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# Genetic variability analysis for yield and grain quality characters in slender grain rice (*Oryza sativa* L.)

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**Abstract**
Twenty-nine rice genotypes along with three checks were evaluated with an objective to determine the nature and magnitude of genetic variability for yield and grain quality characters. A study of the analysis of variance showed the presence of a high degree of genetic variability among the genotypes. Phenotypic coefficient of variance and Genotypic coefficient of variance were high for number of filled grains/panicle (23.99, 23.32) and moderate for flag leaf area (19.40, 18.21), grain yield (18.75, 17.82), 100-grain weight (13.47, 13.40), plant height (11.68, 11.21) and number of effective tillers/plant (13.98, 9.73). High heritability along with high genetic advance percentage over mean was observed for no. of filled grains per panicle, flag-leaf area, grain-yield, and 100-grain weight. Most of the genotypes had long-slender grain type with kernel-length ≥6 mm, L/B Ratio ≥3.0, and showed an intermediate range of amylose content, gelatinization temperature, and medium to soft gel consistency.

**Keywords:** additive gene action, amylose content, gel consistency, gelatinization temperature, grain quality characters, slender-grain

## Introduction
Rice is one of the major food grain crops in the world, particularly in Asian countries. The current rate of population growth of India (annually 1.09%) would set an annual requirement of rice of about 496 million tons by 2020 and 555 million tons by 2035. There is possibly little hope to allocate additional land for growing rice as the total cultivable area is diminishing day by day due to increased requirements for basic infrastructure like housing, roads; industry, etc. The yield breakthrough achieved through the introduction of semi-dwarf high-yielding rice varieties during the green revolution in the 1960s has now plateaued particularly in high productivity areas. Therefore, the task of increasing rice production to meet the anticipated demand is quite challenging.

Traditionally, rice plant breeders mostly concentrated on breeding for high yield. In recent decades as the purchasing power of people has increased, demand for high-quality rice is continuously on the rise. Quality rice is not only in big demand for domestic consumption, but also have great export potential and can earn a lot of foreign exchange for the country. The milling percentage, hulling percentage, grain dimensions, and various cooking qualities such as gelatinization temperature, gel consistency, and amylose-content constitute the quality traits in rice. Grain length (L), breadth (B), and L/B ratio determine the shape of the grain or more popularly called grain type. The gelatinization temperature, gel consistency, and amylose-content are the major rice traits that are directly related to cooking and eating quality. The gel consistency is responsible for softness and amylose-content is responsible for texture and appearance in rice (Hossein Sabouri, 2009) [9]. Like grain yield, quality is also not easily amenable to selection due to its complex nature. Therefore, efforts to enhance rice productivity with keeping grain quality must receive top priority (Dhurai *et al*., 2014) [3]. Keeping in view of the above perspectives the present experiment was carried out to estimate the genetic variability parameters for various yield attributing traits and quality traits in rice.

## Materials and Methods
The present experiment was carried out using 32 genotypes (including 3 check varieties) from the experimental materials of SYT (Slender Grain) at EB-1, Rice Research Station, O.U.A.T., Bhubaneswar during the 2016 Kharif season. The experimental materials were put in a Randomized Block Design with two replications. Observations were recorded for nine different yield-attributing metric traits as well as nine important grain quality traits.

The analysis of variance (ANOVA) was carried out separately for each trait following the procedures of randomized block design analysis (Panse and Shukhatme, 1954). The genotypic coefficient of variation (GCV) and the phenotypic coefficient of variation (PCV) were calculated by using the formula given by Burton (1952). Heritability ($h^2$) estimate was worked out by using the formula suggested by Lush (1949) and Burton and DE Vane (1953). The genetic advance was estimated as per the formula suggested by Johnson, Robinson, and Comstock (1955).

Grain dimensions (length and width of rice grains) were measured with the help of a photographic enlarger. The thickness was measured using a screw gauge (Sidhu *et al*., 1975). The grain shape was determined by grain length and grain width ratio (Sidhu *et al*., 1975) and has been classified into different categories as per the recommendation of Jennings *et al*., (1979). Amylose content in milled rice samples was determined as suggested by Soubhagya and Bhattacharya (1971). Alkali digestion score of the samples was rated visually on a scale of one to seven as described by Little *et al*., (1958). The length of the gel was measured from the bottom of the test tube to the gel front thirty minutes later (Cagampang *et al*).

**Results and Discussion**

From the analysis of variance, it was observed that there exist high significant differences among the test genotypes for all the morphological characters under study. The mean sum of squares due to genotypes was significant for all the characters, indicating ample scope for the selection of different quantitative characters for rice improvement. The estimates of mean, range, PCV, GCV, heritability, and genetic advance as revealed in Table 3 indicated the existence of a considerable amount of variability among the genotypes for all the characters studied.

The genotypic and phenotypic coefficient of variation in different characters maintained a correspondence for all the characters under study. In general, the phenotypic coefficient of variation was higher than the genotypic coefficient of variation suggesting the influence of environment on the expression of these characters. Similar observations have also been noted by Umarani *et al*. (2017) [13], Rashid *et al*. (2017) [8], and Parihar *et al*. (2017) [7]. Among all the characters studied, GCV ranged from 6.06 for days to 50% flowering to 23.32 for no. of filled grains/panicle and PCV ranged from 6.12 for days to 50% flowering to 23.99 for no. of filled grains/panicle. High PCV & GCV was observed for number of filled grains/panicle (23.99, 23.32) and moderate for flag leaf area (19.40, 18.21), grain yield (18.75, 17.82), 100-grain weight (13.47, 13.40), plant height (11.68, 11.21) and number of effective tillers/plant (13.98, 9.73).

The mean performance of various genotypes concerning various characters is shown in table 4. The observed range for no. of effective tillers/plants was from 7.50 to 13.00 with the highest being in OR 2676-2-3 and lowest in OR 2675-1-2. The overall mean of all the genotypes for no. of effective tillers/plants was 9.69. The overall mean of all the genotypes for panicle length was 26.03 cm and the range varied from 18.10 cm to 30.10 cm. The genotype Samba mahsuri was having the lowest panicle length and genotype OR 2676-2-6 was having the highest panicle length. The observed range for no. of filled grains/panicle was 96.15-303.00 and the overall mean was 187.85. The highest and lowest values for no. of filled grains/panicle were observed in genotypes OR 2659-5 and OR 2674-14-1 respectively. The overall mean of fertility% was 77.24% and the range was highest in OR 2674-13 i.e 88.25% and 56.60% in OR 2676-3-2 which was the lowest. The overall mean of 100-grain weight of all the genotypes was 1.99g and the range was from 1.39g to 2.53g in Samba mahsuri and OR 2675-2-3 respectively. The plot yield varied from 21.24 q/ha in OR 2674-14-1 to 51.22 q/ha in OR2676-2-3 with an overall mean of 37.37 q/ha.

In the present study, all the characters showed high heritability except no. of effective tillers/plant which showed moderate heritability. The genetic advance in percentage of mean was high for no. of filled grains/panicle (39.90), grain yield (29.82), flag leaf area (30.09), 100-grain weight (23.48), and moderate to low for all other characters. A high degree of heritability estimates was associated with a high degree of genetic advance for filled grains per panicle, flag leaf area, grain yield, 100-grain weight indicating the presence of additive gene effect and hence selection based on phenotypic performance would be effective. Similar results were obtained by Lakshmi *et al*. (2017) [6], Venkatesan *et al*. (2017) [14], Abebe *et al*. (2017) [1], Iqbal *et al*. (2018) [5].

Grain yield showed moderate PCV & GCV, high heritability, and genetic advance indicating that it is a simply inherited trait possessing additive gene effects, and selection based on phenotype will be effective. Filled grains/panicle showed high PCV, GCV, heritability, and genetic advance indicating that it is a simply inherited trait possessing additive gene effects and selection based on phenotype will be effective.

The range of variability for the grain physical characters of 32 test genotypes was kernel length 4.96 mm to 6.57 mm, kernel width 1.44 mm to 1.96 mm, kernel L/B ratio 2.6 to 4.35. Similar results were obtained by Chukwuemeka *et al*. (2015) [2], Gangadharaiah *et al*. (2016) [4], Tamu *et al*. (2017) [12]. Most of the genotypes were long-slender grain types with kernel length ≥6 mm and L/B Ratio ≥3.0. The range of variability for HRR, milling%, hulling% was from 36% to 63%, 60% to 69%, and 73% to 79% respectively. Similar observations were recorded by M K Singh *et al*. (2017) [11], R S Sandhu *et al*. (2018) [10]. The highest values for grain physical characters observed among the 32 test genotypes were as follows: 6.57 mm kernel length in OR2675-2-1, 1.96 mm kernel breadth in Ranidhan, 4.35 L/B ratio in OR2675-2-5, 63% HRR in OR2674-13, 69% milling% in OR2675-3-2, 79% hulling% in OR2675-3-2.

The overall mean for amylose content was 21.31%. Most of the genotypes had intermediate amylose content ranging from 19.27% to 24.1%. It indicated that most of the genotypes would cook dry and fluffy and will have moderate to high volume expansion upon cooking. Most of the genotypes had intermediate alkali spreading the value of 3 or 4, which corresponds to an intermediate gelatinization temperature of (70-74 ºC). It indicated that rice would cook at a moderate pace and would take less to moderate time to cook. The overall mean gel length was 56.25 mm with the range varying from 47 mm to 63 mm corresponding to medium to soft gel consistency. It indicated that rice would cook soft initially and would take more time to get hardened. The highest values among the 32 test genotypes for amylose content (24.1%) and gel consistency (63 mm) was observed in Samba mahsuri.

Overall the experimental materials showed a high degree of variability among them for all the morphological characters under study. Almost all the characters showed high heritability and a high degree of genetic advance was also observed for filled grains per panicle, grain yield, 100-grain weight indicating the presence of additive gene effect and hence selection based on phenotypic performance would be

effective. Based on the yield of the genotypes OR2676-2-3, OR2675-6-7, Ranidhan, OR2659-7, OR2676-2-6 were found promising and they also showed appreciable, if not best, grain quality characters.

**Table 1:** Details of 32 slender grain rice genotypes used in the study.

| Sl. No. | Genotype Designation | Cross Combination |
|---|---|---|
| 1 | OR2659-5 | IR 72 / Martha fine |
| 2 | OR2659-7 | IR 72 / Martha fine |
| 3 | OR2674-13 | CRMS 32A / OR 1889-5 |
| 4 | OR2674-14-1 | CRMS 32A / OR 1889-5 |
| 5 | OR2675-1-1 | CRMS 32A / OR2324-18 |
| 6 | OR2675-1-2 | CRMS 32A / OR2324-18 |
| 7 | OR2675-2-1 | CRMS 32A / OR2324-18 |
| 8 | OR2675-2-2 | CRMS 32A / OR2324-18 |
| 9 | OR2675-2-3 | CRMS 32A / OR2324-18 |
| 10 | OR2675-2-4 | CRMS 32A / OR2324-18 |
| 11 | OR2675-2-5 | CRMS 32A / OR2324-18 |
| 12 | OR2675-2-6 | CRMS 32A / OR2324-18 |
| 13 | OR2675-3-1 | CRMS 32A / OR2324-18 |
| 14 | OR2675-3-2 | CRMS 32A / OR2324-18 |
| 15 | OR2675-4-1 | CRMS 32A / OR2324-18 |
| 16 | OR2675-5-1 | CRMS 32A / OR2324-18 |
| 17 | OR2675-5-2 | CRMS 32A / OR2324-18 |
| 18 | OR2675-6-4 | CRMS 32A / OR2324-18 |
| 19 | OR2675-6-7 | CRMS 32A / OR2324-18 |
| 20 | OR2676-1-1 | CRMS 32A / OR 234519 |
| 21 | OR2676-1-2 | CRMS 32A / OR 2345-19 |
| 22 | OR2676-1-4 | CRMS 32A / OR 2345-19 |
| 23 | OR2676-2-3 | CRMS 32A / OR 2345-19 |
| 24 | OR2676-2-4 | CRMS 32A / OR 2345-19 |
| 25 | OR2676-2-5 | CRMS 32A / OR 2345-19 |
| 26 | OR2676-2-6 | CRMS 32A / OR 2345-19 |
| 27 | OR2676-3-1 | CRMS 32A / OR 2345-19 |
| 28 | OR2676-3-2 | CRMS 32A / OR 2345-19 |
| 29 | OR2676-4-2 | CRMS 32A / OR 2345-19 |
| 30 | Ranidhan | Swarna / ORR 48-1 |
| 31 | Samba mahsuri | GEB 24 / T(N) 1 |
| 32 | Jajati | Rajeswari / T 141 |

**Table 2:** Analysis of variance for various characters (mean sum of squares) for 32 slender grain rice genotypes

| Sl. No | Characters | Mean sum of squares (df) | | |
|---|---|---|---|---|
| | | Replication (1) | Genotype (31) | Error (31) |
| 1. | Days to 50% flowering | 0.156 | 60.657** | 1.301 |
| 2. | Plant height (cm) | 70.125 | 364.956** | 28.722 |
| 3. | No of Effective tillers/plant | 28.891 | 3.669* | 1.891 |
| 4. | Flag leaf area (cm²) | 0.047 | 165.745** | 19.659 |
| 5. | Panicle length (cm) | 2.703 | 11.172** | 0.809 |
| 6. | No. of filled grains/panicle | 296.750 | 4061.363** | 223.468 |
| 7. | Fertility% | 7.000 | 88.442** | 21.487 |
| 8. | 100 grains weight(g) | 0.003 | 0.144** | 0.001 |
| 9. | Grain yield (q/ha) | 58.828 | 98.180** | 4.554 |

**Table 3:** PCV, GCV, $h^2_{(b.s)}$, GA, mean and range estimates for various characters for 32 slender grain rice genotypes

| Sl. no. | Characters | PCV | GCV | $h^2_{(b.s)}$ | GA (10%) | GA% over mean | Mean | Range |
|---|---|---|---|---|---|---|---|---|
| 1. | Days to 50% flowering | 6.12 | 6.06 | 97.85 | 9.48 | 10.54 | 89.95 | 76.00-101.00 |
| 2. | Plant height (cm) | 11.68 | 11.21 | 92.13 | 21.90 | 18.94 | 115.67 | 76.00-135.00 |
| 3. | No. of Effective tillers/plant | 13.98 | 9.73 | 48.48 | 1.16 | 11.93 | 9.69 | 7.50-13.00 |
| 4. | Flag leaf area (cm²) | 19.40 | 18.21 | 88.14 | 14.12 | 30.09 | 46.93 | 25.40-59.40 |
| 5. | Panicle length (cm) | 9.08 | 8.75 | 92.76 | 3.86 | 14.82 | 26.03 | 18.10-30.10 |
| 6. | No. of filled grains/panicle | 23.99 | 23.32 | 94.50 | 74.95 | 39.90 | 187.85 | 96.15-303.00 |
| 7. | Fertility% | 8.61 | 7.49 | 75.70 | 8.86 | 11.47 | 77.24 | 56.60-88.25 |
| 8. | 100 grains weight (g) | 13.47 | 13.40 | 99.07 | 0.47 | 23.48 | 1.99 | 1.39-2.53 |
| 9. | Grain yield (q/ha) | 18.75 | 17.82 | 90.37 | 11.14 | 29.82 | 37.37 | 21.24-51.22 |

{PCV-Phenotypic coefficient of variance, GCV-Genotypic coefficient of variance, $h^2_{(b.s)}$-Heritability (broad sense), GA- Genetic advance

**Table 4:** Mean performance of various genotypes concerning various characters for 32 slender grain rice genotypes

| Sl. No | Designation | Days to 50% flowering | Plant height (cm) | No. of effective Tillers/plant | Flag leaf Area (cm²) | Panicle length (cm) | No. of Filled grains/ panicle | Fertility% | 100 grains Weight(g) | Grain Yield (q/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | OR2659-5 | 86.00 | 111.00 | 9.00 | 50.80 | 28.50 | 303.00 | 77.80 | 1.51 | 40.85 |
| 2. | OR2659-7 | 86.00 | 110.00 | 11.00 | 48.95 | 25.95 | 255.50 | 78.70 | 1.85 | 47.39 |
| 3. | OR2674-13 | 88.50 | 100.00 | 10.50 | 40.85 | 25.55 | 239.65 | 88.25 | 1.73 | 44.11 |
| 4. | OR2674-14-1 | 76.00 | 110.00 | 8.50 | 45.00 | 25.75 | 96.15 | 73.30 | 2.15 | 21.24 |
| 5. | OR2675-1-1 | 87.50 | 126.50 | 8.00 | 44.85 | 24.40 | 161.15 | 76.30 | 2.03 | 29.42 |
| 6. | OR2675-1-2 | 85.50 | 135.00 | 7.50 | 36.80 | 23.90 | 168.50 | 71.20 | 1.78 | 29.41 |
| 7. | OR2675-2-1 | 86.00 | 111.00 | 8.50 | 44.55 | 26.60 | 156.65 | 79.45 | 2.49 | 34.32 |
| 8. | OR2675-2-2 | 85.00 | 107.00 | 8.50 | 50.25 | 25.65 | 153.15 | 76.70 | 2.14 | 31.05 |
| 9. | OR2675-2-3 | 86.00 | 110.00 | 8.50 | 45.25 | 25.40 | 146.00 | 77.05 | 2.53 | 29.41 |
| 10. | OR2675-2-4 | 86.00 | 110.00 | 9.00 | 41.75 | 26.15 | 143.15 | 76.70 | 2.01 | 32.54 |
| 11. | OR2675-2-5 | 86.00 | 119.00 | 9.50 | 56.35 | 26.85 | 163.15 | 75.20 | 2.11 | 34.31 |
| 12. | OR2675-2-6 | 85.00 | 112.50 | 8.50 | 49.85 | 25.00 | 121.10 | 75.80 | 2.46 | 29.41 |
| 13. | OR2675-3-1 | 89.00 | 131.50 | 10.00 | 42.60 | 24.60 | 202.50 | 77.70 | 1.93 | 39.22 |
| 14. | OR2675-3-2 | 90.50 | 129.00 | 8.00 | 36.70 | 24.15 | 214.45 | 82.55 | 1.96 | 35.95 |
| 15. | OR2675-4-1 | 90.00 | 132.00 | 9.00 | 37.90 | 23.50 | 216.15 | 82.00 | 1.94 | 39.22 |
| 16. | OR2675-5-1 | 86.00 | 129.00 | 9.00 | 33.60 | 26.25 | 236.00 | 74.80 | 1.70 | 39.67 |
| 17. | OR2675-5-2 | 85.50 | 127.50 | 10.00 | 37.45 | 26.25 | 201.70 | 81.35 | 2.07 | 40.66 |
| 18. | OR2675-6-4 | 95.00 | 113.50 | 9.50 | 53.45 | 28.50 | 167.00 | 76.70 | 1.97 | 38.08 |
| 19. | OR2675-6-7 | 87.00 | 115.50 | 12.00 | 51.55 | 26.05 | 256.65 | 85.45 | 2.33 | 49.02 |
| 20. | OR2676-1-1 | 94.00 | 122.00 | 11.00 | 52.45 | 26.20 | 214.65 | 87.00 | 1.85 | 44.12 |
| 21. | OR2676-1-2 | 94.00 | 128.00 | 11.00 | 59.10 | 28.60 | 190.50 | 82.80 | 1.81 | 40.85 |
| 22. | OR2676-1-4 | 95.00 | 120.00 | 10.50 | 59.00 | 28.55 | 216.80 | 82.35 | 1.93 | 42.49 |
| 23. | OR2676-2-3 | 96.00 | 106.50 | 13.00 | 50.70 | 27.45 | 252.80 | 87.65 | 2.03 | 51.22 |
| 24. | OR2676-2-4 | 90.00 | 122.50 | 8.50 | 51.55 | 25.30 | 151.30 | 87.05 | 2.34 | 34.31 |
| 25. | OR2676-2-5 | 96.00 | 116.00 | 10.50 | 57.65 | 28.60 | 173.30 | 79.50 | 1.98 | 40.85 |
| 26. | OR2676-2-6 | 95.00 | 118.00 | 11.50 | 57.10 | 30.10 | 194.10 | 77.40 | 2.10 | 42.76 |
| 27. | OR2676-3-1 | 99.00 | 125.00 | 9.50 | 59.40 | 28.90 | 183.00 | 64.10 | 1.88 | 34.32 |
| 28. | OR2676-3-2 | 98.00 | 118.00 | 9.50 | 58.90 | 26.45 | 182.65 | 56.60 | 1.80 | 35.95 |
| 29 | OR2676-4-2 | 92.00 | 112.00 | 11.00 | 53.20 | 29.25 | 161.30 | 72.80 | 2.13 | 40.85 |
| 30. | Ranidhan | 97.00 | 76.00 | 12.00 | 25.40 | 22.50 | 199.30 | 81.10 | 2.24 | 45.75 |
| 31. | Samba mahsuri | 101.00 | 76.00 | 8.50 | 30.80 | 18.10 | 127.45 | 72.80 | 1.39 | 24.51 |
| 32. | Jajati | 85.00 | 121.50 | 9.00 | 37.85 | 25.95 | 162.60 | 73.20 | 1.59 | 32.68 |
| Grand mean | | 89.95 | 115.67 | 9.69 | 46.93 | 26.03 | 187.85 | 77.24 | 1.99 | 37.37 |
| CD | | 2.32 | 10.92 | 2.80 | 9.04 | 1.83 | 30.47 | 9.45 | 0.07 | 6.27 |

**Table 5:** Variability for Grain quality characters in 32 slender grain rice genotypes

| Sl. No | Genotypes | Kernel Length (mm) | Kernel Breadth (mm) | L/B Ratio | Grain Type | Head Rice Recovery% | Milling% | Hulling% | Amylose Content% | Alkali Spreading Value | Gel Consistency (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | OR2659-5 | 5.26 | 1.63 | 3.22 | SS | 50 | 67 | 76 | 23.1 | 3 | 49 |
| 2 | OR2659-7 | 5.3 | 1.69 | 3.13 | SS | 52 | 67 | 78 | 22.65 | 4 | 50 |
| 3 | OR2674-13 | 5.41 | 1.65 | 3.27 | SS | 63 | 68 | 78 | 21.22 | 3 | 55 |
| 4 | OR2674-14-1 | 6.28 | 1.52 | 4.13 | LS | 48 | 68 | 78 | 22.5 | 3 | 51 |
| 5 | OR2675-1-1 | 6.4 | 1.73 | 3.69 | LS | 55 | 67 | 75 | 23.02 | 4 | 47 |
| 6 | OR2675-1-2 | 6.49 | 1.69 | 3.84 | LS | 55 | 67 | 78 | 19.57 | 4 | 59 |
| 7 | OR2675-2-1 | 6.57 | 1.6 | 4.1 | LS | 46 | 64 | 74 | 21.67 | 7 | 53 |
| 8 | OR2675-2-2 | 6.48 | 1.6 | 4.05 | LS | 47 | 62 | 74 | 21.82 | 7 | 54 |
| 9 | OR2675-2-3 | 6.27 | 1.5 | 4.18 | LS | 45 | 66 | 75 | 22.12 | 4 | 50 |
| 10 | OR2675-2-4 | 6.48 | 1.61 | 4.02 | LS | 45 | 65 | 75 | 21.67 | 7 | 52 |
| 11 | OR2675-2-5 | 6.53 | 1.5 | 4.35 | LS | 50 | 65 | 75 | 22.2 | 7 | 55 |
| 12 | OR2675-2-6 | 6.57 | 1.6 | 4.1 | LS | 48 | 66 | 75 | 21.67 | 4 | 57 |
| 13 | OR2675-3-1 | 6.29 | 1.61 | 3.9 | LS | 44 | 66 | 76 | 19.5 | 3 | 60 |
| 14 | OR2675-3-2 | 6.52 | 1.85 | 3.52 | LS | 48 | 69 | 79 | 20.3 | 3 | 61 |
| 15 | OR2675-4-1 | 6.38 | 1.6 | 3.98 | LS | 42 | 61 | 73 | 19.95 | 4 | 61 |
| 16 | OR2675-5-1 | 5.88 | 1.66 | 3.54 | SS | 55 | 64 | 78 | 21.37 | 3 | 57 |
| 17 | OR2675-5-2 | 6.47 | 1.6 | 4.04 | LS | 50 | 63 | 76 | 21.52 | 3 | 58 |
| 18 | OR2675-6-4 | 5.82 | 1.55 | 3.75 | SS | 46 | 61 | 76 | 21.3 | 4 | 59 |
| 19 | OR2675-6-7 | 6.23 | 1.75 | 3.56 | LS | 40 | 65 | 75 | 23.25 | 4 | 49 |
| 20 | OR2676-1-1 | 6.23 | 1.5 | 4.15 | LS | 44 | 63 | 75 | 21.9 | 3 | 58 |
| 21 | OR2676-1-2 | 6.08 | 1.6 | 3.8 | LS | 50 | 65 | 75 | 22.72 | 3 | 51 |
| 22 | OR2676-1-4 | 6.17 | 1.53 | 4.03 | LS | 42 | 63 | 75 | 21.22 | 4 | 56 |
| 23 | OR2676-2-3 | 6.34 | 1.58 | 4.01 | LS | 46 | 60 | 78 | 21.9 | 3 | 57 |
| 24 | OR2676-2-4 | 6.19 | 1.81 | 3.41 | LS | 45 | 64 | 76 | 20.77 | 3 | 59 |
| 25 | OR2676-2-5 | 6.12 | 1.46 | 4.19 | LS | 54 | 62 | 77 | 20.4 | 3 | 60 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | OR2676-2-6 | 6.2 | 1.45 | 4.27 | LS | 44 | 63 | 74 | 20.7 | 3 | 59 |
| 27 | OR2676-3-1 | 6.11 | 1.44 | 4.24 | LS | 46 | 65 | 76 | 19.5 | 4 | 60 |
| 28 | OR2676-3-2 | 6.33 | 1.51 | 4.19 | LS | 50 | 61 | 76 | 19.65 | 5 | 59 |
| 29 | OR2676-4-2 | 6.1 | 1.55 | 3.73 | LS | 49 | 65 | 76 | 19.27 | 4 | 61 |
| 30 | Ranidhan | 5.1 | 1.96 | 2.6 | MS | 48 | 66 | 76 | 19.72 | 3 | 61 |
| 31 | Samba mahsuri | 4.96 | 1.77 | 2.8 | MS | 50 | 63 | 75 | 24.1 | 4 | 63 |
| 32 | Jajati | 5.39 | 1.85 | 2.91 | MS | 36 | 67 | 77 | 19.72 | 6 | 59 |
| Statistics | | | | | | | | | | | |
| | Range Maximum | 6.57 | 1.96 | 4.35 | | 63 | 69 | 79 | 24.1 | 7 | 63 |
| | Range Minimum | 4.96 | 1.44 | 2.6 | | 36 | 60 | 73 | 19.27 | 3 | 47 |
| | Mean | 6.09 | 1.62 | 3.77 | | 47.90 | 64.62 | 75.93 | 21.31 | 4.03 | 56.25 |
| | Variance | 0.211779 | 0.015978 | 0.210796 | | 26.4748 | 5.40322 | 2.125 | 1.666052 | 1.77318 | 19.09677 |
| | Std. dev | 0.460194 | 0.126405 | 0.459126 | | 5.145367 | 2.32448 | 1.45773 | 1.290756 | 1.33161 | 4.369986 |
| | C.V | 7.55 | 7.76 | 12.17 | | 10.73 | 3.59 | 1.91 | 6.05 | 33.01 | 7.76 |
| | Std. error | 0.08340 | 0.02811 | 0.08835 | | 0.90958 | 0.41091 | 0.25769 | 0.23167 | 0.23539 | 0.77251 |

**SS- short slender, LS- long slender, MS- medium slender

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