

Characterization of rice germplasm of West Bengal

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ABSTRACT

Four hundred thirty one traditional rice cultivars from germplasm collection of Rice Research Station, Chinsurah offered a valuable genepool for the utilization in the breeding program to improve yield, its components and grain size and shape. Characterization had been done on thirty one traits. Among the qualitative traits, considerable variability was recorded for basal leaf sheath colour, awning and auricle colour. Characters like leaf blade colour, panicle exertion, stigma colour etc. showed moderate variability. Maximum variability was observed for grains panicle⁻¹ followed by spikelets panicle⁻¹.

Key words : rice germplasm, West Bengal, auricle, characterization, quantitative traits.

The role of a wide genetic base and systematically characterized germplasm in the crop improvement of cultivated plants has been well recognized. Evaluation, preservation and characterization of the entire existing germplasm are essential to meet the continuously expanding needs of varietal improvement (Chatterjee *et al.*, 2007). Until a collection has been properly evaluated and its attributes are known to breeders, 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 cultivars of rice are still being grown in the country (Roy *et al.*, 1985). Most of the donors against major diseases, pests, environmental stress, problem soil and even scented types have come from these materials. However, the switch over to high yielding varieties with the spread of modern agriculture, posed a great threat to the security of the age-old practice of growing traditional varieties and land races which may have immense potential for different important traits (Richharia 1979, Sharma *et al.* 1987, Patra 2000). In order to prevent further gene erosion, collection and conservation of such invaluable genetic resources of rice is essential. 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 (Dabas *et al.*, 1994).

In view of these facts, the present investigation was planned to characterize a set of *aman* rice genotypes of West Bengal, for different morphological and agronomic traits and inter relationship among them.

MATERIALS AND METHODS

A field experiment was conducted during wet season of 2005 at Rice Research Station, Chinsurah with 431 landraces. Twenty one day olds seedlings were transplanted (single seedling hill⁻¹) in 3m long rows; keeping the row to row and plant to plant distance 20 cm and 15 cm, respectively. There were three rows for each test entry with a gap of 60 cm between the entries. Fertilizers (N:P₂O₅:K₂O) @ 50:25:25 Kg ha⁻¹ were applied. A random sample of five competitive plants were used for observations on different traits under study.

Various morphological and agronomical characters were studied for 431 cultivars e.g. plant height, number of spikelets panicle⁻¹, number of grains panicle⁻¹, grain length, grain width, grain thickness, kernel length, kernel width, thickness, ratio of grain length to grain width, ratio of kernel length to kernel width, hull and kernel colour, grain and kernel weight, fertility percentage, leaf blade colour, leaf blade pubescence, panicle exertion, stigma colour, apiculus colour, panicle

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type, awning, ligule colour, ligule shape, auricle colour, collar colour, leaf length and leaf width. Observations for various characters were recorded at different growth stages of the crop. For characterization, observations were recorded for various characters of each accession. Leaf blade pubescence was evaluated by passing the fingers lightly over the surface of any leaf from the tip towards the base of the leaf blade at the heading stage. The exertion of the panicles above the flag leaf sheath after anthesis was recorded at dough stage. Stigma colour was recorded during half-way anthesis. Apiculus colour was observed and recorded at maturity. Presence or absence and type of awning were recorded at dough stage. Ligule colour was recorded during booting (early boot stage). Ligule shape was also recorded during early boot stage. Auricle colour and collar colour were recorded at early boot stage. Leaf length was measured from the junction of the blade and leaf sheath to the tip of the blade at heading stage. The top most leaf blade, below the flag leaf on the main culm was taken as representative blade. Leaf width was measured at the widest portion of the blade on the leaf below the flag leaf at heading stage. Plant height was measured on main culm from the soil surface to the top of the tallest panicle excluding awn at the dough stage. Length of panicles was measured from neck node to the tip of the panicle at dough stage. Grain length was measured from the base of the lowermost sterile lemma to the tip (apiculus) of the fertile lemma or palea at mature grain stage. In awned varieties, the grain was measured to a point comparable to the tip of the apiculus. Grain width was measured as the distance across the fertile lemma and palea at the widest point at mature grain stage. All the observations were recorded in terms of standard code.

Systems of characterization and descriptors proposed by Shobha Rani *et al.* (2004) were considered. Where actual measurement was not possible, descriptor state code (DSC) was used and the observation was based on 50 % population. Where actual measurement was possible mean value from selected five plants were recorded. DSC was also used for some of the quantitative characters like leaf length, leaf width, grain length, grain width etc. Measurement of the parameters like grain length, grain breadth, grain thickness etc. were done by dial gauge of Mitutoyo company (No. 2050-08) of Japan. Mean, standard error of mean (SE)

and coefficient of variation (CV%) were calculated for each quantitative traits (Singh and Chowdhury, 1977) to study the variability among the varieties.

RESULTS AND DISCUSSION

Various morphological and agronomical characters exhibited large variation (Table 1). Colour of the outer surface of the leaf sheath had considerable variability with maximum of the accessions (80.73%) having green basal leaf sheath.

Table 1. Distribution of morphological characters in the germplasm collected from West Bengal

Description	Code	% Frequency (n/N X 100)
Basal Leaf Sheath Colour (BLSC)		
Green	1	80.73
Purple lines	2	15.1
Light purple	3	3.65
Purple	4	0.52
Others	99	0
Leaf Blade Colour (LBC)		
Light green	1	0.52
Green	2	86.98
Dark green	3	11.98
Purple tips	4	0
Purple margins	5	0
Purple blotch	6	0.52
Purple	7	0
Others	99	0
Leaf Blade Pubescence (LBP)		
Glabrous	1	69.3
Intermediate	2	22.9
Pubescent	3	7.8
Others	99	0
Panicle Exsertion (Exs)		
Well exserted	1	88.57
Moderately well exserted	3	2.86
Just exserted	5	8.57
Partly exserted	7	0
Enclosed	9	0
Others	99	0
Stigma Colour (SC)		
White	1	72.83
Light green	2	0
Yellow	3	1.63
Light purple	4	2.17
Purple	5	20.65
Others	99	2.72

Description	Code	% Frequency (n/N X 100)	Description	Code	% Frequency (n/N X 100)
Apiculus Colour (AC)			Grain Length (GL)		
White	1	59.47	Very short (< 5)	1	0
Straw	2	1.05	Short (5.01 – 7.00)	3	8.47
Brown	3	1.58	Medium (7.01 – 9.00)	5	56.79
Red	4	2.63	Long (9.01 – 11.00)	7	33.05
Red apex	5	2.11	Very long (> 11.00)	9	1.69
Purple	6	16.84	Grain Width (GW)		
Purple apex	7	13.16	Very narrow (<1)	1	0
Others	99	3.16	Narrow (1.01 – 2.00)	3	1.26
Panicle Type (PT)			Medium (2.01 – 3.00)	5	66.81
Absent	1	21.62	Broad (3.01 – 4.00)	7	31.09
Compact	3	0	Very broad (>4)	9	0.84
Intermediate	5	35.14	Kernel Length (KL)		
Open	9	43.24	Short (d ²)	3	0.84
Others	99	0	Medium (2.01 – 5.00)	5	8.79
Awning (An)			Long (5.01 – 7.00)	7	76.99
Absent	0	72.49	Extra long (>7)	9	13.39
Short and partly awned	1	17.46	Kernel Width (KW)		
Short and fully awned	5	3.17	Narrow (d ²)	3	11.35
Long and partly awned	7	1.06	Medium (2.001 – 3.000)	5	85.29
Long and fully awned	9	5.82	Broad (>3)	7	3.36
Others	99	0	Hull Colour (HC)		
Ligule Colour (LC)			Straw	1	54.8
Green	1	97.79	Golden	2	0.42
Light purple	2	1.66	Golden brown	3	1.67
Purple	3	0.55	Brown furrows on straw	4	21.34
Ligule Shape(LS)			Purple	5	0
Truncate	1	0.55	Purple furrows on straw	6	0
Acute	2	99.45	Brown(Tawny)	7	3.35
Split	3	0	Black	8	7.53
Auricle Colour (AC)			Others	99	10.88
Colourless	1	35.75	Kernel Colour (KC)		
Light purple	2	60.90	White	1	49.58
Purple	3	3.35	Light brown	2	7.14
Collar Colour (CC)			Speckled brown	3	0.84
Absent	1	95.03	Brown	4	29.41
Present	9	4.97	Red	5	0
Leaf Length (LL)			Variable purple	6	0
Short (24.0 - 44.0)	3	28.42	Purple	7	0
Medium (44.1 - 64.1)	5	63.16	Others	99	13.03
Long (64.2 - 84.2)	7	8.42	Spikelet Fertility (F%)		
Leaf Width (LW)			Highly fertile (>90%)	1	21.92
Narrow (0.4 - 1.29)	3	81.48	Fertile (75 – 80%)	3	25.34
Medium (1.3 - 2.19)	5	17.46	Partially sterile (50 – 74%)	5	46.58
Broad (>2.19)	7	1.06	Highly sterile (<50% to trace)	7	6.16
Panicle Length (PL)			(0%)	9	0
Very short (<15)	1	0			
Short (15.1 – 20)	3	1.72			
Medium (20.1 – 25.0)	5	36.64			
Long (25.1 – 30.0)	7	56.9			
Very long (>30)	9	4.74			

Moderate variability was found in leaf blade colour. Most of the accessions (86.98%) had green coloured leaf blade. Frequency of glabrous type was very high in the germplasm collected. Rice plant with pubescent leaf blade irritates workers skin during harvesting and threshing, thus glabrousness is fairly desirable.

Most of the accessions had well exerted panicles (88.57%). Moderate variability was noticed in panicle exertion. Good variability was observed in stigma colour with maximum of accessions (72.83%) having white coloured stigma followed by purple (20.65%). High variability was present in apiculus colour with maximum accessions (59.47) with white apiculus. In panicle type variability, 43.24% of the accessions recorded open type followed by intermediate type (35.14 %). Awn is a filiform extension of the keel of the lemma. Farmers prefer awnless grain because awns are objectionable in threshing and milling. In the present collection most of the accessions were awnless. Most of the test entries (72.49%) were awn less. Ligule colour showed least variability with most of the accessions having green ligule colour. Ligule shape all most all the accessions (99.45%) had acute ligule. Considerable variability was present in auricle colour with a maximum of 60.9% of the genotypes having light purple colour. Collar was not coloured in 95.03% of the accessions.

Leaf length varied between 24.0 cm in Nayanmoni to 84.2 cm in Anshpat with an average of 49.89 cm. Width of the leaf blade showed high variability. Evenly distributed narrow and short leaves can reduce mutual shading and increase efficient utilization of light. Average leaf width was 1.13cm with a range from 0.4 cm in GP-342 to 11 cm. Plant height ranged from 62 cm to 182 cm with an average height of 121.18 cm. It had resemblance with the findings of Sinha *et al.*(1990).

Hull colour showed moderate variability with maximum of the accessions (54.8%) having straw coloured hull. Hussain *et al.* (1987) observed a wide range of variability in hull colour. Kernel colour showed moderate variability with maximum of the accessions having white kernel. Spikelet fertility is an important yield attributing trait, as it directly affects grain yield. In general, percentage of fertile grains (mean 77.56) was quite high in the test entries under study. Spikelet

fertility ranged from 25 % (Julia) to 97.1 % (Geetanjali). Shukla *et al.* (1996) also obtained similar results for this trait. The average kernel weight was 2.09 gm 100 kernels⁻¹. This trait ranges from 0.792 g in Gobindobhog to 3.280 g in Jaso. The maximum weight of 100 grains was recorded (3.924 g) in Chamormoni and the minimum (0.978 g) in Gobindobhog. High variability in this trait was also reported by Sharma *et al.*(2004).

Panicle length ranged from 17.8cm in Dudkalma to 34cm in Gopalbhog with an average of 25.82 cm. Variation was low for this trait as compared to others. Similar finding has also been reported by Sinha *et al.* (1990), Shukla *et al.*(1996) and Patra (2000). Number of spikelets panicle⁻¹ ranged from 66 (GP-325) to 383(NC-324) with mean number of 198.39. It is one of the most variable characters. Sharma *et al.* (2004) also reported similar variation in 142 landraces of rice. Number of filled grains panicle⁻¹ is an important yield contributing character, as it directly affects grain yield. It ranged from 43 (Murgisail) to GP 307 (NC-324) with grand mean of 152. The presence of sufficient variability for this character, offers scope for improvement of this trait through selection or hybridization. This was in conformity with the findings of Sinha *et al.* (1990).

Table 2. Distribution of selected quantitative characters in the germplasm collected from West Bengal.

Class Interval	% Frequency (n/N X 100)
Plant Height (PH)	
60 - 90	37.5
91 - 121	14.20
122 - 152	19.89
153 - 183	28.41
Spikelets Panicle ⁻¹ (SP ⁻¹)	
<101	5.48
101 - 150	11.39
151 - 200	32.07
201 - 250	36.71
251 - 300	8.86
>300	5.49
Grains Panicle ⁻¹ (GP ⁻¹)	
<50	0.85
51 - 100	14.1
101 - 150	34.19
151 - 200	37.61
201 - 250	8.97
>250	4.27

Table 3. Range, mean, standard error of mean and coefficient of variation of some quantitative traits of rice.

Quantitative Characters	Range	Mean \pm SE	CV %
Panicle Length (PL)	17.8 – 34cm	25.82 \pm 0.17	9.95
Spikelets Panicle ⁻¹ (SP ⁻¹)	66 – 383	198.39 \pm 3.80	29.65
Grains Panicle ⁻¹ (GP ⁻¹)	43 – 307	152.34 \pm 3.29	33.37
Grain Length (GL)	5.06–11.64mm	8.69 \pm 0.07	12.77
Grain Thickness (GT)	1.57 – 2.51mm	2.02 \pm 0.01	8.42
Grain Width (GW)	1.89 – 6.74mm	2.85 \pm 0.03	17.19
Kernel Length (KL)	1.51 – 8.37mm	6.17 \pm 0.06	15.07
Kernel Thickness (KT)	1.4 – 5.33mm	1.82 \pm 0.02	15.93
Kernel Width(KW)	1.06 – 3.58mm	2.39 \pm 0.02	14.64
Grain Length/Grain Width (G L/W)	2.12 – 4.40	3.13 \pm 0.04	17.57
Kernel Length/Kernel Width (K L/W)	1.57 – 3.96	2.64 \pm 0.03	19.32
Fertility %(F %)	25 – 97.1	77.56 \pm 0.88	17.44
Kernel Weight (Kwt)	0.792 – 3.280g	2.09 \pm 0.03	24.88
Grain Weight (Gwt)	0.978 – 3.924g	2.51 \pm 0.04	23.51
Leaf Length (LL)	24.0 – 84.2cm	49.89 \pm 0.75	20.97
Leaf Width(LW)	0.4 – 11cm	1.13 \pm 0.07	89.03
Plant height (PH)	62 – 182cm	121.18 \pm 2.07	23.70

Grain length varied from 5.06 mm in Kalijeera to 11.64 mm in Patnai-23 with a mean of 8.69. Grain thickness ranged from 1.57 mm in Gobindobhog to 2.44 mm in Doimuri and the mean was 2.02 mm. Grain width varied from 1.89mm in Gopalbhog to 6.74 mm in Sahabsail with an average of 2.85 mm. The longest kernel (8.37mm) was observed in Patnai-23. The present collection showed moderate variation for this trait (CV -15.07 %). During study with traditional rainfed rice cultivars Sinha *et al.* (1990) and Shukla *et al.* (1996) reported less variation for this trait. Kernel thickness ranged from 1.40mm in Gobindobhog to 5.33mm in W1263. Kernel width ranged between 1.06 mm (Kalijeera) to 3.58 mm (Aganni) with a mean of 2.39 mm. Grain length to grain width (GL/GW) ratio ranged from 2.12 in Kalijeera to 4.40 in Suakalma, with the grand mean of 3.13. Kernel length/kernel width (KL/KW) ratio ranged from 1.57 in Aganni to 3.96 in Kalijeera and it exhibited moderate variation. Shukla *et al.* (1996) have reported low variability for this trait.

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