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## RESEARCH ARTICLE

# TRADITIONAL RICE VARIETIES OF WEST BENGAL-PROTECTION CONSERVATION AND RESTORATION FOR SUSTAINABLE AGRICULTURE

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### ABSTRACT

Sustainable genetic diversity is essential for the sustainable agriculture. Crop improvement is solely depending upon the availability of folk varieties because that are evolved for their adaptation to wide range of environmental condition. Conservation and intensifying cultivation of traditional crop varieties is only way to cope up from future food crisis. Fifty-five traditional rice varieties were collected from repository of ARSW society for study the distinctiveness among the varieties. Randomized complete block design was followed for the cultivation of the varieties in on farm condition and Eight important characters (Basal leaf sheath colour, stem length, 50% flowering, grain length, grain shape, grain colour, amylose content and aroma) were used for the establishment of the distinctness among the rice landraces. Agronomic and stress resistant characterization of fifty-five rice landraces was done according to DUS testing at test farm during Kharif season of 2017. All varieties were found distinct in accordance of DUS guidelines in this study. In addition to distinctiveness, landraces like Analaya, Vutmuri, Kelsh, Daharlagra, Dharansal, Patnai-23, Nonabokra, Sindurmukhi and Kataribhog are resistant to drought stress. These varieties may play an important role in crop improvement and sustainable agriculture.

**Key words:** Rice, Landraces, West Bengal, Sustainable agriculture, DUS test, Conservation.

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### INTRODUCTION

West Bengal, the third largest economy in India consists of 23 districts with an area of 88752 Km<sup>2</sup>. Among the states, West Bengal is the leading producer of paddy in the country and has earned the distinction of being one of the "food basket" states of India (Pralhad, 2010). Entire South Asia was the richest reservoir of rice varieties and more than 100000 rice landraces were distributed in the rice fields of various remote villages (Richharia and Govindasamy 1990). West Bengal in India was also a big reservoir of rice biodiversity (Chatterjee, *et al.* 2008). Up to 1970 more than 5000 folk rice varieties had been reported from Bengal (Deb, 2005). Erosion of farmers varieties was beginning in 1975 when modern High Yielding Varieties were introduced. Marginal farmers were cultivated HYVs only for increase production as a result 75% of folk varieties become vanished from the rice fields (Gliessman, 2007). Folk varieties are valuable as they possess treasure of genetic material which may prove valuable in future crop development and improvement programs. Several workers have been working on importance of conservation of folk rice varieties. Deb (2005), Sinha and Mishra (2014, 2015), Charkrobotay *et al.* (2012) etc. worked on diversity of folk rice varieties of West Bengal and also pointed out their gradual degradation.

Misra *et al.* (2010) have worked on status and conservation of rice diversity of Orissa. Kumar *et al.* (2013), Kumar *et al.* (2015) and Patra (2000) had been reported genetic variability of rice of Allahabad agroclimatic region, Bihar and Orissa respectively. Hattori *et al.* (2011), Atlin *et al.* (2006) Patra and Dhua (2010), Karmakar *et al.* (2012) worked on different abiotic stress (drought, flood) resistant capacity of various traditional rice varieties. Anandan *et al.* (2011) reported Zn and Fe content of some folk varieties are much higher than the HYVs. Frankel (1973), Juliano (1993) worked on aesthetic and medicinal values of traditional varieties and also gave preference to the conservation of these varieties. Conservation of genetic diversity is the fundamental of sustainable agriculture. Traditional varieties have their own use value, option value, culture value and existence value (Brush *et al.* 1992). In present changing environmental condition when agriculture come into a vulnerable stage, conservation and utilization of existing traditional varieties is only way out to evolve new improve varieties. Major objective of this paper is to assess the diversity present among the 55 important farmers varieties of rice of West Bengal according to their distinctiveness. Major agronomic features and resistances to various abiotic and biotic factors are also investigated in this work.

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Fig. 1. Seed bed and transplantation of folk varieties into the farm land



Fig. 2. Vegetative stage of folk varieties in of farm condition

Table 1. List of existing farmers varieties of West Bengal

Sl.	Name of Landraces	Sl.	Name of Landraces	Sl.	Name of Landraces
1	Agniban	20	Gokulsal	39	Murkimala
2	Asanlaya	21	Jaladhi	40	Nabanna
3	Bahurupi	22	Jaldhepa	41	Nagrasal
4	Baskamini	23	Jamaynadu	42	Narkeljhopa
5	Bhadoi	24	Jhilik	43	Neta
6	Bharamarmali	25	Jhulur	44	Nonabogra
7	Bhuri	26	Kabiraj	45	Nugenbaro
8	Bombaimugi	27	Kaksal	46	Panati
9	Byamajhupi	28	Kalobyar	47	Patnai-23
10	Chinakamini	29	Kalojira	48	Radhatilak
11	Chotodidi	30	Kartiksal	49	Rupsal
12	Daharlagra	31	Kasiphul	50	Sindurmukhi
13	Dangapatnai	32	Kataribhog	51	Sonagori
14	Dharansal	33	Laltipa	52	Suakalma
15	Dudherswar	34	Langalmura	53	Talmugurdhan
16	Dudhkalam	35	Like-Kakua	54	Valki
17	Fulkhar	36	Malsira	55	Vutmuri
18	Fulpagri	37	Marichsal		
19	Gheush	37	Mukta		

## MATERIALS AND METHOD

Seed sample of traditional rice varieties of West Bengal was collected from the repository of Amakanan Rural Socio-environmental Well fare society (ARSW Society) to study the distinctiveness among the rice accessions. List of rice descriptors are given in Table 1. Rice cultivars was grown in on farm condition at village Ranbahal of district Bankura of West Bengal during two consecutive kharif season 2016-2017. Seeds were grown on Randomized complete block design (Clewer and Searisbrick, 2001) (Addelman, 1969). Each entry was shown on 30 rows of 6m length. Row to row and plant to plant distance was 30 cm and 20 cm respectively. Total 60 plants of each variety was taken for the observation and characterization.

Important agromorphic characters of these traditional varieties was recorded in various growth stage of the rice varieties according to the guideline of DUS (Test for Distinctness, Uniformity and Stability) protocol (Shobha Rani, 2004) to assess the diversity among the varieties and are given in Table 2. Amylase content of endosperm of each variety was estimated according to the simplified procedure proposed by Juliano (1971).

## RESULTS AND DISCUSSION

Agromorphic characters for diversity analysis of total 55 traditional rice varieties of West Bengal has been examined. To assess distinctness among the rice cultivars two morphological characters (Viz. Basal leaf sheath colour, and stem length),

**Table 2. Distinct characters and their descriptor of farmers varieties of rice**

Sl. No	Characteristics	States	Note	Stage of Observation	Types of assessment
1.	Basal leaf: sheath colour	Green	1	40	VS
		Light purple	2		
		Purple line	3		
		Purple	4		
2.	Time of heading (50% of plants with panicles)	Very early (<71 days)	1	55	VG
		Early (71-90 days)	2		
		Medium(91-110 days)	3		
		Late(111-130 days)	4		
		Very late(>130 days)	5		
3.	Stem: length (excluding panicle; excluding floating rice)	Very short(<91cm)	1	70	VS
		Short(91-110cm)	2		
		Medium(110-130 cm)	3		
		Long(131-150 cm)	4		
		Very long(>150 cm)	5		
4.	Decorticated grain: length	Very short	1	92	MS
		Short	2		
		Medium	3		
		Long	4		
		Very long	5		
5.	Decorticated grain: shape (in lateral view)	Short slender	1	92	MS
		Short bold	2		
		Medium slender	3		
		Long slender	4		
		Long bold	5		
		Extra long	6		
		Slender	7		
6.	Decorticated grain: colour	White	1	92	VG
		Light brown	2		
		Variegated brown	3		
		Dark brown	4		
		Light red	5		
		Red	6		
		Variegated purple	7		
		Purple	8		
		Dark purple	9		
7.	Endosperm: content of amylase	Very low (<10%)	1	92	MG
		Low (10-19%)	2		
		Medium((20-25%)	3		
		High (26-30%)	4		
		Very high (>30%)	5		
8.	Decorticated grain: aroma	Absent	1	92	MG
		Present	2		

**Legends****Stage of observation**

(10)- First leaf through coleoptile, (40)-Booting (early boot stage), (60)- Beginning of anthesis, (65)- Anthesis half-way, (70)- Milk development; (90)- Repining (terminal spikelet repined). (92)- Caryopsis hard (can no longer be dented by thumbnail and over 90% of spikelets ripened).

**Types of assessment:**

**VS-** Visual assessment by observation of individual plant or parts of plants

**VG-** Visual assessment by a single observation of a group of plants or parts of plants

**MS-** Measurement of a number of individual plants or parts of plants

**MG-**Measurement by a single observation of a group of plants or parts of plants

one physiological character (Viz. 50% flowering), and five agronomic characters (Viz. grain length, grain shape, grain colour, amylose content and aroma content) has been taken. Characterization of 55 landraces of rice as per distinct characters are given in Table 3. Vast differentiation has been observed on 50% flowering, grain shape, grain colour and amylose content of each of the accession. This variation clearly indicates the diversity present among the cultivars. Importance of agromorphic characters for grouping of rice varieties was previously reported by many workers like Sinha and Misra (2013, 2014, 2015), Sinha, (2015), Chakravorty and Gosh (2012), Deb (2009) etc. Subba rao (2013) grouped 65 farmers varieties of rice by using essential characters and found 32 distinct varieties among the 65 rice accessions. In spite of agromorphic characters rice varieties have their own ethical value also. From the stress resistant study, it was observed that, variety

Asanlaya, Vutmuri, Kelesh, Daharlagra, Dharansal, Nona, Patnai-23, Dangapatnai, Nonabokra, Badshabhog, Sindurmukhi, Kataribhog, Latisal etc. have potentiality to resist against the various biotic and abiotic stress. Rice varieties resistant to various stress are given in Table 4. The results of this study will be use full for selection of rice varieties for hybridization programme. Rice landraces with distinct characters must be restore because these varieties have wide genetic variation into their gene pool and which will be utilized for the improved varieties in future and these varieties are the backbone of sustainable agriculture. Morphological variation is a clear indication of presence of genetic variation among the different varieties. But in spite of having poor yield characters the role of these folk varieties for sustainable agriculture are enormous because all HYVs are evolved from these folk varieties and theses varieties consist of numerous important QTL which may use for the future crop improvement.

Table 3. Characterization of 55 landraces of rice as per distinct characters

Name of Landraces	BLC	50% FL	ST	DGL	DGS	GC	AMY	AR
Agniban	Green	Late	very short	Medium	Medium Sl.	White	High	Absent
Asanlaya	Light purple	Early	very short	Medium	Short bold	White	high	Absent
Bahurupi	Green	Medium	very short	Medium	Short bold	White	high	Absent
Baskamini	Green	Medium	very short	Long	Long sl.	Light brown	Medium	Present
Bhadoi	Green	Early	very short	Medium	Short bold	Light red	Medium	Absent
Bharamarmali	Uniform purple	Medium	very short	Medium	Short bold	Dark brown	Medium	Absent
Bhuri	Green	Late	very short	Medium	Long bold	Light brown	Medium	Absent
Bombaimugi	Light purple	Late	very short	Medium	Medium Sl.	Dark brown	Medium	Absent
Byamajhupi	Green	Medium	very short	Medium	Long bold	Light purple	Medium	Absent
Chinakamini	Green	Late	very short	Long	Long sl.	Light brown	Medium	Absent
Chotodidi	Green	Medium	very short	Medium	Short bold	Light brown	high	Absent
Daharlagra	Green	Early	very short	Medium	Short bold	White	Medium	Absent
Dangapatnai	Uniform purple	Medium	very short	Medium	Short bold	White	Medium	Absent
Dharansal	Green	Medium	very short	Medium	Long bold	White	Medium	Present
Dudherswar	Green	Medium	very short	Medium	short sl.	Light brown	Medium	Present
Dudhkalam	Green	Medium	very short	Medium	Medium Sl.	Light brown	high	Present
Fulkhar	Green	Late	very short	Medium	Long bold	White	high	Absent
Fulpagri	Green	Late	short	Medium	Medium Sl.	White	Low	Absent
Gheush	Green	Early	very short	Medium	Long bold	White	high	Absent
Gokulsal	Green	Medium	very short	Medium	Short bold	White	high	Absent
Jaladhi	Green	Late	very short	Medium	Long bold	Vari. brown	high	Absent
Jaldhepa	Light purple	Late	very short	Medium	Short bold	White	Medium	Absent
Jamaynadu	Light purple	Medium	very short	Medium	Short bold	White	Medium	Absent
Jhilik	Green	Late	very short	Long	Long sl.	Light brown	High	Absent
Jhulur	Green	Late	very short	Medium	Long sl.	Light brown	high	Absent
Kabiraj	Green	Early	very short	Long	Long sl.	White	high	Absent
Kaksal	Green	Late	very short	Medium	Short bold	Dark brown	Medium	Absent
Kalobayar	Uniform purple	Late	very short	Medium	Long bold	Light brown	Medium	Absent
Kalojira	Light purple	Medium	very short	Short	Medium Sl.	White	Medium	Present
Kartiksal	Green	Medium	very short	Short	Medium Sl.	White	Medium	Present
Kasiphul	Green	Medium	very short	Medium	Medium Sl.	Light brown	Medium	Absent
Kataribhog	Green	Medium	very short	Short	Short bold	White	High	Present
Laltipa	Green	Medium	very short	Medium	Short bold	Dark brown	Medium	Absent
Langalmura	Uniform purple	Medium	very short	Medium	Long bold	Dark brown	Medium	Absent
Like-Kakua	Green	Medium	very short	Short	Short bold	Dark brown	high	Absent
Malsira	Green	Medium	very short	Medium	Short bold	White	Medium	Absent
Marichsal	Green	Medium	very short	Short	Short bold	Light brown	Medium	Absent
Mukta	Green	Late	very short	Medium	Medium Sl.	White	High	Absent
Murkimala	Uniform purple	Late	short	Long	Short bold	Light brown	Medium	Absent
Nabanna	Green	Medium	very short	Long	Long sl.	Light brown	Medium	Absent
Nagrasal	Green	Medium	very short	Medium	Short bold	Light brown	Medium	Absent
Narkeljhopa	Green	Medium	very short	Medium	Medium Sl.	White	Medium	Absent
Neta	Light purple	Medium	very short	Medium	short sl.	White	Medium	Absent
Nonabogra	Green	Medium	very short	Medium	Short bold	Light red	Medium	Present
Nugenbaro	Green	Medium	very short	Medium	Long bold	White	Medium	Absent
Panati	Green	Late	very short	Short	Short bold	White	High	Absent
Patnai-23	Green	Medium	very short	Long	Long sl.	White	Medium	Absent
Radhatilak	Green	Late	very short	Medium	Short bold	White	Medium	Present
Rupsal	Green	Medium	very short	Medium	Long sl.	White	Medium	Absent
Sindurmukhi	Green	Medium	very short	Medium	Short bold	Light brown	high	Absent
Sonagori	Green	Late	very short	Short	Short bold	Dark brown	Medium	Absent
Suakalma	Green	Late	very short	Long	Long sl.	White	Medium	Absent
Talmugurdhan	Green	Late	very short	Short	Short bold	Dark brown	Medium	Absent
Valki	Green	Medium	very short	Medium	Short bold	Light brown	Medium	Absent
Vutmuri	Green	Medium	very short	Medium	Long sl.	Light brown	Medium	Absent

**Legends:**

[BLC- Basal leaf: Sheath colour,

50%FLA- 50% of plants with panicles,

ST- Stem length,

DGL-Decorticated grain length,

DGS- Decorticated grain shape,

GC- Decorticated grain colour,

AMY- Content of amylose in endosperm,

AR- Grain aroma]

Table 4. Traditional rice varieties Resistance to various abiotic and biotic Stress

Biotic stress	Drought	Asanlaya, Vutmuri, Kelesh, Daharlagra, Dharansal
		Salinity
Abiotic stress (disease resistant)	BLB	Badshabhog
	Sheath Blight	Sindurmukhi
	Tungro	Kataribhog, Latisal

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