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CHARACTERIZATION OF GERMPLASM OF UPLAND RICE (*ORYZA SATIVA* L.)

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Abstract

Rice (*Oryza sativa* L.) is the unique grain that is entirely used as human food, unlike other cereals, which are also used extensively as feed. In India it is most important staple food crop covering 44 million hectares of land and providing 105 million tonnes of production (Survey of Indian Agriculture, 2014). Rice cultivars are usually grown under rainfed conditions on undulating unbounded lands of Chotanagpur and Santhal Pargana. Upland rice ecology consisted of harsh environment for rice production in which intermittent drought and weed competition are the major constraints. Of all the ecotypes the upland ecology is more variable and varietal improvement is more challenging. Eighty percent of the varieties released so far are for irrigated ecology and hardly 5 percent for uplands and low productivity reduces the average yield of the rainfed upland areas. Besides this, continuous and intensive cultivation of high yielding varieties under high fertility condition resulted in problem related to pest population pressure and outbreak of epidemics. To combat these problems breeders are looking for new sources of genetic materials for incorporation of multiple resistances for which traditional cultivars have been found to be the major donors. The traditional varieties which is grown here, are tall tolerant to drought and poor yielding but well adapted to red lateritic, acidic and poor soil. Information regarding their varietal diversities for various morphological traits is scant. The rice here is generally grown in tanr-1 and tanr-2 of uplands where the water stress condition prevails during major portion of crop growth. The rice grown here is generally early in maturity and they seem to have remarkable capacity to tolerate water stress under such condition.

The collection, conservation and cataloguing of rice germplasm are the backbone of any crop improvement program (Khush and Coffman, 1977). The experiment was conducted in Rice Research Experimental area of Birsa Agricultural University, Kanke, Ranchi during *Kharif*-2014, using randomized block design with two replications. Altogether fifty direct seed rice were studied for twelve characters of which ten is quantitative, one is qualitative and rest one is biotic stress. These characters were summarized with a view to complete a record to prepare a catalogue of direct seeded rice. Besides some of the germplasm were selected for use as donors for many favorable traits in future breeding program.

Key words : Genetic diversity, germplasm, landraces, morphological attributes, rice.

Introduction

Rice (*Oryza sativa* L.), is the most important staple food of more than half of the human race and it is primarily a high calorie food containing 8.5 percent protein,0.34 percent fat, about 90 percent carbohydrate and trace amount of ash, fiber and vitamin after milling. It is the unique grain that is entirely used as human food, unlike other cereals, which are also used extensively as feed (Swaminathan, 1999). It is the world's most important food crop and a primary source of food for more than two third of world's population (Singh and Singh, 2008). It occupies second position in the world in acreage and production, only after wheat. Its area is concentrated in South-East Asian countries, which account for 80percent of the tatol production. Rice is cultivated in both Kharif and Rabi season but bulk of production comes from Kharif. It occupies nearly 165 million ha area in the world and producing 723 million tonnes of paddy with an average productivity of 4.38 t/ha (Anonymous, 2012). Among the

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rice growing countries, India has the largest area of 44 million hectares under four major ecosystem i.e irrigated (21 million ha), rainfed lowland (13.6 million ha), rainfed upland (6.3 million ha) and flood prone (3.1 million ha) (Hand Book of Agriculture) and ranks second in production with 105 million tonnes of rice with average productivity of 2.30 t/ha in the year 2013-14. In Jharkhand, rice is cultivated in 1.7 million hectare with production of 3.4 million tonnes with productivity of 2.0 tonnes per hectare (SAMETI, Jharkhand). The demand for increasing rice production is particularly urgent, because the population of traditional rice-producing countries will require 70% more rice by the year 2025 (IRRI, 1995; Swaminathan, 2007). Hence, the world rice production must increase by approximately 1% annually to meet the growing demand (Rosegrant *et al*., 1995).

Upland rice ecology is consisted of harsh environment for rice production in which intermittent drought and weed competition are the major constraints (Hanamarati *et al*., 2005). Weeds are estimated to cause rice yield loss of 35 per cent in the tropics (Oerke and Dehne, 2004) and it could be much greater under severe weed infestation. Cultivar weed competitiveness is a function of weed tolerance or the ability to maintain high yields despite weed competition and weed suppressive ability through competition (Jannink *et al*., 2000). Though, the development of competitive rice cultivars would provide a safe and environmentally benign tool for weed management (Cousins, 1996 and Dinghkuhn *et al*., 1999), it has not been considered seriously by the breeders. To meet the continuously expanding needs of varietal improvement, the assemblage, evaluation, characterization and preservation of the entire existing germplasm are essential and would be more rewarding (Chatterjee *et al*., 2007). Collection has been properly evaluated; it has little practical use (Chang, 1976). India has a rich and diverse genetic wealth of rice. It has been estimated from various surveys that nearly 50,000 of rice germplasm are still being grown in the country (Roy *et al*., 1985). Characterization should eventually lead to a system of recording and storing useful data that can be readily retrieved and made available to others and help in planning breeding programmes (Debas *et al*., 1994). Qualitative traits being more stable over generations (Raut, 2003) hence are reliable for characterization. Thus, there is a need to collect, evaluate and exploit the untapped germplasm. The collections, conservation and cataloguing of rice germplasm are the backbone of any crop improvement program (Khush and Coffman, 1977). The present study was, therefore undertaken to characterize and evaluate the existing collection of rice, so that a catalogue could be prepared for ready references of breeders or scientists working in rice improvement programme of this plateau region of Jharkhand. Keeping this in view, the present investigations were undertaken with the following objectives :

1. Study of economically important traits, which could be directly used as donor's in future breeding program.
2. To study the importance of germplasm for cataloguing of different traits.
3. The cataloguing of germplasm of upland rice to develop improved varieties through selection and hybridization.

Materials and Methods

The present investigation entitled – Characterization of rice (*Oryza sativa* L.) genotypes under rainfed upland ecology was carried out in Rice Research Experimental area of Birsa Agricultural University, Kanke, Ranchi – 6, during *Kharif* – 2014. Geographically, it is located in plateau region of Jharkhand at 23^0 17' N latitude, 85^0 19'E longitude and 625m above mean sea level (MSL). Fifty germplasm direct seeded rice including three checks (Birsa Dhan-101, Birsa Dhan-102 & Birsa Dhan-103) were received from Rice Research Project of the Department of Plant Breeding & Genetics, BAU, Ranchi. The experimental materials were directly sown on 30th June 2014 in upland field in Randomized Block Design (RBD) with two replications. Each plot was of 5 m × 3 m and row to row spacing of 20 cm. In the present study fifty germplasm including three checks were shown in line and characterized under upland condition. In the first relication crop row started from check varieties and in the second replications crop row started from 50^{th} germplasm ended with check variety Birsa Dhan-101. Data recording were primarily based on morphological characteristics and yield components based on 5 randomly selected plants of each germplasm grown during *Kharif* 2014. Then the entire fifty germplasm were evaluated and compared with checks. The observations in field were recorded based on five representative plants randomly selected from each plot in every replication for recording of data for following characters. For maintenance of accessions, the samples were entered in the accession register and serial numbers were given to them in the present study. After collection of germplasm, it is necessary to maintain the germplasm so that they can be conserved for future use, since there is no mid-term storage facility it becomes necessary to regenerate the materials almost every year.

Table 1 : List of characters studied.

Quantitative Characters
1. Plant height (cm)
2. Panicle length (cm)
3. Plant type
4. Days to 50% flowering
5. Number of tillers/plant
6. Number of ear bearing tillers/plant
7. Number of grains/panicle
8. Type of leaves (Surface type)
9. 1000 Grains weight
10. Dry matter Wt (gm)
11. Angle of flag leaf
12. Disease(s) observations
a. Blast
b. Brown spot
c. Bacterial Leaf Blight (BLB)

1. Plant height (cm)

Plant height was measured at full-grown crop from the ground level to the highest panicle in centimeters in 5 randomly selected plants**.**

2. Length of panicle (cm)

Panicle length was measured in cm from the basal node of the panicle to the tip of the panicle at dough stage in 5 randomly selected plants.

3. Plant type

Plant type is of four types observed on the basis of morphological feature, *i.e.* dwarf, semi-dwarf, semitall and tall.

Scale of plant type

1. Semi dwarf(less than 110cm)

5. Intermediate (110-130cm)

7. Tall (more than 130cm)

4. Days to 50% flowering (DF)

Number of days was calculated right from the date of sowing to 50% plant of the germplasm flowered.

5. Number of tillers/plant (T/H)

The number of tillers was counted from five randomly selected hills after formation of grains. The average number of tillers per plant was calculated as follows :

Average number of tillers per plant = Total number of tillers in 5 hills / 5

6. Number of ear bearing tillers/plant (T/H)

Tillers of crop, which bears ears are known as ear bearing tiller.So; the ear-bearing tiller number was counted in randomly selected plants after bearing ear on tiller. The average of 5 randomly selected plants ear bearing tillers was measured as number of ear bearing tillers/ plant.

7. Numbers of grains/panicle

The individual panicle of each plant was threshed. The number of fertile spikelets was counted. The fertile spikelets are known as filled grains.

8. Type of leaves (Surface type)

Type of leaves observed on the basis of roughness and smoothness of leaf surface. Rough surface was recorded as pubescent and smooth surface leaf was recorded as glaborous.

Scale for type of leaves:-

Pubescent-9 and Glaborous-1

9. 1000 seeds weight (1000 GW)

Thousand filled grains of genotypes from each replication were counted and weighed on an electronic balance in gram.

10. Dry matter weight plant (gm)

The crops are fully dried after harvesting and then threshed to measure as dry matter weight. So,5-randomly selected plants devoid of grain were weighed and average of such observations were recorded in each germplasm**.**

Plants were harvested and threshed, grains were sun dried for 5 days and then weight was taken in kg and converted into q/ha.

11. Angle of flag leaves (AFL)

Orientation of flag leaf was classified as below by measuring their angle at boot stage. Observations were recorded separately as follows :

Description	Code
Erect	1
Intermediate	3
Horizontal	5
Descending	7

12. Disease(s) observations

Blast, Brown spot and BLB : The disease observations were taken by using 0-9 scale as per Standard Evaluation System for rice (IRRI, 1996)

Scale for rice blast

Description	Code	Disease reaction
No lesion	0	HR
Small brown specks of pinhead size	1	HR

Continued...

Larger brown specks	2	R
Small roundish to slightly elongated necrotic gray spot, about 1- 2mm in diameter	3	MR
Typical blast lesions elliptical, 1-2 cm long usually confined to the area of two main veins infected less than 4% of the leaf area	4	MS
Typical blast lesions infecting 4-10% of the leaf area	5	MS
Typical blast lesions infecting 11-25% of the leaf area	6	MS
Typical blast lesions infecting 26-50% of the leaf area	7	S
Typical blast lesions infecting 51-75% of the leaf area	8	HS
More than 75% leaf area affected	9	HS

Scale for Brown spot of rice:

Description	Code	Disease reaction
No incidence	0	HR
Less than 1%	1	HR
1-3%	2	R
4-5%	3	MR
6-10%	4	MS
11-15%	5	MS
16-25%	6	MS
26-50%	7	S
51-75%	8	HS
76-100%	9	HS

Scale for Bacterial Leaf Blight (BLB)

Description	Code	Disease reaction
No incidence	0	HR
Less than 1%	1	HR
1-3%	2	R
4-5%	3	MR
6-10%	4	MS
11-15%	5	MS
16-25%	6	MS
26-50%	7	S
51-75%	8	HS
76-100%	9	HS

Results and Conclusion

To meet the continuously expanding needs of varietal improvement, the collection, evaluation, preservation and characterization of the entire existing germplasm are essential and would be more rewarding breeding efforts. Hence, an effort was made in the present study to

Table 2 : Selected germaplasm for different agro-morphological character and resistant to diseases among 50 germaplasm of direct seeded rice.

Character	Germplasm
Plant height	Nanhi Gora I (126.33cm),Saraya Gora I (126.33cm), Karanga Gora IT (127.33cm), Black Gora III (126.13cm), Pawas Gora I (122.13cm), Gora Dhan VIII (86.67cm) and Naud Gora I (66. 66cm).
Panicle length	Sahar Gora 1 (23.80cm),White Gora 1(23.10cm), Black Gora I(22cm), Black Gora vn (22.23cm), Nawa Khani Gora I (21.00cm), Saraya Gora I (21.00cm), Chotka Gora I (21.10cm) and Black Gora VI (23.00cm).
Days to 50% flowering	Gora Dhan XI (53 days), Karanga Gora II (51 days), Nanhi Gora I(51 days), GoraGP 1(54 days), and Gora GPll (54 days)
Number of grains per panicle	Nawa Khani Gora I (126.33), Gora GP IT(143.00), Lahar Gora I (113.33), Naud Gora I (117.33), Gora Dhan XII (140.00), Gora Dhan X (120.33) and Black Gora II(115.66)
Number of tillers per plant	White Gora II (7 tiller), JD 29(7 tiller), Barka Gora II(7 tiller), Pawas Gora I (tiller) and Rasgadadi Gora I (7 tiller).
1OOO-grain weight	Chotka Gora I (31.S3gm), Chaina Gora I (30.47gm), Gora Dhan T (30.47gm), Lalmati Gora I(30.00gm), Gora Dhan II(31.03gm), Gora Dhan IV (30.00gm), Gora Dhan V (31.13gm) and Gora Dhan XI (31.25gm)
Severity of disease (a)Blast	Pawas Gora I (score-e), Gora GP (score-S), Gora Dhan XI (score- 5), Karanga Gora II (score-I), White Gora II (score-I), Gora G.PIlI (score-I), Naud Gora I(score-I), Gora G.P I (score"-l), Barka . Gora I (score-I) and Chotka Gora l(score-l).
(b) Brown Spot	Gora Dhan XI.(score-s),Pawas Gora I (score-4), 'Dudhi Gora I (score-s), Nawa Khani Gora I(scoreD),' and JD 29 (score-O).
(c) BLB	Gora GP II (score-O), Pawas Gora (score-O), Crasa Gora I (score-O), Naud Gora I (score-O), Gora Dhan I (score-O), Karanga Gora II (score-l), and . Gora Dhan II (score-I).

characterize and evaluate the existing collections of rice for cataloguing and summarizing the various traits with an objective to study the economically important traits of rainfed upland genotypes for their use in future breeding programme. Present investigation were carried out in Rice Research Experimental Area of Birsa Agricultural University, Kanke, Ranchi-6 during *Kharif*-2014 in Randomized Block Design with two replications taking fifty germplasm of upland rice for characterization and evaluation. So, that catalogue could be prepared and summarized for various traits. Data were recorded for all the fifty germplasm on 12 different characters and characterized them into various groups.The characters which are favourable for the farmers are plant height, length of the panicle, days to 50% flowering, number of tillers per plant, number of grains per panicle, 1000 grain weight, angle of flag leaf and resistance to various diseases, which are more prevalent in Jharkhand.

Studies for such favourable genetic traits could help in identification of a large number of germplasm with one or few such traits and for describing tyhem in result for their use as donors for future hybridization program. On the whole 8 promising germplasm of direct seeded upland rice were selected for future utilization in the hybridization program or for direct use as variety for location specific area. Some of the salient points of such germplasm are summarized in the table 2.

On the basis of results summarized in the table, it may be concluded that traditional upland rice of the plateau region of Jharkahand possess large variability for economically important characters, which may be termed as favourable genetic characters and thus could be directly used as donors in future breeding program. Therefore, catalogue of fifty germplasm of rice for 12 characters have been prepared and thus could be used to take help to compare when new sample is collected in future. It is further concluded that Karanga Gora-I(Sl No 15) and Naud Gora (Sl. No. 4) were the two most promising variety among all 50 germplasm evaluated during *Kharif* season of 2014 and this could be released after further testing as variety for cultivation in uplands of this plateau region of Jharkahand.

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