Characterization of Landraces of Rice from Eastern India

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For the establishment of the distinctness, a set of 51 landraces of rice were characterized for 46 characters following standard Distinctiveness, Uniformity and Stability (DUS) testing guidelines for three seasons. Out of 51 varieties studied, 27 were found to be distinctive on the basis of 22 essential and 24 additional characters. The present study will be useful for breeders, researchers and farmers to identify valuable germplasm and their conservation as well as utilization in rice improvement as well as also to seek protection under Protection of Plant Varieties and Farmers' Rights Act.

Key Words: Characterization, DUS test, PPV&FR Act, Rice landraces, Varieties

Introduction

To meet the continuously expanding needs of varietal improvement, the assemblage, evaluation, preservation and characterization of the entire existing germplasm are essential to more rewarding breeding efforts. Until a collection has been properly evaluated it has little practical use (Chang, 1976). India has a rich and diverse genetic wealth of rice and it has been estimated from various surveys that nearly 50,000 types of rice are still being grown in the country (Roy *et al*. 1985).The switch over to high yielding varieties with the spread of modern agriculture, has posed a great threat to the security of the age old practice of growing traditional varieties and landraces which may have immense potential for different important traits (Richharia, 1979; Sharma *et al*., 1987; Patra, 2000). In order to prevent any further gene erosion, collection and conservation of such invaluable genetic resources of rice is essential. Characterization of variety is useful to identify and avoid duplication. 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). Qualitative traits being more stable over generations (Raut, 2003) are reliable for characterization of varieties.

Being signatory to the General Agreement on Trade and Tariffs, Government of India has enacted its *sui-generis* system, Protection of Plant Varieties and Farmers' Right Act (PPV&FRA), 2001 for providing protection to plant varieties based on distinctiveness, uniformity and stability (DUS) test, apart from novelty (Anonymous, 2001). Therefore, the characterization of a variety is a prerequisite and identification of plant varieties of common knowledge is essential for the protection of new plant varieties. Article 15.3(b) of the PPV&FRA states that the new variety must be clearly distinguishable by one or more essential characters from any variety whose existence is a matter of common knowledge at the time of seeking protection. The uniqueness of a variety is to be established by following standard DUS testing guidelines.

Keeping in view these facts, the present investigation was planned to characterize a set of *aman* rice genotypes of West Bengal, to understand *in situ* variability of different agro-morphological traits and interrelationship among them.

Materials and Methods

Fifty one landraces of rice were grown in a Randomized Complete Block Design with two replications at the research farm of Zonal Adaptive Research Station, (23˚24´N latitude and 88˚31´E longitude with an altitude of 9.75 meters msl) Krishnagar, Nadia, West Bengal, India during *kharif* season for three consecutive years of 2008, 2009 and 2010. The soil is slightly acidic with pH of 6.0, low soluble salts (EC of 0.15 dS m^{-1}**),** medium organic carbon content (0.57%), Total N (0.056%), medium in available P (25.28 kg ha^{-1}) and K (148.77 kg ha^{-1}). The experimental site belongs to tropical humid climate having the average rainfall of 1464 mm, most of the amount falls between June to September. The minimum temperature reaches 7.6˚C in the month of January and the maximum 41.1˚C in the month of May. It has been

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observed that 74.7% of the annual rainfall is obtained during June to September and more than 83.6% during June to October. The materials were transplanted in 3.0×2.85m^2 plot with plant to plant spacing 15 cm within a row and row to row spacing of 20 cm, plot to plot distance was 60 cm. A random sample of five competitive plants was used for observations on different traits under study. Crop was raised following recommended package of practices. Fertilizers (N:P_2O_5:K_2O) @ 50:25:25 kg ha^{-1} were applied.

Among the qualitative trait, 46 visually assessed characteristics were observed according to the National Test Guidelines for DUS test in rice developed by Directorate of Rice Research, Hyderabad in consultation with the national core group experts for development of national guidelines in crop plants and also with the rice experts. The observation of various characteristics was recorded at different stages of growth with appropriate procedures as per the DUS test guidelines of PPV&FRA, (Shobha Rani *et al.,* 2004).

Results and Discussion

Qualitative characters are considered as marker characters in the identification of landraces of rice, which are less influenced by environmental fluctuations. The work on inheritance and linkage studies of qualitative characters was reviewed by Raut (2003). The published work (Satyavathi and Subramanyam, 2004) also substantiated that the flower petal colour, presence and absence of pod hair, colour of hair, seed colour were the most stable characters across the agroclimatic zones. To establish distinctiveness among rice cultivars, data on 46 characters have been recorded (Table 1).

For leaf characteristics, intensity of green colour was dark in 17 cultivars. Out of 51 cultivars, 25 cultivars had leaf anthocyanin colouration. Among 25, variety G28 is distinct for having uniform distribution of anthocyanin colouration. Anthocyanin colouration in leaf sheath was present in 18 cultivars, out of which, 3 cultivars (G6, G36 and G41) had medium, 5 cultivars (G7, G2, G20, G49 and G29) had weak intensity of anthocyanin colouration. Three cultivars (G22, G28 and G48) were found to be distinct for having strong pubescence while 7 cultivars were marked for absence of pubescence in leaf blade.

Seven cultivars were distinguished for absence of leaf auricle (G7, G8, G16, G18, G23, G25 and G45). Out of rest 44 varieties, 6 varieties (G17, G21, G24, G39, G41 and G510) were marked for having purpled coloured auricle. Leaf collar was absent in two cultivars *viz.*, G20 and G45. Out of 49 cultivars, 6 cultivars (G5, G21, G30, G41, G46 and G51) were distinguished for having anthocyanin colouration both in leaf auricle and leaf collar (Table 1).

Regarding leaf ligule shape, variety G49 was distinct for having truncate ligule shape. Six varieties (G12, G14, G15, G24, G42 and G45) were distinguished for having acute ligule shape. Rest of the varieties had split shaped ligule. Two cultivars *viz.* G20 and G45 were marked for absence of leaf ligule among 51 cultivars. Six cultivars (G6, G7, G21, G23, G37 and G51) were distinguished for having purple coloured ligule (Table 1).

Cultivars *viz*., G5, G11, G12, G16, G27 G28, G42 and G45 were found to possess long leaf length and broad leaf breadth along with erect early flag leaf attitude. Since, erect flag leaf angle was associated with high yield in rice (Chang and Tagumpay, 1970), hence, cultivars with erect flag leaf are more disinguished here. Increasing light penetration into crop canopy has been suggested as one of the ways of obtaining higher grain yields. Duncan (1971) showed that increased penetration of light into canopy would increase photosynthetic rate and perhaps enhance grain yield.

There was no deflexed flag leaf at early observations but 5 cultivars (G15, G18, G22, G31 and G49) showed deflexed flag leaf attitude during the late observations (Table 1).

In case of time of heading, 7 cultivars (G7, G16, G18, G25, G27, G41 and G45) were distinguished for early category while 7 cultivars *viz*., G28, G29, G30, G32, G36, G44 and G48 showed very late time of heading. It was very interesting to find out that varieties G30 and G44 with spreading culm attitude showed very late time of heading while cultivars *viz.,* G7, G16, G27 and G41 having early time of heading showed erect culm attitude (Table 1).

Regarding anthocyanin colouration in lemma of spikelet, 3 cultivars *viz*., G22, G47 and G50 had strong colouration in keel, two cultivars *viz*., G17 and G50 had strong colouration at the area below apex and three cultivars viz., G5, G23 and G50 had strong anthocyanin colouration at the apex. Cultivars G38 and G51 were distinguished for having purple coloured stigma (Table 1).

Table 1. Characterization of the cultivars (total 51) as per DUS guidelines

Sl. No.	Cultivars	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
G1	Ranisal	C	G	M	P	IBO	A	-	W	P	C	P	A	P	S	LP	M	M	SE	Ho	SE	L	VW	A	A	w	M	M	A	-	A	M	Ss	M	A	w	Sw	A	-	-	-	P	W	E-S	PE	L	I
G2	Badhabna	G	G	M	P	IBO	P	VW	M	P	C	P	A	P	S	LP	M	M	SE	Ho	SE	L	W	W	A	LG	M	M	A	-	A	M	Ss	M	A	w	Sw	A	-	-	-	P	S	SE	ME	M	E
G3	Machkata	C	G	D	P	IBO	A	-	W	P	C	P	A	P	S	LP	M	M	Ho	Ho	SE	L	W	W	A	LG	M	Sh	A	-	A	M	Ss	M	M	b	GG	A	-	-	-	P	S	E-S	ME	L	L
G4	Laldhula	C	G	M	P	IBO	A	-	M	P	C	P	A	P	S	LP	M	M	SE	Ho	E	M	VW	A	A	w	Tn	M	A	-	A	Lg	Ss	M	M	B	GG	A	-	-	-	P	S	E-S	PE	M	I
G5	Dhula-dhan	P	G	D	A	-	A	-	A	P	C	P	P	P	S	LP	L	B	E	SE	E	L	VW	W	S	LG	M	M	A	-	P	Lg	s	F	S	B	b	A	-	-	-	P	S	E-S	PE	L	L
G6	Dhuri	C	G	M	P	IBO	P	M	M	P	C	P	A	P	S	P	M	M	SE	Ho	O	M	VW	A	A	LG	M	M	A	-	P	M	s	m	W	w	Sw	A	-	-		P	W	E-S	PE	M	E
G7	Kalam-kathi	P	G	M	P	IBO	P	W	W	A	-	P	A	P	S	P	S	N	E	SE	E	E	VW	A	A	LG	M	Sh	A	-	A	VSh	s	M	W	Y	Sw	A	-	-	-	P	W	E	ME	E	E
G8	Suakalma	C	G	M	A	-	A	-	M	A	-	P	A	P	S	LP	M	M	SE	Ho	E	L	W	M	A	LG	Tn	Sh	A	-	P	M	D	m	W	Y	By	A	-	-	-	P	W	E-S	ME	L	E
G9	Nakrasal	C	G	D	A	-	A	-	W	P	C	P	A	P	S	LP	M	M	SE	Ho	E	L	VW	A	A	LG	Tn	M	A	-	A	Lg	D	M	W	Y	Bf	A	-	-	-	P	W	E-S	ME	L	E
G10	Asanlaya (White)	C	G	M	A	-	P	VW	W	P	C	P	A	P	S	LP	M	M	E	SE	E	L	VW	A	A	LG	Tn	Lg	A	-	A	Lg	s	F	W	w	Sw	A	-	-	-	P	W	E-S	ME	L	E
G11	Asanlaya (Red)	C	G	M	P	IBO	A	-	M	P	C	P	A	P	S	LP	L	B	E	SE	E	L	VW	A	A	LG	Tn	Lg	A	-	A	Lg	s	F	A	w	Sw	A	-	-	-	P	S	E-S	PE	L	E
G12	Pubalgara	C	G	M	A	-	P	W	A	P	LP	P	A	P	Ac	LP	L	B	E	SE	E	L	VW	A	A	w	Tk	Lg	A	-	A	Sh	Ss	M	S	Y	Bs	P	Yw	L	UHO	P	W	E-S	ME	L	L
G13	Daharn-agra	G	LP	M	A	-	A	-	A	P	LP	P	A	P	S	LP	M	M	SE	Ho	E	L	VW	A	A	w	Tn		A	-	A	M	Ss	F	S	Y	Bf	A	-	-	-	P	S	E-S	ME	L	I
G14	Kalonunia	C	G	D	P	OMO	A	-	W	P	C	P	A	P	Ac	LP	M	M	SE	Ho	SE	L	VW	A	A	w	Tn	VSh	A	-	A	M	Ss	M	W	Y	GG	A	-	-	-	P	S	E-S	ME	L	I
G15	Tulsibhog	C	G	L	A	-	A	-	W	p	LP	P	A	P	Ac	LP	S	N	SE	DF	E	L	VW	A	A	w	M	M	A	-	A	VLg	s	M	W	Y	GG	P	b	M	TO	P	W	E-S	WE	L	I
G16	Mahisl-adan	C	G	M	A	-	A	-	M	A	-	P	A	P	S	LP	L	B	E	SE	E	E	W	A	A	LG	M	Lg	A	-	A	M	s	m	M	B	Bf	P	b	VSh	WL	P	W	E-S	ME	E	L
G17	Dudhk-alma	C	G	M	A	-	A	-	M	P	P	P	A	P	S	LP	M	M	SE	Ho	SE	L	M	S	A	LG	Tk	Vl	A	-	A	M	s	M	W	b	Pf	A	-	-	-	P	S	E-S	PE	L	L
G18	Sankarsal	G	LP	L	A	-	A	-	W	A	-	P	A	P	S	LP	S	N	Ho	DF	Sp	E	VW	A	A	w	Tn	Sh	A	-	A	Sh	D	F	W	w	Sw	A	-	-	-	P	W	E	ME	E	E
G19	Badsa-bhog	C	G	D	A	-	A	-	W	P	C	P	A	P	S	LP	M	M	Ho	Ho	O	L	VW	A	A	w	M	Lg	A	-	A	M	Ss	M	M	w	Bt	A	-	-	-	P	W	E-S	PE	L	I
G20	Agnisal	C	G	M	P	OMO	P	W	M	P	C	P	A	A	S	G	M	M	SE	SE	SE	L	VW	A	W	LG	M	M	A	-	A	Lg	Ss	F	S	B	Bf	A	-	-	-	P	S	E-S	WE	L	I
G21	Chandra-kanta	C	G	M	A	-	A	-	W	P	P	P	P	P	S	P	M	M	SE	Ho	Sp	M	VW	A	A	LG	M	Lg	A	-	A	M	Ss	F	M	B	Bf	P	Yw	L	TO	P	S	E-S	ME	M	I
G22	Muktasal	G	G	D	P	OMO	P	VW	S	P	LP	P	A	P	S	LP	L	B	SE	DF	E	M	S	W	A	LG	Tk	VLg	A	W	A	M	s	F	M	Y	Sw	P	Yb	L	TO	P	W	E-S	ME	M	L
G23	Punjubsal	P	PL	M	A	-	A	-	W	A	-	P	A	P	S	P	M	M	SE	Ho	Sp	M	VW	W	S	LG	M	VSh	A	-	A	Sh	s	M	M	P	Bt	P	Yw	M	WL	P	W	E-S	ME	M	L
G24	Sitasal	C	G	D	P	IBO	A	-	W	P	P	P	A	P	Ac	LP	L	B	SE	Ho	E	L	VW	A	A	LG	Tk	M	A	-	A	Lg	s	M	W	Y	Sw	A	-	-	-	P	S	E	PE	L	L
G25	Behalsal	C	G	D	A	-	A	-	M	A	-	P	A	P	S	LP	M	M	E	SE	SE	E	VW	A	A	LG	Tn	M	A	-	A	Sh	Ss	F	W	w	GG	P	Yw	VLg	TO	P	W	E	PE	E	E
G26	Kabirajsal	C	G	M	A	-	A	-	A	P	C	P	A	P	S	LP	S	N	SE	Ho	E	L	VW	A	A	w	M	M	A	-	A	Lg	Ss	M	W	w	GG	A	-	-	-	P	W	E-S	ME	L	I
G27	Laldhusri	C	G	D	P	OMO	A	-	M	P	C	P	A	P	S	LP	L	B	E	SE	E	E	W	A	A	LG	M	M	A	-	A	VLg	s	F	W	w	GG	A	-	-	-	P	W	E	PE	E	I
G28	Malliksal	G	G	D	P	U	A	-	S	P	C	P	A	P	S	LP	L	B	E	SE	E	VL	VW	A	A	w	Tk	Lg	A	-	A	Lg	s	M	W	w	GG	P	Yw	VLg	TO	P	S	E-S	ME	VL	I
G29	Baidjhulur	G	G	D	P	OMO	P	VW	M	P	LP	P	A	P	S	LP	L	B	SE	Ho	E	VL	VW	A	A	w	Tn	Sh	A	-	A	Lg	Ss	M	W	Y	Sw	A	-	-	-	P	W	E-S	ME	VL	I

G30	Jhulur	G	G	M	P	OMO	A	-	M	P	C	P	P	P	S	G	M	M	E	Ho	Sp	VL	VW	A	A	LG	Tk	VLg	A	-	A	Lg	Ss	M	M	Y	Bf	A	-	-	-	P	W	E	PE	VL	L
G31	Manika-nchan	C	G	L	A	-	A	-	W	P	C	P	A	P	S	G	S	N	Ho	DF	O	M	VW	A	A	w	Tk	VLg	A	-	A	Sh	D	M	W	w	Sw	A	-	-	-	P	W	S-S	ME	M	L
G32	Nagra	G	G	M	A	-	P	VW	M	P	C	P	A	P	S	LP	M	M	SE	SE	Sp	VL	W	A	A	w	M	M	A	-	A	Lg	s	F	W	w	GG	A	-	-	-	P	W	E-S	ME	VL	I
G33	Danaguri	G	G	M	A	-	P	VW	M	P	C	P	A	P	S	LP	S	N	SE	SE	O	M	VW	W	A	LG	Tn	Sh	A	-	P	M	Ss	M	W	w	Sw	A	-	-	-	P	W	E	ME	M	I
G34	Majhisal	C	G	M	A	-	P	VW	W	P	C	P	A	P	S	LP	M	M	SE	SE	O	M	VW	A	A	LG	Tk	Lg	A	-	A	M	s	F	S	B	GG	A	-	-	-	P	W	E-S	PE	M	I
G35	Basmoti -local	C	G	M	A	-	P	VW	W	P	C	P	A	P	S	LP	S	N	SE	SE	O	M	VW	A	M	w	Tk	Sh	A	-	A	M	Ss	M	M	Y	Bt	A	-	-	-	P	S	E-S	ME	M	I
G36	Netaisal	C	G	M	P	OMO	P	M	W	P	C	P	A	P	S	LP	M	M	SE	SE	SE	VL	VW	W	A	Y	Tn	M	A	-	A	VLg	Ss	m	W	Y	Bt	A	-	-	-	P	W	E	ME	VL	I
G37	Sankar Kalma	C	G	M	P	OMO	A	-	M	P	LP	P	A	P	S	P	M	M	E	E	E	L	VW	A	A	w	M	Lg	A	-	A	Lg	Ss	m	M	B	Bt	P	B	M	TO	P	W	E	PE	L	I
G38	Rupsal	C	G	L	A	-	A	-	A	P	C	P	A	P	S	G	M	M	SE	SE	Sp	L	VW	A	A	P	Tk	Lg	A	-	A	Lg	Ss	M	W	P	Bs	A	-	-	-	P	W	E	PE	L	L
G39	Jhingasal	C	G	M	P	IBO	A	-	M	P	P	P	A	P	S	LP	M	M	E	E	O	L	VW	A	VS	LG	Tk	Lg	A	-	A	Lg	Ss	M	W	Y	Bt	A	-	-	-	P	S	E	PE	L	L
G40	Sungakalma	C	PL	M	P	OMO	A	-	W	P	C	P	A	P	S	LP	L	B	SE	SE	E	L	VW	A	A	w	M	M	A	-	A	Lg	s	M	M	w	Bs	A	-	-	-	P	W	E-S	PE	L	L
G41	Jhuli	P	PL	M	P	IBO	P	M	A	P	P	P	P	P	S	LP	L	B	SE	SE	E	E	W	A	A	w	M	M	A	-	A	VLg	Ss	m	M	w	Bs	A		-	-	P	W	E-S	PE	E	I
G42	Raja Badsa	C	PL	D	A	-	A	-	W	P	C	P	A	P	Ac	LP	L	B	E	SE	O	L	M	A	A	w	Tk	Lg	P	S	P	Lg	Ss	m	W	Y	Sw	A	-	-	-	P	W	E-S	ME	L	E
G43	Kalma	C	PL	M	P	OMO	P	VW	M	P	C	P	A	P	S	LP	M	M	E	SE	Sp	M	VW	W	VS	LG	M	Lg	A	-	A	Lg	Ss	F	M	P	Pf	P	P	M	TO	P	W	E-S	PE	M	E
G44	Sunga Nagra	C	PL	D	P	OMO	P	VW	M	p	C	P	A	P	S	LP	M	M	SE	SE	Sp	VL	VW	A	A	LG	M	M	A	-	A	VLg	Ss	F	W	w	Sw	P	P	M	TO	P	W	E	WE	VL	I
G45	Kerala Sundari	C	PL	M	A	-	A	-	A	A	-	P	A	A	Ac	LP	L	B	E	SE	E	E	VW	A	A	w	M	M	A	S	P	VLg	s	M	M	Y	Sw	P	Yw	M	TO	P	W	E-S	PE	E	I
G46	Baloramsal	C	PL	D	P	OMO	P	VW	M	P	C	P	P	P	S	LP	M	M	SE	SE	Sp	L	VW	A	A	LG	Tk	M	A	-	A	Lg	D	M	W	Y	Bs	A	-	-	-	P	W	E-S	WE	L	I
G47	Danga	C	PL	M	A	-	A	-	M	P	C	P	A	P	S	G	L	B	SE	SE	SE	L	S	W	A	LG	Tk	M	A	-	A	Lg	Ss	M	M	B	Bf	P	Yw	L	TO	P	W	E-S	WE	L	I
G48	Asanlaya	C	PL	D	A	-	A	-	S	P	C	P	A	P	S	G	M	M	E	SE	E	VL	VW	A	W	LG	Tk	M	A	-	A	Sh	s	F	W	B	GG	A	-	-	-	P	W	E-S	ME	VE	I
G49	Lalhusri	C	PL	M	A	OMO	P	W	W	P	LP	P	A	P	Tr	LP	S	M	SE	DF	Sp	L	VW	A	W	Y	M	Lg	P	W	P	M	D	M	M	Y	Bs	A	-	-	-	P	S	Sr	WE	L	L
G50	Annada	C	PL	D	A	IBO	A	-	M	P	C	P	A	P	S	LP	M	M	E	SE	SE	M	S	S	S	LP	Tk	Lg	A	-	A	Lg	s	M	M	B	Bt	P	P	VLg	WL	P	W	S-S	WE	M	L
G51	Sarkele aman	G	PL	D	A	IBO	A	-	M	p	P	P	P	P	S	P	M	M	SE	Ho	O	L	VW	W	VWP		Tk	Lg	P	W	P	Lg	s	M	M	R	Bf	P	Yw	M	TO	P	S	E-S	PE	L	L

N.B. Place of collection: Zonal Adaptive Research Station (Z.A.R.S.), Krishnagar, Nadia, West Bengal

1.Coleoptile Colour, 2.Basal leaf sheath colour, 3.Intensity of green colour, 4.Anthocyanin colouration, 5.Ditribution of anthocyanin colouration, 6.Leaf sheath anthocyanin colouration, 7.Intensity of anthocyanin-colouration, 8.Pubescence of blade surface, 9.Auricle, 10.Anthocyanin colouration of auricle11.Leaf collar, 12.Anthocyanin colouration of collar, 13 Leaf ligule, 14.Ligule shape, 15.Ligule colour, 16.Length of leaf blade, 17.Width of leaf blade, 18.Flag leaf (early observation), 19.Flag Leaf (Late observation), 20.Culm-stem attitude. 21.Time of heading, 22.Anthocyanin colouration of keel, 23.Anthocyanin colouration of area below apex, 24.Anthocyanin colouration of apex, 25.Colour of stigma. 26.Stem, thickness, 27.Length, 28.Anthocyanin colouration of the node, 29.Intensity of anthocyanin colouration the node, 30.Intensity of anthocyanin colouration the internode, 31.Length of main axis, 32.Curvature of main axis, 33.Number per plant, 34.Density of pubescence of lemma, 35.Colour of tip of lemma. 36.Colour of lemma and pelea in spikelet, 37.Awns, 38.Colour of awns, 39.Length of longest awn,40.Distribution of awn.41.Presence of secondary branching, 42.Secondary branching, 43.Attitude of branches, 44.Exsertion, 45.Time of maturity, 46.Leaf senescence.

A=Absent, Ac=Acute, B=broad, B=black, By=Browm tawny, BS=Brown spot, BF=Brown furrows, PF=Purple furrows, C=Colourless, D=Drooping, D=Dark, DF=deflexed, E=erect, F=Few, G=Green, GG=Gold & Gold furrows, Ho=Horizontal, LP=Light purple, LI=Light, LO=Long, Lg=long, M=medium, ME=Mostly exserted, N=Narrow, O=Open, OTO=On Tip Only, OMO=On Margins Only, OBO=On Blotches Only, P=purple, PL=Purple Lines, P=Present, PE=Partly exserted, R=Red, S=Strong, SP=Split, SH=Short, SE=Semierect, S-E=Semierect to Spreading, S=Straight, SS=Semi Short, TR=Truncate, U=Uniform, VW=Very Weak, VE=very Early, VLg=Very Long, VL=Very Late, Vsh=Very Short, W=White, W=weak, WE=Well exserted, Y=Yellowish.

In case of stem, cultivars with thick and very long stem were G17, G30 and G31. Besides, cultivars G12, G34, G38, G39, G42, G50 and G51 were distinguished for having thick stem with long stem length. Anthocyanin colouration was found in node of three cultivars *viz*., G22, G42 and G49, among which G22 had strong colouration. Cultivars G42 and G49 have anthocyanin colouration in internode along G5, G6, G8, G33, G45 and G51.

In explaining the panicle features, cultivars G36 and G41 were distinguished for having very long panicle length along with many panicle numbers/plant with semi straight curvature on the mail axis. Few cultivars like G16, G37 and G42 although having many panicle numbers/plant, have medium to long panicle length of main axis. Drooping curvature on main axis were found in 6 cultivars *viz.,* G8, G9, G18, G31, G46 and G49.

In case of density of pubescence on lemma on spikelets, it was absent in 5 cultivars *viz*., G1, G2, G11, G24 and G25 but it was very strong in cultivars like G5, G12, G13, G20 and G34 which are very much distinct from the rest varieties. Also, colour of tip of the lemma was purple in varieties like G23, G38 and G43 but red in G51.

A large amount of variation in colour have been found in the colouration of lemma and palea (Table 6). Awn was present in 15 cultivars, out of which, very long awn was found in G25 and G50, long in G12, G21, G22 and G47 and very short in G16. The rest 36 cultivars were lacking this awn. Much variation was found in colouration of the awn (Table 1). Awns were distributed on whole length in G16, G23 and G50, only on upper half in G12 and on tips only in the rest of the cultivars (Table 1).

Thus, variations in anthocyanin pigmentation have been found in the plant parts, such as, apiculous, awn, leaf blade, coleoptiles, collar, hull (lemma and palea), internode, leaf sheath, leaf tip and margin, ligule, midrib and stigma. The colour variations were colourless (white), green pink, red and several shades of purple.

The genes controlling anthocyanin pigmentations are basically three complementary genes: C_5, A and P_6. The gene C is basic for producing chromagen, while A controls the conversion of chromagen into anthocyanin and P controls the distribution or localization of anthocyanin in specific plant organ or organs. Non-anthocyanin pigmentation generally involves a single pair or a series of alleles, such as *Bf* alleles for brown furrows on hull at maturity, *Bh* genes for black hull and *gh* for gold hull (Anonymous, 1959).

Secondary branching was present in all the cultivars but strong branching was found in 16 cultivars. Well exertion of panicle was found in 7 cultivars like G15, G20, G44, G46, G47, G49 and G50. Cultivars like G36 and G48 were distinguished for very early time of maturity while 5 cultivars *viz.,* G23, G24, G28, G29, G30, G32 and G44 were distinguished for very late time of maturity. Seven cultivars had early but maximum accessions showed late time of maturity. Leaf senescence was early in 11 cultivars while it was late in 16 cultivars. Cultivars G28, G29, G32, G44 and G48 had intermediate while G30 had late leaf senescence (Table 1).

Studies on quantitative traits have earlier been made by Chakravorty and Ghosh (2011). Maximum plant height (43.0 cm) was obtained in variety G51 while minimum (24.0 cm) in variety G15. Data on 1000 grain weight among varieties varied from 10.4 g (in G26) to 29.91 g (in G51). G23 and G24 recorded the late maturity in days (172.5 days) while it was recorded to be shortest with G36 (116 days).

Thus, it is concluded that out of 51 landraces of rice, 27 cultivars were found to be distinctive on the basis of 22 essential and 24 additional characters.

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