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# Variation of Hull Over Grain Weight Percentage of Rice *(Oryza Sativa L.)* From Pakistan

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## Abstract

*Rice (Oryza sativa L.) is an important cash crop in the world. Rice is 2nd most important food and cash crop of Pakistan after wheat. Forty accessions consisting of 20 conventional varieties and 20 New Plant Type (NPT) lines were used to determine percentage of hull over grain weight. The percentage of hull over grain weight was significantly different among varieties. The hull over grain weight percentage for varieties ranged from 10.5% to 30%. The percentage of hull /grain weight varied from 7.5% to 27.33 % for NPT lines and there was significant difference among NPT lines for this trait. This trait can be used in breeding program in order to increase rice production through increasing the milling efficiency by having thinner hull.*

**Keywords:** *rice, hull weight, ANOVA, milling efficiency, grain* weight

## Introduction

Rice (*Oryza sativa* L.) is an important cash crop of the world. It is used as a staple food by more than 50% of the world's population (Lachagari *et al.*, 2019). Rice is primary source of food for seventeen countries in Asia, nine countries in Africa and contributes 20% of world energy (Li *et al.*, 2016). Rice is 2nd most important food and cash crop of Pakistan after wheat. The annual yield of milled rice is about 6.5 MT sharing 4.9% in agricultural economy and 1.1% in Gross Domestic products (GDP) of Pakistan (Adams, 2019). Pakistan ranks 13th in term of rice yield and fourth in long grain aromatic basmati rice export in the world (Jabran *et al.*, 2017). Pakistan is larger rice exporters of Basmati rice to different countries in the world especially European Union. In Pakistan, Basmati rice is preferred among rice growers, millers, exporters and consumers. It has about double price than any other rice variety in the market hence named "Golden Grain of Pakistan" (Hussain *et al.*, 2018). Rice provides 60–70% daily calorie, 20% protein and 2% fats around three billion people in the world (Shabir *et al.*, 2013). Rice is a source of phosphorus, magnesium, niacin, thiamin, zinc, copper and vitamin B6. Some varieties have potassium, iron and folic acid. Other than energy rich compounds such as carbohydrates, protein, fat, a reasonable amount of calcium and riboflavin is present in rice (Richa *et al.*,

2017). It is also a model plant in the molecular biology studies of *Graminae* because of its small genome size, diploid and high level of genetic polymorphism (Akter *et al.*, 2016). Rice is important as a source of income and employment for common people. Rice has extensive curative and protective properties against human ailments like indigestion, arthritis, epilepsy, rheumatism, chronic headache, internal rejuvenation of tissues, paralysis, diabetes, postnatal weaknesses, skin diseases, colon cancer and blood pressure (Sadiq *et al.*, 2019). *Japonica* type rice is grown in Khyber Pakhtunkhwa and Azad Jammu and Kashmir. Short and medium grain type rice commonly called "Begami" is grown in Swat region. There is high demand of this rice in Japan, Korea and Russia as well as in national markets. The yield and cultivated area under rice tends to decrease in Khyber Pakhtunkhwa from the last decade, which is an alarming condition for poor rice consumers of country (Bibi *et al.*, 2017). Rice kernels develop inside the hull, so the size and shape of the grain is determined by the hull. Hull weight to whole-grain weight percentage is ranged from 19.6 to 25.6%. Decrease in grain size and variation in grain shape from round to slender greatly influences hull percentage (Beloshapka et al., 2016). Grain filling also significantly affects hull percentage. During the milling and polishing process, the hull is first removed from the grain (rough rice or paddy rice) in a sheller. The mills which buy paddy rice and then convert it to milled rice prefer to buy low hull weight varieties (Lin et al., 2012). Keeping in view the importance of hull weight over grain weight in rice varieties, the present study is proposed with the aim to screen selected rice varieties of Pakistan for the hull over grain weight percentage.

## Material and Methods

Forty rice accessions consisting of 20 conventional varieties from major rice growing areas of Pakistan were acquired from gene bank at Plant Genetic Resource Institute (PGRI), National Agriculture Research Center (NARC) and 20 New Plant Type (NPT) lines developed by Dr. Fida Muhammad Abbasi at Hazara University Mansehra were used during the study. Ten rice varieties and ten NPT lines were of long grain *Indica* type while ten varieties and ten NPT lines were of short grain *Japonica* type rice. Data was recorded at National Tea and High Value Crop Research Institute (NTHRI) Shinkiari, Mansehra. All of the genotypes used in this study have been maintained in the gene bank for conservation and future utilization for crop improvement program.

The seed was placed in plastic pots accommodating twenty seedlings with equal plant spacing. The pots were kept under greenhouse conditions with appropriate temperature and irrigation. Forty days old seedlings were transplanted from pots to field in Randomized Complete Block design with three replications. Keeping a distance of 20 cm between and within rows. Standard agronomic practices and plant protection measures were adopted for all the accessions. Three check varieties were repeated after every 20 rows. The field work was carried out from May to October during 2014.

For determination of hull over grain weight percentage ten healthy seeds of each variety and NPT lines were taken and weighed with hull and then dehulled and weighed again by electric balance. The hull weight was calculated as follows;

Hull weight = grain weight – brown rice weight.

For hull/grain weight percentage this formula was used

$$\frac{\text{Hull weight}}{\text{Grain weight}} \times 100$$

Data obtained for all the varieties were subjected to analysis of variance (ANOVA) using statistical software STATISTICA version 7.

## Results and Discussion

In post-production of rice, milling is a crucial step. The major objective of a rice milling machine is to remove the hull and the bran layers from paddy rice, and yield an edible white rice grain that is adequately milled and free of bran layers. Hull includes lamma and palea structures such as the sterile lemmas, rachilla, the awn if present (Xie *et al.*, 2006). Depending on the choice of the rice consumer, the rice kernel should milled to have a minimum number of broken rice grains.

Table 2. Varieties and NPT lines used for variation in hull/grain weight percentage of rice.

| S.No | Names of NPT lines | S.No | Names of varieties |
|---|---|---|---|
| 1. | MR-10-3-9-8 | 1. | DR 92 |
| 2. | MR-10-12-5-4 | 2. | JP-5 |
| 3. | LINE 82 | 3. | NIAB-IR 9 |
| 4. | LINE 107 | 4. | FAKHR-E MALAKAND |
| 5. | MR-10-1-1 | 5. | SATHRA |
| 6. | LINE 105 -14 | 6. | PAKHAL |
| 7. | LINE 25 | 7. | MUSHKAN |
| 8. | LINE 17 | 8. | SWAT 1 |
| 9. | L3 | 9. | JAJAI 77 |
| 10. | L4 | 10. | SUGDASI |
| 11. | NPT 160 | 11. | LATEEFY |
| 12. | M2 | 12. | MEHLAR 346 |
| 13. | NPT 156 | 13. | BAS 198 |
| 14. | LINE 61 | 14. | SADAHYAT |
| 15. | NPT 146 | 15. | IR 8 |
| 16. | NPT 174 | 16. | TN1 |
| 17. | MR-10-2-3-18 | 17. | PK 177 |
| 18. | MR-10-3-7-2-5 | 18. | PULMAN SUFAID |
| 19. | MR5-2-2-1 | 19. | KS -282 |
| 20. | LINE NO 9 | 20. | BAS -C- 622 |

Hull over grain percentage is related to the weight of grain that is related to yield attributing traits of rice. Result showed that among varieties the hull over grain percentage ranged from 10.5 to 30 with mean value 20.17. Maximum value was recorded for Dr-92 (30) followed by Pk-177 (26), Fakhr-e-Malakand (25.33) and Jajai-77 (25). Minimum value was recorded for Sugdasi (10.50) followed by TN1 (14.67), Bas-C-622 (15) (Table 2).

Hulls are usually removed in a dehuller or sheller. The percentage of hull over grain weight (paddy rice) is important agro-morphological trait. Hull over grain percentage may vary from 16 to 35 percent among cultivars. For NPT lines the percent of hull/grain weight varied from 7.5 to 30 with mean value 17.33. Maximum value was recorded for LINE MR-10-3-9-8 (30) followed by L-3 (29.67), Line-82 (27.33) and line-05-14 (25.33) (Table 2). Minimum value was recorded for LINE MR-10-12-5-4 (7.5) followed by L4 (8.5) and LINE MR-10-1-1(11). So it is possible to increase brown rice production through decrease in ratio of hull over grain weight percentage. If this character is controlled by single or major genes it will provide very useful information for rice breeders in future breeding programs (IRRI 1977)

Table 3. Variation of hull / grain weight percentage

| **Names of varieties** | **Hull/grain** | **wt%age** | **Names of lines** | **Hull/grain** | **wt% age** |
|---|---|---|---|---|---|
| Dr-92 | 30 | A | LINE MR-10-3-9-8 | 30 | A |
| Jp-5 | 16.33 | FG | LINE MR-10-12-5-4 | 7.5 | J |
| Niab-IR-9 | 24 | BC | LINE 82 | 27.33 | AB |
| Fakhr-e-Malakand | 25.33 | B | LINE 107 | 14 | FGHI |
| Sathra | 18.67 | EF | LINE MR-10-1-1 | 11 | HIJ |
| Pakhal | 19.67 | DE | LINE 105 -14 | 25.33 | ABC |
| Mushkan | 17 | FG | LINE 25 | 20.67 | CDE |
| Swat-1 | 18.33 | EF | LINE 17 | 18.67 | DEFG |
| Jajai-77 | 25 | B | L3 | 29.67 | AB |
| Sugdasi | 10.5 | H | L4 | 8.5 | IJ |
| Lateefy | 21.67 | CD | NPT 160 | 15.33 | EFGH |
| Mehlar-346 | 24.67 | B | M2 | 17.67 | DEFG |
| Bas 198 | 18.67 | EF | NPT 156 | 23.67 | BCD |
| Sadahyat | 24.00 | BC | LINE 61 | 13.33 | GHIJ |
| IR-8 | 19.67 | DE | NPT 146 | 19.83 | CDEF |
| TN1 | 14.67 | G | NPT 174 | 25.00 | ABC |
| PK-177 | 26.00 | B | MR-10-2-3-18 | 14.33 | FGHI |
| Pulman Sufaid | 20.67 | DE | MR-10-3-7-2-5 | 14.67 | EFGH |
| Ks-282 | 23.67 | BC | MR5-2-2-1 | 15.67 | EFGH |
| Bas-C-622 | 15.00 | G | LINE NO 9 | 17 | EFGH |

Means: sharing same letters in a column are not significantly different at 5% probability level using LSD TEST.

## Conclusion

NPT line L4 showed minimum hull/grain weight percentage it is in process of evaluation for other characters also and then will be released as variety. Similarly among the varieties, cultivar Sugdasi was found promising showing for low hull/grain weight percentage character.

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