resources from farmers' fields, driven by multiple factors including the widespread adoption of modern high-yielding varieties, rapid land-use changes, and intensifying environmental pressures (Rana et al., 2021). Despite the profound implications of this genetic erosion for future food security, the phenomenon has received insufficient scientific attention in the context of traditional rice ecosystems (Negrao et al., 2022). As noted by several researchers, the systematic assessment of genetic erosion represents a fundamental prerequisite for developing effective conservation strategies for crop genetic resources (Tester & Langridge, 2023).

Among the various rice ecotypes, upland *ahu* rice - traditionally cultivated under rainfed conditions - has seen relatively limited genetic improvement compared to irrigated varieties (Pandey et al., 2023). Tribal farming communities, particularly the Mising people of Assam, have maintained diverse landrace collections, though these are increasingly threatened by complex socio-ecological challenges including habitat degradation, climate change-induced disasters, and shifting agricultural economies (Singh, 2022). Recent investigations into genotype-environment interactions have further highlighted the importance of preserving these genetic resources, particularly for their adaptive traits under stress conditions (Chhaya et al., 2023). A comprehensive understanding of the dynamics governing genetic erosion and on-farm diversity within these traditional cultivation systems is therefore essential for formulating science-based conservation policies and establishing robust benchmarks for future research initiatives (Ray et al., 2023).

In light of these critical considerations, the present study was conceived to systematically evaluate genetic erosion patterns, phenotypic variability, and trait associations in upland *ahu* rice landraces cultivated by Mising tribal farmers across selected villages in Assam's Jorhat and Golaghat districts. By integrating advanced agronomic assessments with genetic analyses, this research aims to contribute substantive data to ongoing efforts to preserve rice biodiversity while informing the development of sustainable cultivation practices in vulnerable agro-ecosystems. The findings are expected to provide valuable insights for policymakers, conservationists, and plant breeders working to enhance the resilience of traditional rice production systems in the face of mounting environmental and socio-economic challenges.

**MATERIALS & METHODS:**

The study was conducted in two villages predominantly inhabited by Mising tribal farmers, located in Jorhat and Golaghat districts of Assam. Field trials were established using traditional *ahu* rice varieties collected from these villages at the Instructional-cum-Research (ICR) Farm of the College of Agriculture, with complementary laboratory analyses performed in the Plant Breeding and Genetics laboratories.

The investigation focused on twelve indigenous rice genotypes traditionally cultivated under direct-seeded upland conditions during the *ahu* season by Mising farmers in the selected villages of Hatisal (Jorhat district) and Danichapori (Golaghat district). The studied varieties included: Ikorguni, Bihari, Erepi, Borkola, Kopowguni, Ikhojoi, Kola Bengan, Amrow, Luit, Disang, Kolong, and Rongkhang.

The experimental trial was conducted using a randomized complete block design (RCBD) with three replications under upland direct-seeded conditions. Each experimental unit consisted of a 3.1 m² plot (2.2 m × 1.4 m). A comprehensive evaluation of morpho-physiological characteristics was performed following standardized protocols for rice varietal assessment.

Growth parameters were recorded during early developmental stages, including coleoptile length, plumule length, and radicle length measurements. Phenological observations focused on days to 50% flowering, while agronomic measurements included plant height determination, tiller density quantification (expressed as number of tillers per square meter), and panicle density assessment (number of panicles per square meter).

Leaf morphological and physiological traits were systematically evaluated, incorporating measurements of leaf length, leaf breadth, and derived leaf area. Additional foliar assessments included determination of leaf area index (LAI), chlorophyll content analysis, chlorophyll stability index (CSI) evaluation, and stomatal conductance measurements.

Yield component analysis involved multiple parameters: panicle length measurement, spikelet enumeration per panicle, filled grain count per panicle, spikelet fertility calculation, and 1000-grain weight determination. Final grain yield was recorded at harvest maturity. Grain quality assessment included dimensional analysis of both whole grains and kernels, with measurements of length and breadth, followed by computation of corresponding length-to-breadth ratios.

All data collection procedures adhered to established agronomic research protocols for rice varietal evaluation. The acquired dataset was subjected to statistical processing to generate mean values for each measured parameter across experimental replications, ensuring robust characterization of the evaluated traits.

**Statistical Analysis**

The mean values obtained from all observations for each entry across replications were subjected to comprehensive statistical and biometrical analysis. The following analytical procedures were employed:

**Analysis of Variance:**

The mean data for each character in each replication were analyzed using Analysis of Variance (ANOVA) following a Randomized Block Design. Genotypic variances were tested against error variances using F-tests for significance determination. Mean differences between genotypes were evaluated by calculating the Critical Difference (CD) using the formula :

where:  
r = number of replications  
t = tabulated t-value at appropriate degrees of freedom

**Genetic Parameters Estimation**  
Genetic parameters were calculated for various characters using the following formulas:

1. Genotypic variance (σ²g):

where:  
MSg = mean square due to genotype  
MSe = mean square due to error  
r = number of replications

1. Phenotypic variance (σ²p):

where:  
σ²e = MSe (error variance)

1. Genotypic coefficient of variation (GCV):
2. Phenotypic coefficient of variation (PCV):
3. Heritability in broad sense (h²b):

**Correlation Analysis**  
Correlation coefficients among various parameters at genotypic and phenotypic levels were calculated as follows:

1. Genotypic correlation coefficient (rgxy):

where:  
σgxy = genotypic covariance between traits X and Y  
σ²gx = genotypic variance of trait X  
σ²gy = genotypic variance of trait Y

1. Phenotypic correlation coefficient (rpxy):

where:  
σpxy = phenotypic covariance between traits X and Y  
σ²px = phenotypic variance of trait X  
σ²py = phenotypic variance of trait Y

The significance of genotypic and phenotypic correlation coefficients was tested using t-tests:

with (n-2) degrees of freedom, where n = number of observations.

**RESULTS & DISCUSSION:**

**Participatory assessment of rice diversity**

It was evident from the study that the farmers in the past used to grow the landraces like Ikorguni, Kopowguni, Borkola, Erepi, Ikhojoi, Kola Bengan, Boga Amro, Kola Amro, Betguti, Kutkong, Messap (scented), Rongadoria and Gerem ahu .Of which the last four Kutkong, Messap, Rongadoria and Gerem ahu had been abandoned by the community.But in the recent period, they started growing another set of varieties like Ikorguni, Kopowguni, Borkola, Erepi, Ikhojoi, Kola Bengan, Amrow, Bihari, Luit, Disang, Kolong and Rongkhang The last four happened to be very recent addition

**Analysis of variance**

The analysis of variance revealed the presence of significant variation among the genotypes for all the characters except radicle length, leaf area index, photosynthesis and stomatal conductance.

# Table1: Analysis of variance of various morpho-physiological traits (Part -I)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sourcesof | Degree | Meansquare | | | | | | |
| variation | offreedom | Coleoptilelength | Plumulelength | Radiclelength | Days to50%  flowering | Plantheight | Numberoftillers/m2 | Numberofpanicles/m  2 |
| Replicatio  n | 2 | 0.35\*\* | 0.75 | 0.75 | 0.33 | 29.9\*\* | 806.25 | 602.78 |
| Genotypes | 11 | 0.09\* | 3.09\*\* | 3.90 | 129.8\*\* | 294.8\*\* | 6943.9\*\* | 7530.1\*\* |
| Error | 22 | 0.04 | 0.86 | 2.54 | 1.09 | 4.35 | 468.37 | 275.51 |

**Table2: Analysis of variance of various morpho-physiological traits (Part-II)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sources of variation | Degreeof freedom | Mean square | | | | | | |
| Leaf length | Leaf breadth | Leaf area | Leaf area index | Chlorophyll content | Chloro-phyll stability index | Conductance |
| Replication | 2 | 10.15\*\* | 0.001 | 6.34 | 0.06 | 0.24 | 0.03 | 0.230\*\* |
| Genotypes | 11 | 47.32\*\* | 0.033\* | 61.03\*\* | 0.11 | 6.39\*\* | 7.87\*\* | 0.009 |
| Error | 22 | 1.42 | 0.014 | 5.69 | 0.18 | 0.19 | 0.34 | 0.005 |

# Table.3:Analysis of variance of various morpho-physiological traits (Part-III)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sources of variation | Degree of freedom | Mean square | | | | | |
| Panicle length | Spikelet/panicle | Filled  grains/panicle | Spikelet  fertility(%) | 1000-grainweight | Grain yield/m2 |
| Replicatio  n | 2 | 0.26 | 26.33 | 31.44 | 6.78 | 0.94 | 454.53 |
| Genotypes | 11 | 18.03\*\* | 891.15\*\* | 610.88\*\* | 57.99\*\* | 28.63\*\* | 5716.62\*\* |
| Error | 22 | 0.32 | 12.30 | 12.47 | 4.57 | 0.68 | 322.30 |

**Table.4: Analysis of variance of various morpho-physiological traits (Part- IV)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sources of variation | Degree of freedom | Mean square | | | | | |
| Grain length | Grain breadth | Grain L/Bratio | Kernel length | Kernel breadth | Kernel  L/Bratio |
| Replicatio  n | 2 | 0.01 | 0.06\* | 0.03 | 0.01 | 0.13\*\* | 0.04 |
| Genotypes | 11 | 1.47\*\* | 0.17\*\* | 0.18\*\* | 1.48\*\* | 0.17\*\* | 0.22\*\* |
| Error | 22 | 0.03 | 0.01 | 0.01 | 0.06 | 0.01 | 0.02 |

\*Significantat5percentlevelofsignificance

\*\*Significantat1percentlevelofsignificance

# Mean performance

The mean and range of various traits studied and the mean performances of all the genotypes for different traits with coefficient of variation and critical difference at 5 per cent level of significance

# Table 5: Mean performance of the varieties in respect of various traits (Part-I)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variety | Coleoptile length  (cm) | Plumule length  (cm) | Radicle length  (cm) | Days to50%  flowering | Plant height  (cm) | Number of tillers/m2 | Number of panicles/m2 |
| Ikorguni | 1.9 | 6.6 | 6.6 | 64 | 88.6 | 248 | 222 |
| Bihari | 1.8 | 6.9 | 7.8 | 78 | 93.8 | 372 | 342 |
| Erepi | 1.9 | 6.5 | 8.0 | 65 | 86.4 | 230 | 180 |
| Borkola | 1.9 | 6.5 | 7.5 | 66 | 88.5 | 257 | 222 |
| Kopowguni | 1.7 | 5.7 | 4.7 | 65 | 91.8 | 200 | 160 |
| Ikhojoi | 2.1 | 8.4 | 8.6 | 62 | 81.5 | 258 | 197 |
| KolaBengen | 1.9 | 8.0 | 6.9 | 66 | 92.0 | 217 | 168 |
| Amrow | 1.7 | 4.9 | 5.2 | 75 | 96.5 | 222 | 168 |
| Luit | 1.6 | 8.2 | 6.8 | 78 | 75.5 | 223 | 192 |
| Disang | 1.7 | 7.6 | 7.5 | 80 | 65.9 | 187 | 152 |
| Kolong | 1.4 | 6.8 | 6.2 | 72 | 69.8 | 278 | 207 |
| Rongkhang | 1.8 | 6.8 | 7.8 | 64 | 92.2 | 268 | 188 |
| C.D. 5% | 0.32 | 1.57 | NS | 1.77 | 3.53 | 36.65 | 28.11 |
| C.V. | 10.75 | 13.43 | 22.90 | 1.50 | 2.45 | 8.77 | 8.31 |

**Table 6: Mean performance of the varieties in respect to various traits (Part-II)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variety | Leaf length  (cm) | Leaf breadth  (cm) | Leaf area(cm2) | Leaf area index | Chlorophyll content  (mgg-1) | Chlorophyll stability index  (%) | Conductance(mmolm-2S-  1) |
| Ikorguni | 17.70 | 1.10 | 14.4 | 1.2 | 5.6 | 3.3 | 0.27 |
| Vihari | 29.30 | 1.2 | 25.8 | 1.5 | 5.6 | 2.7 | 0.17 |
| Erepi | 19.97 | 0.97 | 14.4 | 1.6 | 6.5 | 3.1 | 0.14 |
| Borkola | 18.63 | 1.10 | 15.4 | 1.4 | 10.4 | 7.6 | 0.22 |
| Kopowguni | 21.93 | 0.97 | 15.8 | 1.2 | 6.4 | 2.2 | 0.21 |
| Ikhojoi | 18.17 | 0.87 | 11.8 | 1.5 | 7.2 | 3.1 | 0.15 |
| Kola  Bengen | 20.83 | 1.07 | 16.8 | 1.1 | 6.3 | 2.4 | 0.17 |
| Amrow | 30.00 | 1.13 | 26.0 | 1.6 | 8.1 | 3.9 | 0.31 |
| Luit | 22.63 | 0.87 | 14.7 | 1.5 | 6.2 | 1.5 | 0.16 |
| Disang | 19.90 | 0.97 | 14.7 | 1.5 | 7.2 | 3.9 | 0.14 |
| Kolong | 21.63 | 0.90 | 14.5 | 1.2 | 8.7 | 5.1 | 0.12 |
| Rongkhang | 23.33 | 1.07 | 18.8 | 1.2 | 5.4 | 2.5 | 0.18 |
| C.D. 5% | 2.02 | 0.20 | 4.04 | NS | 0.74 | 0.98 | NS |
| C.V. | 5.41 | 11.47 | 14.09 | 30.65 | 6.24 | 16.88 | 36.37 |

# Table 7: Mean performance of the varieties in respect of various straits (Part-III)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety | Panicle  length(cm) | Spikelets/panicle | Filled  grains/panicle | Spikelet  fertility(%) | 1000-grainweight  (g) | Grain  yield/m2(g) |
| Ikorguni | 18.5 | 63 | 52 | 82 | 25.8 | 118 |
| Vihari | 22.9 | 102 | 83 | 81 | 23.9 | 216 |
| Erepi | 14.3 | 75 | 54 | 71 | 20.4 | 129 |
| Borkola | 16.6 | 79 | 61 | 77 | 21.4 | 138 |
| Kopowguni | 18.6 | 85 | 66 | 78 | 22.5 | 151 |
| Ikhojoi | 16.3 | 92 | 76 | 83 | 21.3 | 180 |
| KolaBengen | 18.7 | 64 | 46 | 73 | 27.1 | 107 |
| Amrow | 21.1 | 75 | 54 | 72 | 22.2 | 129 |
| Luit | 18.7 | 66 | 47 | 72 | 20.9 | 109 |
| Disang | 19.0 | 60 | 43 | 72 | 19.1 | 104 |
| Kolong | 18.6 | 118 | 86 | 73 | 25.9 | 240 |
| Rongkhang | 14.6 | 81 | 64 | 79 | 16.3 | 142 |
| C.D. 5% | 0.95 | 5.94 | 5.98 | 3.62 | 1.39 | 30.40 |
| C.V. | 3.10 | 4.38 | 5.79 | 2.81 | 3.70 | 12.23 |

**Table 8: Mean per formance of the varieties inrespect of various traits (Part-IV)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety | Grainlength(mm) | Grainbreadth(mm) | GrainshapeL/Bratio | Kernellength(mm) | Kernelbreadth(mm) | Kernelshape (L/Bratio) |
| Ikorguni | 7.9 | 3.7 | 2.1 | 5.9 | 3.3 | 1.8 |
| Vihari | 8.8 | 3.4 | 2.6 | 6.8 | 2.9 | 2.4 |
| Erepi | 7.7 | 3.5 | 2.2 | 5.5 | 3.1 | 1.8 |
| Borkola | 7.4 | 3.6 | 2.0 | 5.6 | 3.2 | 1.7 |
| Kopowguni | 7.9 | 3.6 | 2.2 | 6.0 | 3.1 | 1.9 |
| Ikhojoi | 8.0 | 3.6 | 2.2 | 6.0 | 3.1 | 1.9 |
| KolaBengen | 7.9 | 3.7 | 2.1 | 5.9 | 3.2 | 1.8 |
| Amrow | 7.6 | 3.6 | 2.1 | 5.4 | 3.2 | 1.7 |
| Luit | 8.9 | 3.3 | 2.7 | 6.5 | 2.9 | 2.2 |
| Disang | 8.5 | 3.2 | 2.7 | 6.6 | 2.8 | 2.3 |
| Kolong | 8.8 | 3.5 | 2.5 | 7.0 | 2.9 | 2.4 |
| Rongkhang | 6.4 | 2.9 | 2.2 | 4.4 | 2.5 | 1.8 |
| C.D. 5% | 0.29 | 0.18 | 0.18 | 0.42 | 0.19 | 0.24 |
| C.V. | 2.18 | 3.13 | 4.71 | 4.17 | 3.68 | 7.12 |

**Coleoptile length:** The mean value of coleoptile length measured after 7 days of germination was 1.78 cm for the genotypes**.** Ikhojoi had the longest coleoptile (2.1cm) and shortest coleoptile length (1.4 cm) was observed in Kolong

**Plumule length:** The mean value of plumule length measured after 7 days of germination was

6.91 cm for the genotypes. The plumule length among the 20 varieties ranges from 4.9 cm to

8.4 cm considering that variety Ikhojoi had the longest plumule (8.4cm) and Amrow has the shortest plumule length (4.9 cm)

**Radicle length:** The radicle length among these genotypes ranged from 4.7 cm to 8.6 cm. Among these varieties, Ikhojoi had the longest radical length (8.6cm) and the shortest was observed in Kopowguni (4.7 cm).

**Days to 50% flowering:** The mean value of days to 50% flowering was 69 days. The variety Disang took the longest duration of 80 days to flower and Ikhojoi was the earliest (62 days) among all the varieties and differed significantly with the others in duration taken for flowering. **Plant height:** The tallest variety was Amrow (96.5 cm) followed by Bihari (93.8cm) and they were at par with each other. On the other hand, the shortest variety was Disang (65.9 cm) and was significantly shorter than all other varieties.

**Number of tillers per m2:** Bihari recorded the highest number of tillers per m2 (372) and Disang recorded the lowest (187)

**Number of panicles per m2:** Like that in case of the number of tillers per m2, Bihari and Disang recorded the highest and lowest number of panicles per m2 (342 and 152, respectively).

**Leaf length:** The mean value of leaf length was recoreded to be 22 cm ranging from 17.70 cm to 30 cm. Among the varieties, Amrow had the longest leaf of 30 cm which was statistically *at par* with the variety Bihari. The shortest leaf length was observed in Ikorguni (17.7 cm) which was statistically *at par* with Borkola and Ikhojoi.

**Leaf breadth:** The overall mean value of leaf breadth was 1.01 cm. The leaf breadth among the genotypes ranged from 0.87 cm to 1.2 cm. Among the varieties, Bihari had the widest leaf (1.2 cm) and the narrowest was observed in Ikhojoi and Luit (0.87 cm) which was statistically *at par* with Kopowguni, Kolong, Disang and Erepi.

**Leaf area:** The leaf area per plant for the genotypes varied from 11.8 cm2 to 26 cm2 and the grand mean was 16.92 cm2*.* Among the varieties, Amrow had the largest leaf (26 cm) while the smallest was observed in Ikhojoi (11.8 cm)

**Leaf area index:** The overall mean the genotypes for leaf area index was 1.37. The leaf area index ranged from 1.1 for Kolabengan to 1.6 for Amrow.

**Chlorophyll content:** The grand mean of all the genotypes for chlorophyll content was 6.96 mg g-1 and it varied from 5.4 mg g-1 for Rongkhang to 10.4 mg g-1 for Borkola.

**Chlorophyll stability index**: The grand mean of chlorophyll stability index was 3.44 per cent and it varied from 1.5 per cent for Luit to 7.6 per cent for Borkola. The varieties Kolabengan, Kopowguni were *at par* with the lowest ranking variety Luit.

**Stomatal conductance:** The overall mean of all the genotype was 0.19 m mol m-2 s-1. The mean value for the character varied from 0.12 m mol m-2 s-1 for Kolong to 0.31 m mol m-2 s-1 for Amrow.

**Panicle length:** The overall mean for the genotypes was 18.16 cm. The variety Bihari had the longest panicle length (22.9 cm) followed by Amrow and they were at par with each other. The shortest panicle (14.3 cm) was observed in the variety Erepi

**Spikelets per panicle:** The variety Kolong had the highest number of spikelets (118). The lowest number of spikelets was observed in Disang. The overall mean for all the genotypes was 61 spikelets.

**Filled grains per panicle:** The variety Kolong had the highest number of filled grains (86) followed by Bihari and they were at par with each other. The lowest number of filled grains was observed in Disang that was *at par* with Kolabengan and Luit. The overall mean for all the genotypes was 61 filled grains.

**Spikelet fertility:** The mean spikelet fertility of the genotypes was 75.94 per cent and it varied from 71 per cent for Erepi to 83 per cent for Ikhojoi. The genotypes Kolabengan, Amrow, Luit, Disang, Kolong were *at par* with Erepi in respect of, the spikelet fertility.

**1000 grain weight:** Kolabengan had the heaviest grains with its 1000 grain weight being as high as 27.1 gram while the lightest grains were borne by the variety Rongkhang being as low as 16.3 gram

**Grain yield:** The overall mean for all the genotypes was 146.85 gram per m2. Kolong showed the highest performance (240 g/m2) which was statistically *at par* with Bihari. On the other hand, the lowest yield was recorded by the variety Disang (104 g/m2) which was statistically *at par* with Luit, Amrow, Kolabengan, Erepi and Ikorguni.

**Grain length & breadth:** The length of the grains in the test varieties varied from 6.4 mm to

8.9 mm. Among all the genotypes, Luit had the longest grain of 8.9 mm and Rongkhang had the shortest grain size of 6.4 mm.

The breadth of the grains in the test varieties varied from 2.9 mm to 3.7 mm. Among the genotypes, Ikorguni and Kolabengan had the widest grain of 3.7 mm. On the other hand, Rongkhang had the narrowest grain size of 2.9 mm that differed significantly from all the other varieties. The grand mean of all the genotype was 3.47 mm.

**Grain shape:** The ratio of the grain length to breadth (L/B ratio) varied from 2.0 to 2.7. The varieties Luit and Disang recorded similar L/B ratio of 2.7 and were statistically *at par* with Bihari. The variety Borkola recorded the lowest L/B ratio of 2.0 and was *at par* with Ikorguni, Kolabengan and Amrow.

**Kernel length & breadth :** The length of the milled kernel in the test varieties varied from 4.4 mm to 7.0 mm. Among all the genotypes, Kolong had the longest kernel of 7.0 mm and Rongkhang had the shortest kernel size of 4.4 mm.

The breadth of the grains in the test varieties varied from 2.5 mm to 3.3 mm. Among all the genotypes, Ikorguni had the widest grain of 3.3 mm. On the other hand, Rongkhang had the narrowest grain size of 2.5 mm that differed significantly from all the other varieties. The grand mean of all the genotype was 3.02 mm.

# Genetic parameters

The GCV and PCV estimates were low to moderate. The highest estimates of GCV and PCV were recorded for chlorophyll stability index (46.13% and 49.12%) while the lowest estimates were recorded for spikelet fertility (5.56% and 6.23%). Moderate estimates were recorded for plant height, number of tillers per m2, leaf length, panicle length, 1000 grain weight, chlorophyll content, kernel length and kernel shape while low estimates were recorded for all other remaining traits.

Heritability in broad sense ranged from 14 % for leaf area index to as high as 98 % for days to 50% flowering. Heritability estimates were relatively high for plant height, leaf length, number of panicles per m2, number of tillers per m2, panicle length, filled grains per panicle, spikelets per panicle, 1000 grain weight, grain yield, chlorophyll content, chlorophyll stability index, grain length and breadth, grain shape and kernel length and breadth respectively. The traits like leaf area, spikelet fertility and kernel shape had moderate estimates of heritability while the other remaining traits exhibited low heritability estimates. Genetic advance as percentage of mean (GA) ranged from as low as just 8.04 % for leaf area index to as high as 89.24 % for chlorophyll stability index followed by grain yield (54.78%). The others had rather low GA.

# Table 9: Genetic parameters of various traits

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Character** | **σ²g** | **σ²p** | **GCV(%)** | **PCV(%)** | **h2**  **bs**  **(%)** | **GA as %ofmean** |
| Coleoptile length | 0.02 | 0.06 | 8.00 | 13.40 | 36 | 9.84 |
| Plumule length | 0.74 | 1.60 | 12.48 | 18.33 | 46 | 17.50 |
| Radicle length | 0.45 | 3.00 | 9.66 | 24.85 | 15 | 7.74 |
| Daysto50%flowering | 42.91 | 44.00 | 9.39 | 9.51 | 98 | 19.11 |
| Plant height | 96.82 | 101.17 | 11.55 | 11.80 | 96 | 23.27 |
| Number of tillers/m2 | 2158.52 | 2626.89 | 18.84 | 20.78 | 82 | 35.17 |
| Number of panicles/m2 | 2418.18 | 2693.69 | 24.62 | 25.99 | 90 | 48.06 |
| Leaf length | 15.30 | 16.72 | 17.78 | 18.59 | 92 | 35.04 |
| Leaf breadth | 0.007 | 0.02 | 7.95 | 13.96 | 32 | 9.32 |
| Leaf area | 18.44 | 24.13 | 25.38 | 29.03 | 76 | 45.71 |
| Leaf area index | 0.02 | 0.16 | 10.59 | 28.77 | 14 | 8.04 |
| Chlorophyll content | 2.07 | 2.26 | 20.65 | 21.57 | 92 | 40.72 |
| Chlorophyll stability index | 2.51 | 2.85 | 46.13 | 49.12 | 88 | 89.24 |
| Conductance | 0.003 | 0.007 | 21.29 | 42.14 | 26 | 22.15 |
| Panicle length | 5.90 | 6.22 | 13.38 | 13.73 | 95 | 26.85 |
| Spikelets/panicle | 292.95 | 305.25 | 21.40 | 21.84 | 96 | 43.18 |
| Filled grains/panicle | 199.47 | 211.94 | 23.16 | 23.88 | 94 | 46.29 |
| Spikelet fertility | 17.81 | 22.37 | 5.56 | 6.23 | 80 | 10.21 |
| 1000-grainweight | 9.32 | 10.00 | 13.73 | 14.22 | 93 | 27.30 |
| Grain yield/m2 | 1798.11 | 2120.40 | 28.88 | 31.36 | 85 | 54.78 |
| Grain length | 0.48 | 0.51 | 8.67 | 8.94 | 94 | 17.33 |
| Grain breadth | 0.05 | 0.06 | 6.63 | 7.33 | 82 | 12.35 |
| Grain shape(L/Bratio) | 0.05 | 0.07 | 10.10 | 11.14 | 82 | 18.85 |
| Kernel length(mm) | 0.47 | 0.53 | 11.53 | 12.26 | 88 | 22.33 |
| Kernel breadth(mm) | 0.05 | 0.06 | 7.57 | 8.42 | 81 | 14.02 |
| Kernel shape(L/Bratio) | 0.07 | 0.09 | 13.08 | 14.90 | 77 | 23.67 |

**Association**

Coleoptile length showed significantly positive correlation with plant height, spikelet fertility at both genotypic and phenotypic levels and significantly positive genotypic correlation with grain breadth and kernel breadth and significantly negative genotypic correlation with days to 50% flowering, leaf length, panicle length, grain length and shape and kernel length and shape. Plumule length was found to have significantly positive genotypic and phenotypic correlation with grain and kernel length and shape and negative correlation with plant height, leaf length and leaf area. Days to 50% flowering was found to have significantly positive genotypic and phenotypic correlation with leaf length, leaf area, panicle length, grain length and shape, kernel length and shape and negative phenotypic and genotypic correlation with spikelet fertility and plant height. Plant height showed significantly positive correlation with leaf length, breadth and area at both genotypic and phenotypic levels. It recorded negative correlation with grain length and shape and kernel length and shape at both phenotypic and genotypic levels. Number of tillers per m2 was found to have significantly positive phenotypic and genotypic correlation with number of panicles per m2, leaf length, leaf area, filled grains per panicle, spikelets per panicle, spikelet fertility and grain yield. Similarly, number of panicles per m2 had significantly positive phenotypic and genotypic correlation with leaf length, leaf area, filled grains per panicle, spikelets per panicle, spikelet fertility, grain yield and panicle length. Leaf length was found to have significant positive phenotypic and genotypic correlation with leaf breadth, leaf area, panicle length. Leaf breadth had significantly negative genotypic relation with grain length and shape and kernel length and shape. Leaf area

had significantly positive phenotypic and genotypic correlation with panicle length.

Spikelets per panicle showed significantly positive phenotypic and genotypic correlation with grain yield and kernel shape. Spikelet fertility had significant positive phenotypic correlation with grain yield as well. 1000 grain weight showed significantly positive correlation with grain length and breadth, kernel length and breadth at phenotypic and genotypic level.

Grain yield recorded highly significant correlation with number of tillers and panicles per square meter and number of spikelets and filled grains per panicle both at genotypic and phenotypic levels. Again, at phenotypic level, grain yield had significant positive correlation spikelet fertility percentage, kernel length and shape. However, grain yield showed correlation with none of the leaf related traits. Among leaf characters, there were close correlation among themselves. Similarly, chlorophyll content was found to have significant positive genotypic and phenotypic correlation with chlorophyll stability index.

Grain length showed significant positive correlation with grain shape and kernel length and shape both at genotypic and phenotypic levels. Similarly, grain breadth had highly significant positive correlation with kernel breadth and negative correlation with both grain and kernel shape at genotypic and phenotypic levels.

**Table 10: Estimates of genotypic correlation coefficient (rg) (upper diagonal) and phenotypic correlation coefficient (rp) (lower diagonal) among different traits**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Character | Coleoptilelength | Plu mulelength | Daysto50  %  flowering | Plantheight | Numberoftillers  /m  2 | Numberofpanicles  /m  2 | Leaflength | Leafbreadth | Leafare a | Chlorophyllcontent | Chlorophyllstabilityindex | Paniclelength | Spikelets  /pa nic le | Filledgrains  /pa nic le | Spikeletfertility | 10  00-  grainweight | Grainyield/m2 | Grainlength | Grainbreadth | Grainshape | Kernellength | Kernelbreadth | Kernelshape |
| Coleoptile |  | 0.0 | - | 0.5 | 0.0 | 0.0 | - | 0.1 | - | - | - | - | - | - | 0.6 | - | - | - | 0.3 | - | - | 0.5 | - |
| length | 5 | 0.8 | 8\* | 9 | 9 | 0.4 | 8 | 0.2 | 0.10 | 0.01 | 0. | 0.3 | 0.1 | 9\* | 0.1 | 0.3 | 0.5 | 5\* | 0.8 | 0.6 | 3\* | 0.8 |
|  |  | 0\*\* | \* |  |  | 1\* |  | 1 |  |  | 45 | 2 | 1 | \* | 7 | 2 | 7\* |  | 0\* | 5\* | \* | 9\* |
|  |  |  |  |  |  |  |  |  |  |  | \*\* |  |  |  |  |  | \* |  | \* | \* |  | \* |
| Plumule | 0.3 |  | 0.0 | - | 0.0 | 0.0 | - | - | - | - | - | - | - | - | 0.0 | - | - | 0.3 | - | 0.4 | 0.3 | - | 0.4 |
| length | 3 | 3 | 0. | 5 | 7 | 0. | 0. | 0. | 0.27 | 0.35 | 0.2 | 0.1 | 0.1 | 9 | 0.0 | 0.0 | 6\* | 0.2 | 6\* | 5\* | 0.1 | 0\* |
|  |  |  | 60 |  |  | 54 | 84 | 66 |  | \* | 1 | 4 | 0 |  | 1 | 8 |  | 4 | \* |  | 5 |  |
|  |  |  | \*\* |  |  | \*\* | \*\* | \*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Daysto | - | 0.0 |  | - | 0.1 | 0.2 | 0.5 | 0.0 | 0.4 | 0.00 | - | 0.6 | - | - | - | - | 0.0 | 0.6 | - | 0.8 | 0.6 | - | 0.7 |
| 50% | 0.4 | 5 | 0.4 | 0 | 2 | 7\* | 1 | 6\* |  | 0.09 | 9\* | 0.0 | 0.1 | 0.4 | 0.0 | 3 | 4\* | 0.3 | 5\* | 0\* | 0.3 | 5\* |
| flowering | 5 |  | 0\* |  |  | \* |  | \* |  |  | \* | 1 | 1 | 7\* | 3 |  | \* | 4 | \* | \* | 2 | \* |
|  | \*\* |  |  |  |  |  |  |  |  |  |  |  |  | \* |  |  |  |  |  |  |  |  |
| Plant | 0.3 | - | - |  | 0.2 | 0.2 | 0.4 | 0.9 | 0.6 | - | - | 0.1 | - | 0.0 | 0.3 | 0.1 | - | - | 0.2 | - | - | 0.2 | - |
| height | 5 \* | 0.3 | 0.3 | 6 | 5 | 3\* | 3\* | 1\* | 0.22 | 0.14 | 0 | 0.0 | 4 | 5\* | 1 | 0.0 | 0. | 8 | 0.6 | 0.6 | 7 | 0.7 |
|  |  | 7 \* | 9 \* |  |  | \* | \* | \* |  |  |  | 6 |  |  |  | 9 | 55 |  | 7\* | 0\* |  | 0\* |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | \*\* |  | \* | \* |  | \* |
| Number | - | - | 0.1 | 0.2 |  | 0.9 | 0.4 | 0.5 | 0.4 | - | 0.10 | 0.3 | 0.6 | 0.7 | 0.5 | 0.1 | 0.7 | 0.1 | - | 0.2 | 0.2 | - | 0.3 |
| of | 0.0 | 0.0 | 0 | 4 | 4 | 1\* | 2 | 8 | 0.10 |  | 2 | 7 | 5 | 2 | 6 | 3 | 8 | 0.1 | 4 | 0 | 0.2 | 4 |
| tillers/m2 | 4 | 3 |  |  | \*\* |  | \*\* | \*\* |  |  |  | \*\* | \*\* | \*\* |  | \*\* |  | 4 |  |  | 5 |  |
| Number | 0.0 | - | 0.2 | 0.2 | 0.9 |  | 0.3 | 0.6 | 0.4 | - | 0.09 | 0.4 | 0.4 | 0.5 | 0.5 | 0.2 | 0.5 | 0.3 | - | 0.3 | 0.3 | - | 0.3 |
| of | 0 | 0.0 | 0 | 4 | 4 | 8\* | 0\* | 8\* | 0.12 |  | 6 | 8\* | 8\* | 2\* | 5 | 7\* | 3 | 0.0 | 0 | 3 | 0.0 | 7\* |
| panicles/ |  | 3 |  |  | \*\* |  | \* | \* |  |  | \*\* | \* | \* | \* |  | \* |  | 2 |  |  | 8 |  |
| m2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Leaf | - | - | 0.5 | 0.3 | 0.3 | 0.3 |  | 0.5 | 0.9 | - | - | 0.6 | 0.2 | 0.2 | - | - | 0.2 | 0.1 | - | 0.2 | 0.0 | - | 0.2 |
| length | 0.2 | 0.3 | 4 | 9 \* | 5 \* | 3 \* | 5 | 6 | 0.16 | 0.24 | 7 | 8 | 4 | 0.1 | 0.0 | 7 | 1 | 0.1 | 6 | 2 | 0.2 | 1 |
|  | 6 | 5 \* | \*\* |  |  |  | \*\* | \*\* |  |  | \*\* |  |  | 7 | 2 |  |  | 9 |  |  | 8 |  |
| Leaf | 0.1 | - | 0.0 | 0.5 | 0.2 | 0.2 | 0.3 |  | 0.7 | - | 0.25 | 0.5 | - | - | 0.3 | 0.2 | - | - | 0.1 | - | - | 0.2 | - |
| breadth | 8 | 0.2 | 6 | 5 | 4 | 9 | 9 \* | 7 | 0.08 |  | 1 | 0.1 | 0.0 | 2 | 2 | 0.1 | 0. | 7 | 0.4 | 0.4 | 4 | 0.5 |
|  |  | 5 |  | \*\* |  |  |  | \*\* |  |  | \*\* | 5 | 6 |  |  | 2 | 44 |  | 7 | 4 |  | 4 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | \*\* |  | \*\* | \*\* |  | \*\* |
| Leafarea | - | - | 0.4 | 0.5 | 0.3 | 0.3 | 0.9 | 0.7 |  | - | - | 0.6 | 0.1 | 0.1 | - | 0.0 | 0.1 | - | - | 0.0 | - | - | 0.0 |
|  | 0.1 | 0.3 | 2 \* | 4 | 7 \* | 7 \* | 0 | 4 | 0.14 | 0.11 | 9 | 7 | 7 | 0.0 | 4 | 7 | 0.0 | 0.0 | 6 | 0.1 | 0.1 | 0 |
|  | 0 | 8 \* |  | \*\* |  |  | \*\* | \*\* |  |  | \*\* |  |  | 2 |  |  | 5 | 9 |  | 1 | 5 |  |
| Chloroph | - | - | 0.0 | - | - | - | - | - | - |  | 0.90 | - | 0.2 | 0.1 | - | 0.0 | 0.1 | - | 0.3 | - | 0.1 | 0.3 | - |
| yllcontent | 0.1 | 0.1 | 1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | \*\* | 0.0 | 2 | 3 | 0.2 | 4 | 5 | 0.0 | 6\* | 0.2 | 2 | 8\* | 0.1 |
|  | 0 | 6 |  | 3 | 1 | 3 | 4 | 3 | 1 |  | 5 |  |  | 5 |  |  | 2 |  | 1 |  |  | 0 |
| Chloroph | - | - | - | - | 0.0 | 0.0 | - | 0.1 | - | 0.89 |  | - | 0.1 | 0.1 | - | 0.0 | 0.1 | - | 0.2 | - | 0.0 | 0.3 | - |
| yll | 0.0 | 0.2 | 0.0 | 0.1 | 6 | 6 | 0.1 | 7 | 0.0 | \*\* | 0.0 | 9 | 5 | 0.0 | 5 | 7 | 0.1 | 6 | 0.2 | 2 | 1 | 0.1 |
| stability | 5 | 2 | 7 | 4 |  |  | 9 |  | 5 |  | 9 |  |  | 4 |  |  | 6 |  | 8 |  |  | 6 |
| index |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Panicle | - | - | 0.6 | 0.0 | 0.2 | 0.4 | 0.6 | 0.2 | 0.5 | - | - |  | 0.1 | 0.1 | 0.0 | 0.5 | 0.2 | 0.6 | 0.2 | 0.4 | 0.6 | 0.1 | 0.5 |
| length | 0.2 | 0.1 | 7 | 9 | 6 | 2 \* | 0 | 6 | 6 | 0.05 | 0.11 | 5 | 5 | 1 | 1\* | 4 | 3\* | 3 | 5\* | 2\* | 4 | 3\* |
|  | 8 | 4 | \*\* |  |  |  | \*\* |  | \*\* |  |  |  |  |  | \* |  | \* |  | \* | \* |  | \* |
| Spikelets/ | - | - | - | - | 0.6 | 0.4 | 0.2 | - | 0.1 | 0.25 | 0.23 | 0.1 |  | 0.9 | 0.2 | 0.1 | 1.0 | 0.2 | 0.0 | 0.2 | 0.3 | - | 0.4 |
| panicle | 0.2 | 0.1 | 0.0 | 0.0 | 6 | 9 | 6 | 0.1 | 3 |  |  | 4 | 7 | 5 | 8 | 0\* | 4 | 1 | 1 | 2 | 0.2 | 2\* |
|  | 2 | 4 | 1 | 5 | \*\* | \*\* |  | 1 |  |  |  |  | \*\* |  |  | \* |  |  |  |  | 2 |  |
| Filled | - | - | - | 0.0 | 0.7 | 0.5 | 0.2 | - | 0.1 | 0.16 | 0.18 | 0.1 | 0.9 |  | 0.4 | 0.1 | 0.9 | 0.1 | 0.0 | 0.1 | 0.2 | - | 0.3 |
| grains/pan | 0.0 | 0.0 | 0.1 | 5 | 5 | 9 | 3 | 0.0 | 4 |  |  | 3 | 7 | 7 | 5 | 8 | 8 | 0 | 5 | 6 | 0.2 | 6\* |
| icle | 8 | 9 | 0 |  | \*\* | \*\* |  | 5 |  |  |  |  | \*\* | \*\* |  | \*\* |  |  |  |  | 1 |  |
| Spikelet | 0.4 | 0.1 | - | 0.3 | 0.5 | 0.5 | - | 0.1 | 0.0 | - | - | - | 0.2 | 0.4 |  | 0.0 | 0.3 | - | 0.0 | - | - | 0.0 | - |
| fertility | 4 | 1 | 0.3 | 1 | 2 | 1 | 0.1 | 4 | 0 | 0.29 | 0.07 | 0.0 | 4 | 7 | 1 | 0 | 0.1 | 1 | 0.2 | 0.1 | 1 | 0.1 |
|  | \*\* |  | 9 \* |  | \*\* | \*\* | 1 |  |  |  |  | 3 |  | \*\* |  |  | 7 |  | 1 | 4 |  | 3 |
| 1000- | - | 0.0 | - | 0.1 | 0.1 | 0.2 | - | 0.1 | 0.0 | 0.06 | 0.05 | 0.4 | 0.1 | 0.1 | 0.0 |  | 0.2 | 0.5 | 0.8 | - | 0.5 | 0.6 | 0.1 |
| grain | 0.1 | 1 | 0.0 | 1 | 8 | 6 | 0.0 | 1 | 4 |  |  | 9 | 9 | 7 | 5 | 5 | 0 | 3 | 0.0 | 4 | 7 | 3 |
| weight | 0 |  | 3 |  |  |  | 1 |  |  |  |  | \*\* |  |  |  |  | \*\* | \*\* | 8 | \*\* | \*\* |  |
| Grain | - | - | 0.0 | - | 0.7 | 0.5 | 0.2 | - | 0.1 | 0.20 | 0.21 | 0.2 | 0.9 | 0.9 | 0.3 | 0.2 |  | 0.3 | 0.0 | 0.3 | 0.4 | - | 0.5 |
| yield | 0.1 | 0.0 | 4 | 0.0 | 3 | 9 | 4 | 0.0 | 4 |  |  | 1 | 6 | 6 | 6 \* | 6 | 5\* | 1 | 0 | 3\* | 0.2 | 2\* |
|  | 8 | 8 |  | 7 | \*\* | \*\* |  | 6 |  |  |  |  | \*\* | \*\* |  |  |  |  |  | \* | 0 | \* |
| Grain | - | 0.3 | 0.6 | - | 0.1 | 0.2 | 0.0 | - | - | - | - | 0.6 | 0.2 | 0.1 | - | 0.4 | 0.2 |  | 0.1 | 0.7 | 0.9 | 0.1 | 0.8 |
| length | 0.3 | 3 | 1 | 0.5 | 4 | 8 | 9 | 0.3 | 0.0 | 0.02 | 0.16 | 0 | 1 | 5 | 0.1 | 5 | 7 | 8 | 8\* | 9\* | 3 | 6\* |
|  | 4 \* |  | \*\* | 2 |  |  |  | 0 | 7 |  |  | \*\* |  |  | 7 | \*\* |  |  | \* | \* |  | \* |
|  |  |  |  | \*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Grain | 0.1 | - | - | 0.2 | - | - | - | 0.0 | - | 0.33 | 0.27 | 0.2 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.1 |  | - | 0.2 | 1.0 | - |
| breadth | 4 | 0.1 | 0.3 | 8 | 0.0 | 0.0 | 0.1 | 9 | 0.0 |  |  | 0 | 0 | 1 | 5 | 0 | 4 | 4 | 0.4 | 3 | 4 | 0.3 |
|  |  | 7 | 1 |  | 9 | 1 | 7 |  | 8 |  |  |  |  |  |  | \*\* |  |  | 7 |  | \*\* | 5\* |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | \*\* |  |  |  |
| Grain | - | 0.3 | 0.7 | - | 0.1 | 0.2 | 0.2 | - | 0.0 | - | - | 0.3 | 0.1 | 0.1 | - | - | 0.1 | 0.7 | - |  | 0.7 | - | 1.0 |
| shape | 0.4 | 4 \* | 5 | 0.6 | 6 | 3 | 3 | 0.3 | 3 | 0.19 | 0.27 | 9 \* | 8 | 2 | 0.2 | 0.0 | 9 | 4 | 0.5 | 4 | 0. | 0 |
| (L/B | 2 \* |  | \*\* | 3 |  |  |  | 0 |  |  |  |  |  |  | 3 | 7 |  | \*\* | 4 | \*\* | 56 | \*\* |
| ratio) |  |  |  | \*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  | \*\* |  | \*\* |  |
| Kernel | - | 0.2 | 0.5 | - | 0.1 | 0.2 | 0.0 | - | - | 0.08 | - | 0.5 | 0.2 | 0.2 | - | 0.5 | 0.3 | 0.9 | 0.1 | 0.6 |  | 0.1 | 0.8 |
| length | 0.3 | 6 | 4 | 0.5 | 4 | 8 | 3 | 0.2 | 0.0 |  | 0.01 | 8 | 8 | 3 | 0.1 | 0 | 4 \* | 4 | 6 | 9 | 4 | 6\* |
|  | 0 |  | \*\* | 6\* |  |  |  | 2 | 8 |  |  | \*\* |  |  | 3 | \*\* |  | \*\* |  | \*\* |  | \* |
|  |  |  |  | \* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Kernel | 0.2 | - | - | 0.2 | - | - | - | 0.0 | - | 0.30 | 0.25 | 0.1 | - | - | 0.0 | 0.6 | - | 0.1 | 0.8 | - | 0.1 |  | - |
| breadth | 1 | 0.1 | 0.2 | 3 | 0.1 | 0.0 | 0.2 | 5 | 0.1 |  |  | 7 | 0.1 | 0.1 | 1 | 2 | 0.1 | 0 | 3 | 0.4 | 1 | 0.4 |
|  |  | 8 | 8 |  | 8 | 5 | 2 |  | 2 |  |  |  | 8 | 7 |  | \*\* | 6 |  | \*\* | 6 |  | 0\* |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | \*\* |  |  |
| Kernel | - | 0.3 | 0.6 | - | 0.2 | 0.2 | 0.1 | - | 0.0 | - | - | 0.4 | 0.3 | 0.3 | - | 0.1 | 0.3 | 0.7 | - | 0.8 | 0.8 | - |  |
| shape(L/B  ratio) | 0.3  4 \* | 5 \* | 4  \*\* | 0.6  1 | 3 | 8 | 6 | 0.2  1 | 1 | 0.08 | 0.15 | 2  \*\* | 5 \* | 0 | 0.1  0 | 0 | 9 \* | 8  \*\* | 0.3  2 | 7  \*\* | 2  \*\* | 0.4  7 |
|  |  |  |  | \*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | \*\* |

\*, \*\* Significant at P = 0.05 and 0.01 levels, respectively

**Genetic erosion and variation:**

The present study very clearly revealed the loss of rice landraces from the farmers’ fields proving the apprehension of genetic erosion correct. The analysis of variance revealed existence of significant variation among the varieties for most of the characters except few. In the study, almost all the farmers’ varieties were very early maturing with relatively good early vigour and similar plant stature indicating to the farmers’ deliberate choice of varieties with specific combination of characters to suit the direct seeded upland rice ecosystem.

### ****Genetic Analysis****

The analysis of variance revealed significant genetic variation among the studied rice varieties for most traits, with few exceptions. This genetic variability is essential for effective selection and breeding progress, as it provides the foundation for crop improvement (Tester & Langridge, 2023).

The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) values were generally low across traits, indicating limited variability in the population. However, chlorophyll stability index showed the highest GCV and PCV, followed by grain yield, suggesting strong genetic control of these traits. Moderate variability was observed for plant height, tiller density, leaf length, panicle length, 1000-grain weight, chlorophyll content, kernel length and kernel shape. These findings align with recent studies demonstrating similar patterns of trait variation in traditional rice landraces (Singh et al., 2023; Wang et al., 2022).

High heritability estimates were recorded for days to 50% flowering, plant height, spikelet number per panicle, filled grains per panicle and 1000-grain weight, indicating these traits are predominantly controlled by additive gene effects. As demonstrated by recent genomic studies, such traits with high heritability are particularly responsive to selection (Varshney et al., 2021). The combination of high heritability with substantial genetic advance for grain yield and chlorophyll stability index suggests strong potential for genetic improvement through phenotypic selection, consistent with findings in modern rice breeding programs (Yu et al., 2023).

**Association Studies**

Correlation analysis provides critical information for developing effective breeding strategies by identifying suitable selection criteria for trait improvement. In the present study, we computed both genotypic and phenotypic correlation coefficients for all trait combinations.

Grain yield exhibited highly significant positive correlations (p<0.01) with tiller density (number of tillers per m²), panicle density (number of panicles per m²), spikelet number per panicle, and filled grain number per panicle at both genotypic and phenotypic levels. These findings align with recent genome-wide association studies demonstrating that yield components collectively contribute to final grain yield in rice (Li et al., 2022). The strong association between tiller density and grain yield corroborates earlier findings (Chitra et al., 2005), with modern research attributing this relationship to conserved genetic pathways regulating tillering and panicle development (Wang et al., 2023).

A significant negative correlation (p<0.05) was observed between days to 50% flowering and spikelet fertility at both genotypic and phenotypic levels. This inverse relationship, previously reported by Das and Borthakur (1973), may reflect resource allocation trade-offs between vegetative growth and reproductive success, as demonstrated in recent phenomic studies (Zhang et al., 2023).

The 1000-grain weight showed significant positive correlations (p<0.01) with:

1. Grain dimensions (length and width)
2. Kernel morphology (length and width)

These results support the findings of De and Rao (1988) and are consistent with current understanding of grain size regulation by conserved genetic networks (Huang et al., 2022). Notably, kernel length maintained a strong positive genotypic correlation with kernel shape (length-to-width ratio), confirming earlier observations by Nayak et al. (2003) and recent QTL analyses identifying pleiotropic loci controlling both traits (Chen et al., 2023).

**CONCLUSION:**

The study documented the loss of several traditional rice landraces from farmers' fields, underscoring the ongoing threat of genetic erosion in the region. Analysis of variance indicated significant morphological and physiological variability among the evaluated genotypes for most traits, except radicle length, leaf area index, photosynthesis, and stomatal conductance. Notably, the newly introduced variety Kolong exhibited superior performance, recording the highest grain yield along with the maximum number of filled grains per panicle and spikelets per panicle. Kolong also produced the longest and most slender kernels, whereas Amrow displayed the shortest kernels, statistically comparable to Rongkhang. Genetic parameter estimates revealed high genotypic and phenotypic coefficients of variation, along with significant genetic advance, for chlorophyll stability index, while days to 50% flowering exhibited high heritability. Grain yield demonstrated a significantly positive correlation with key yield-related traits—number of tillers per m², panicles per m², spikelets per panicle, filled grains per panicle, and spikelet fertility—at both genotypic and phenotypic levels, with these traits also showing strong interrelationships.

Given its preliminary nature, this study was limited to two villages and serves as the foundational step toward a more comprehensive investigation into genetic erosion and the systematic evaluation of Assam’s rice genetic resources. To achieve a deeper understanding of genetic erosion and its bio-cultural implications, future research should expand to a broader geographical area, incorporating diverse ethno-cultural groups for a more representative assessment.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

The author(s) hereby explicitly declare that no generative artificial intelligence (AI) tools—including but not limited to large language models (e.g., ChatGPT, Copilot) and text-to-image generators—were utilized at any stage in the drafting, writing, or editing of this manuscript. All content presented is the original work of the human author(s), with no AI-assisted text generation or modification.

**AUTHORS’ CONTRIBUTIONS**

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

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