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Research article

Morphological study on rice (*Oryza sativa* L.) varieties of Parbatjhora Sub-division, Kokrajhar district, Assam, India

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Abstract: Collection of rice (*Oryza sativa*) followed by evaluation of morphometric character of the seed, in-house germination and cytological characterization were made to rice varieties of Parbartjhora sub-division, Kokrajhar district, Assam. A large array of variation among five studied varieties along with 2n=24 indicates its individual entity. Another remarkable feature is the growth of in-house germinated seedling *Holijam* has shown the highest rate and *Malsyra* the slowest in comparison to other variety.
Keywords: Parbatjhora - Rice variety - Landrace - Gene pool.

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INTRODUCTION

Rice (*Oryza sativa* L.) is regarded as one of the most important staple foods in the world with high agronomic and nutritional importance (Borthakur 1992, Pathak *et al*. 2018). India has the world's largest area under rice with 44 million ha and she contributes 21% of global rice production. It occupies 1/3 of the total cropped area, contributes about 40% to 43% of total food grain production and continues to play a key role in the national food and livelihood security system (FAO 2010). Diverse rice varieties grown in different places of North Eastern Region of India are valuable genetic resources that may be useful for future crop improvement (Hore 2005, Sarma & Pattanayak 2009, Das & Ghosh 2010). Kokrajhar is an administrative district in the state of Assam in North Eastern India. Agriculture is the main trade of Kokrajhar district and contributes a major part in the district economy. Rice covers an area of about 80% of the Gross Irrigated Area covered by *Ahu*, *Sali* and *Boro* paddy crops. The Gross Cropped Area of the district is 1,77,394 ha as against the Net Cropped Area of 1,08,167 ha (Report of KVK, Gossaigaon). Similarly, Parbatjhora sub-division, one of the potential areas of traditional rice cultivation, has very rich number of cultivars, wild and weedy relatives (Rabha 2019). The agro-ecological situation of the sub-division consists of high elevation red soil, prone to high run-off and erosion. The sub-division is also less prone to flood and drought damage. Thus, less damage of crops due to extreme climatic hazards is reported by the farmers; however, some damage of crops due to pests and insects are reported. The cultivars of the region resort to the traditional varieties and cultivation practices maintaining a diverse gene pool of traditional rice which differs in various aspects from high yielding varieties (HYV). These rice cultivars are grown from time immemorial to cater the household needs of the farmers which are maintained from many previous generations. However, some farmers have changed traditional varieties to newer crops due to the availability of HYV seeds, they have also changed the cropping pattern to earn more profit. The most popular and genetically diverse traditional rice varieties cultivated in this area include *Joha (aromatic), Waxy (bora), Semiwaxy (chokuwa), Red Bao (deep and floating)* rice and various *Sali* varieties. Many of these varieties were grown only in restricted pockets in the area of collection. The cultivation of these traditional varieties can be attributed to its good taste and tolerance to pests and diseases.

Genetic and hierarchical information about traditional varieties is the primary requirement for germplasm conservation (Sinha & Mittra 2013). Collection, conservation and characterization of such germplasm may provide good scope to utilize them in crop improvement. Many of the traditional genotypes are known for their pest and disease resistance and traditional practices for the cultivation of these varieties help to preserve the

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genetic purity without any hindrance. Such a valuable rice genepool has immense potentiality in regards to the rice improvement programme (Fukui & Iijima 1991). Genotypes characterized for distinctness, uniformity and stability using morphological observation from different places of Parbatjhora sub-division was not characterized earlier despite having a rich diversity of rice. Hence, the present study was undertaken to make a database based on morpho-cytological investigation of the collected rice varieties native to the Parbatjhora sub-division of Kokrajhar district.

MATERIALS AND METHODS

Study area

Rice varieties were collected from three villages of the Parbatjhora sub-division (Fig. 1) during March 2019. Five traditional varieties namely *Dhaba*, *Malsyra*, *Holijam*, *Jhul* and *Kati Sali* were selected based on local demand and suitable to grow in semi wetland field for the present study.

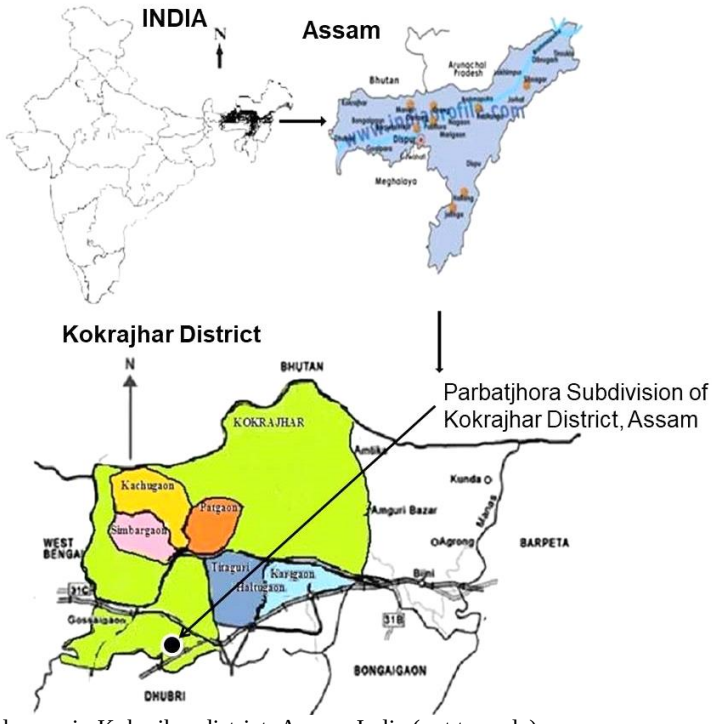

Figure 1. Location of study area in Kokrajhar district, Assam, India (not to scale).

Method adopted

The morphometric characters like grain and kernel colour, shape, length, breadth and thickness were evaluated as per the method of Sharma *et al*. (1990); Sinha & Mittra (2013) and Baruah *et al*. (2017). Furthermore, the presence of awn and aroma were also recorded. The colour of the grain and kernel was recorded through visual observation. The shape of the grain and kernel were determined by grouping into four categories according to Rosta (1975) and Parikh *et al*. (2012) as- (a) Spherical: 2.0, (b) Semi-spherical: 2.0-2.4, (c) Semi-long: 2.4-3.0, (d) Elongated: >3.0.The length, breadth and thickness of the grain and kernel were evaluated in cm using centimeter scale as the distance from the base of the lowermost sterile lemma to the tip of the lemma or palea.

The shoot and root length were determined through in-house germination and growth of seedlings. Rice seeds were placed in a little water filled petridish and kept in an incubator with an optimum temperature of 27ºC. A cotton layer was placed just below the rice samples so that it makes a wet substratum and kept for germination. The developed shoot and root length were measured after 7 days using centimeter scale. For shoots length, the distance from the lowermost base of the shoot to the tip as well as root length was determined.

The collected rice samples were evaluated for total chromosome number in each selected varieties through squash preparation. Root tips were collected around 10:30 to 11:30am followed by washing with distilled water. Pretreatment was done with 0.001% colchicine's in a microcentrifuge tube at 4ºC for 2 hours (Sharma & Mukherjee 1955). The pre-treated root tips were washed out thoroughly with distilled water and kept in freshly prepared 3:1 ethanol (95%) and acetic acid for overnight at room temperature. The fixed root tips were taken out and washed thoroughly with distilled water and the root tips were put in 1% aceto-orceine solution along with 1N HCL in the volume of 9:1, heated at 55ºC on spirit lamp and kept it for 2–3 hours as per the method of

Sharma & Sharma (1980). Thereafter, well prepared slides were observed under LABOMED Lx 400 microscope and chromosome number was counted besides capturing the microphotograph of mitotic metaphase plate of each sample.

RESULTS AND DISCUSSION

Altogether five no of rice varieties were collected, germinated and evaluated their morphological, total chromosome number, germination and growth behavior of the same in laboratory. Data are presented in Tables 1, 2 & 3, Figs. 2, 3, 4 respectively. Similarly a graphical analysis on germination and growth behavior of rice varieties is presented in figure 5. According to Sinha & Mittra (2013), the cyto-morphological characterization of rice is considered as one of the most important criteria in assessments of the genetic diversity present in the traditional rice varieties. Collection, in-house germination and characterization of such cultivars may provide good scope to utilize them in future crop improvement. The study has revealed that light golden yellow grain colour was recorded in *Jhul* and *Kati Sali*, golden yellow colour with brown elongated stripes was recorded in *Dhaba*, deep brown colour with black spots in *Malsyra* and Golden yellow colour in *Holijam*. Yellowish white kernel colour was recorded in *Dhaba*, *Malsyra*, *Holijam* and *Kati Sali*. Elongated grain shape was recorded in *Holijam* and *Kati Sali*, semi-long in *Malsyra* and *Jhul* and semi-spherical in *Dhaba*. Semi-long kernel shape was recorded in *Malsyra*, *Holijam* and *Kati Sali*, spherical in *Dhaba* and semi-spherical in *Jhul*. Presence of minute awn was recorded in *Dhaba*, presence of distinct awn was recorded in *Jhul*. The other three varieties revealed absence of awn. All the collected rice varieties revealed absence of aroma (Table 1).

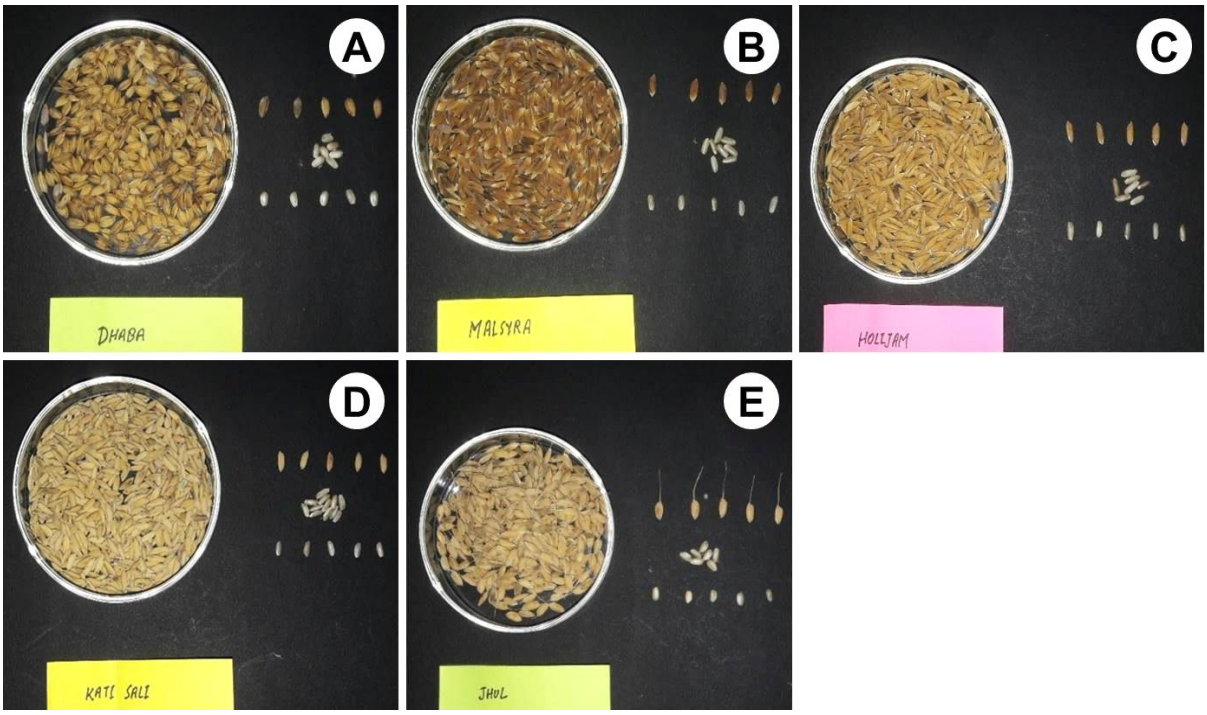

Figure 2. Image of collected rice varieties: A, *Dhaba*; B, *Malsyra*; C, *Holijam*; D, *Jhul*; E, *Kati Sali*.

Table 1. Grain and kernel colour, shape, presence or absence of awn and aroma.

Rice variety	Grain colour	Kernel colour	Shape of grain	Shape of kernel	Presence or absence of awn	Presence or absence of aroma
Dhaba	Golden yellow with brown elongated stripes	Yellowish white	Semi-spherical	Spherical	Minute awn present	Absent
Malsyra	Deep brown with black spots	Yellowish white	Semi-long	Semi-long	Absent	Absent
Holijam	Golden yellow	Yellowish white	Elongated	Semi-long	Absent	Absent
Jhul	Light golden yellow	Light yellowish white	Semi-long	Semi-spherical	Distinct awn present	Absent
Kati Sali	Light golden yellow	Yellowish white	Elongated	Semi-long	Absent	Absent

Table 2. Grain and kernel total length, breadth and thickness of collected rice varieties.

Rice variety	Total grain length/cm	Total grain breadth/cm	Total grain thickness/cm	Total kernel length/cm	Total kernel breadth/cm	Total kernel thickness/cm
Dhaba	1.73	1.36	1.26	1.66	1.26	1.16
Malsyra	1.83	1.30	1.20	1.73	1.20	1.10
Holijam	1.90	1.30	1.20	1.80	1.20	1.10
Jhul	1.76	1.33	1.20	1.66	1.23	1.10
Kati Sali	1.71	1.30	1.20	1.63	1.20	1.10

The maximum grain and kernel length of 1.90 cm and 1.80 cm was recorded in *Holijam* while minimum grain and kernel length of 1.71 cm and 1.63 cm was recorded *Kati Sali*. The maximum grain and kernel breadth of 1.36 cm and 1.26 cm was recorded in *Dhaba*, minimum grain breadth of 1.30 cm was recorded in *Malsyra*, *Holijam* and *Kati Sali*, while minimum kernel breadth of 1.20 cm was recorded in *Malsyra*, *Holijam* and *Kati Sali*. The maximum grain and kernel thickness of 1.26 cm and 1.16 cm was recorded in *Dhaba* while minimum grain and kernel thickness of 1.20 cm and 1.10 cm was recorded in *Malsyra*, *Holijam*, *Jhul* and *Kati Sali* (Table 2).

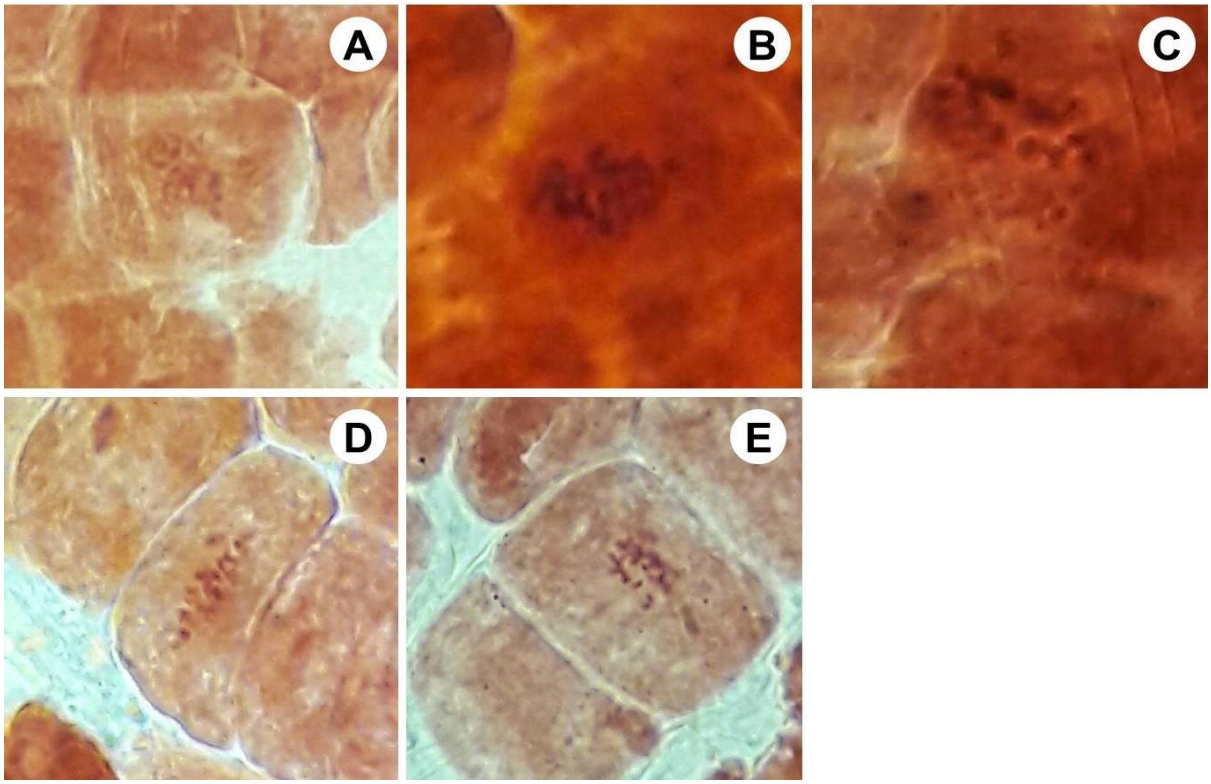

Figure 3. Micro photographic image of somatic metaphase plate showing diploid (2n) chromosome number of the rice varieties: A, *Dhaba*; B, *Malsyra*; C, *Holijam*; D, *Jhul*; E, *Kati Sali*.

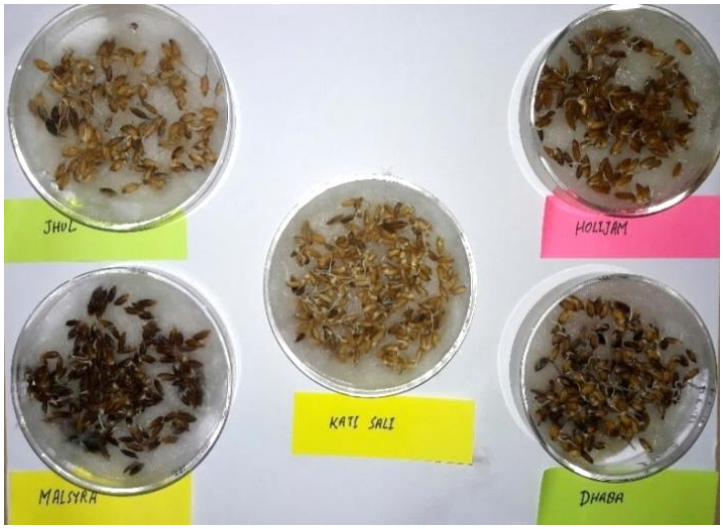

Figure 4. Image of one week old rice seedlings germinated in laboratory.

Table 3. Shoot and root length with their total length of one week old seedling.

Rice variety	Shoot length/cm	Root length/cm	Total length/cm
Dhaba	6.9 cm	5.5 cm	12.4 cm
Malsyra	6.0 cm	5.0 cm	11.0 cm
Holijam	12.0 cm	13.0 cm	25.0 cm
Jhul	8.0 cm	7.0 cm	15.0 cm
Kati Sali	7.5 cm	9.0 cm	16.5 cm

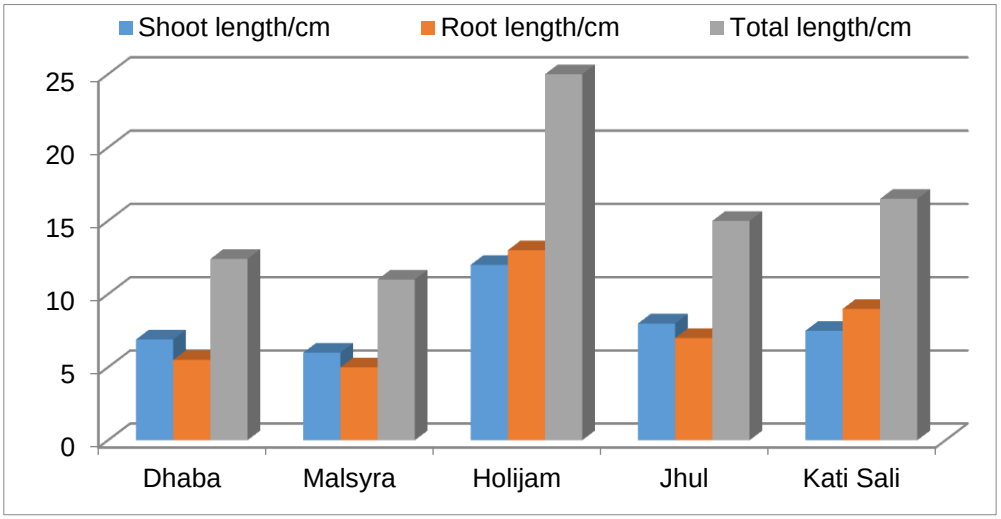

Figure 5. Showing the germination and growth behaviour of five rice varieties.

The total chromosome number (2n=24) was recorded in all the collected five rice varieties viz. *Dhaba*, *Malsyra*, *Holijam*, *Jhul* and *Kati Sali* (Fig. 3). It has supported the views of earlier workers (Kuwada 1910, Ishii & Mitsukuri 1960), but variation of chromosome number is a common feature of rice growing in wild. However, cytological data with basic chromosome number can be used for identification and validation of taxonomy. Germination and growth of rice is another important factor that has strong relationship with its production. The growth-related parameters with respect to all samples germinated artificially inside the laboratory as shown in figures 4 & 5; table 3, the maximum shoot and root length of 12 cm and 13 cm with total length of 25 cm was recorded in *Holijam* while minimum shoot and root length of 6 cm and 5 cm with total length of 11 cm was recorded in *Malsyra*.

CONCLUSION

The study provides a reliable data on morpho-cytological content of five traditional rice varieties collected from different localities of Parbatjhora. The qualitative and quantitative character studied revealed distinctness and uniformity. Such a valuable rice genepool has immense potentiality in regards of rice improvement programme. Seemingly rice varieties are well adapted in the local agro-climatic conditions and it has been using for cultivation as landrace since time immemorial. Conservation of such rice landraces is an urgent necessity to preserve the genetic potentiality and also need to encourage the farmers to practice cultivation with traditional varieties. Our findings may be helpful in the further studies for conservation as well as permanent database development which will add a new dimension confining itself to Parbatjhora sub-division, Kokrajhar district, Assam.

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