Reprint **ISSN 1991-3036 (Web Version)**

International Journal of Sustainable Crop Production (IJSCP)

(*Int. J. Sustain. Crop Prod.*)

Volume: 15 **Issue: 1** **May 2020**

Int. J. Sustain. Crop Prod. 15(1): 13-19 (May 2020)

DISTINCTNESS, UNIFORMITY AND STABILITY (DUS) CHARACTERIZATION FOR BRRI DEVELOPED RICE VARIETIES OF BANGLADESH

S.K. DEBSHARMA, P.R. ROY, R.A. BEGUM, K.M. IFTEKHARUDDAULA, K.K. ROY AND M.Z. HOSSAIN

An International Scientific Research Publisher

Green Global Foundation©

Web address: http://ggfjournals.com/e-journals archive

E-mails: editor@ggfjournals.com and editor.int.correspondence@ggfjournals.com

ISSN-1991-3036 (Online)
Int. J. Sustain. Crop Prod. 15(1):13-19(May 2020)

DISTINCTNESS, UNIFORMITY AND STABILITY (DUS) CHARACTERIZATION FOR BRRI DEVELOPED RICE VARIETIES OF BANGLADESH

S.K. DEBSHARMA[1*], P.R. ROY[2], R.A. BEGUM[2], K.M. IFTEKHARUDDAULA[1], K.K. ROY[3] AND M.Z. HOSSAIN[2]

[1]Plant Breeding Division, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh; [2]Seed Certification Agency (SCA), Ministry of Agriculture, The People's Republic of Bangladesh, Gazipur-1701, Bangladesh; [3]Plant Pathology Division, Bangladesh Wheat and Maize Research Institute, Dinajpur-5200, Bangladesh.

*Corresponding author & address: Sanjoy Kumer Debsharma, E-mail: sanjoybrri@gmail.com
Accepted for publication on 7 May 2020

ABSTRACT

Debsharma SK, Roy PR, Begum RA, Iftekharuddaula KM, Roy KK, Hossain MZ (2020) Distinctness, Uniformity and Stability (DUS) characterization for BRRI developed rice varieties of Bangladesh. *Int. J. Sustain. Crop Prod.* 15(1), 13-19.

For characterization of the distinctness and uniformity among eighteen newly released rice varieties developed by BRRI, thirty-eight characters were used. Characterization were performed using thirty-eight agro-morphological traits following Distinctiveness, Uniformity and Stability test (DUS) during T. Aman and Boro season of 2018 and 2019, respectively at the Seed Certification Agency (SCA) farm, Gazipur-1701, Bangladesh. Among the 38 DUS characters utilized in the characterization of eighteen rice genotypes, five characters *viz*., penultimate leaf: ligule, shape of the ligule, anthocyanin colouration of internodes, panicle: attitude of branches, and sterile lemma length of spikelet's showed no variation and found distinctive among all of the cultivars. Maximum variability was observed with respect to pubescence of penultimate leaf, Spikelet-colour of tip of lemma, Panicle-exertion and Grain-length among all the cultivars. Anthocyanin colour of leaf sheath was present in BRRI dhan80 and BRRI dhan91. Dark green leaves colour was noticed in BRRI dhan86, BRRI dhan91 and BRRI dhan95. Cultivar BRRI dhan86 was identified with the presence of very short yellow white awns. The variety BRRI dhan80 was found with purple stigma while BRRI dhan83 as red, and remarkable purple tip colour of lemma was noticed in BRRI dhan80. Test weight of 1000 fully developed grains and grain length (without dehulling) of BRRI dhan90 were found as very low and very short, respectively. Decorticated unpolished grain colour was white as observed in BRRI dhan80 and BRRI dhan89, while only red colour in BRRI dhan84. Decorticated grain of BRRI dhan80 and BRRI dhan90 was identified based on light aroma. The cultivars BRRI dhan81, BRRI dhan84 and BRRI dhan89 were found chalkiness or size of white core in polish grain. This study will be useful for breeders, researchers and farmers to identify and choose the restoration and conservation of beneficial genes for crop improvement and also to establish protection under Plant Varieties and Farmer's Rights Protection Act.

Key words: *dus test, brri, rice varieties, characterization, bangladesh*

INTRODUCTION

Rice is one of the most important crops that belong to the family Poaceae and a major source of nutrition for about 2.5 billion people around the globe (Aiswariya and Thomas, 2016). In Bangladesh, there are three major growing seasons for rice namely Aus, T. Aman and Boro which constitute 100% of total rice production and grown in three overlapping seasons. To meet the continuously expanding needs of varietal improvement, the assemblage, evaluation, preservation and characterization of the entire existing germplasms are essential to more rewarding breeding efforts (Chatterjee *et al.* 2007). 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 development of one or more varieties depends on the final selection of superior plants by the plant breeder who uses several techniques to create the genetic variation and to select from within that variation (Subba Rao *et al.* 2013). Bangladesh has a rich and wide range of genetic wealth with biotic and abiotic stress tolerant rice genotypes. Internationally, DUS testing is coordinated by the International Union for the Protection of New Varieties of Plants (UPOV), which produces guidelines detailing lists of characters to be used for examination of different species. To comply with Trade Related Aspects of Intellectual Property Rights Agreement (TRIPs) under WTO and UN Convention on Biological Diversity (CBD), Bangladesh has been going to enact the Plant Varieties Protection and Farmers' Rights Act (PVPFR) very soon to provide legal framework for plant breeder's and farmer's rights. DUS are the essential requirements for grant of protection to all the varieties. DUS testing is a way of determining whether a newly bred variety differs from existing varieties within the same species (the Distinctness part), whether the characteristics used to establish Distinctness are expressed uniformly (the Uniformity part) and these characteristics do not change over subsequent generations (the Stability part). In Bangladesh, there is a provision of DUS tests for notified crops such as rice, wheat, jute, potato, sugarcane, kenaf and mesta by the organization SCA according to UPOV. The ability to distinguish and clearly identify the varieties of cultivated species is fundamental for the operational aspects in the seed trade. Therefore, a more precise system for identification of varieties, parents of hybrids and specific biodiversity units is the fundamental requirement to enforce this protection. Conventionally, morphological descriptors are routinely used for establishing the identity of varieties in the test. But the morphological descriptors suffer from many drawbacks such as influence of environment on trait expression, epistatic interactions, pleiotropic effects etc. The varieties have different physiological and

morphological characteristics that contribute towards yield (Yang *et al.* 2007; Yang and Hwa, 2008). One of researcher Ashrafuzzaman *et al.* (2009) found some variations in morphological and yield components in different varieties of aromatic rice. In this context, an attempt was made to characterize a set of eighteen BRRI newly released rice varieties for different morphological and agronomic traits, and to identify the variability available in the collection.

MATERIALS AND METHODS

Eighteen BRRI released varieties of rice were grown at the Seed Certification Agency (SCA) farm, Gazipur, situated at 23.98^{o}N latitude and 90.39^{o}E longitude (Table 1). The materials were grown in a complete randomized block design with five checks in two replications during both T. Aman and Boro season of 2018 and 2019, respectively. Each entry was sown in three-rows of 20 plants each, at a spacing of 15 cm between plants and 20 cm between rows and 1m isolation distance was maintained between two entries in each block. All the cultural practices followed according to the package of practices developed by Bangladesh Rice Research Institute (BRRI). Observations were recorded on five randomly selected plants of each genotype for all the traits in this study, at different stages of crop growth with appropriate procedures as per the Zadoks code. The traits studied were Leaf sheath: anthocyanin colour, Leaf colour, Penultimate leaf : pubescence of blade, Penultimate leaf : anthocyanin colour of auricles & collar, Penultimate leaf: ligule, Penultimate leaf: shape of the ligule, Flag leaf: attitude of blade, Time of heading (50% of plants with heads), Lemma and palea: anthocyanin colouration, Lemma : anthocyanin colouration below apex, Lemma: anthocyanin colouration of apex, Spikelet: colour of stigma, Culm diameter, Culm: Length, Stem: anthocyanin colouration of nodes, Stem: Intensity of anthocyanin colouration of nodes, Stem: anthocyanin colouration of internodes, Panicle: length, Panicle: curvature of main axis, Panicle: number of effective tillers in plant, Spikelet: pubescence of lemma and palea, Spikelet: colour of tip of lemma, Panicle: awn in spikelet, Panicle: length longest awn, Panicle: distribution & colour of awns, Panicle: attitude of branches, Panicle: exertion, Time of maturity, Grain: wt. of 1000 fully developed grains (at 12% moisture content), Grain: length (without dehulling), Spikelet : Sterile lemma length, Decorticated grain: length (After dehulling, before milling), Leaf senescence, Decorticated grain: shape (Length-breadth ratio), Decorticated unpolished grain: colour, Polished grain: size of white core or chalkiness, Endosperm: content of amylose, and Decorticated grain: aroma.

Table 1. Name of the genotypes, parentages and place of collection

Sl. No.	Name of genotypes	Parentage	Year of release	Growing season	Place of collection
01	BRRI dhan78	IR84645 / IR84649	2016	T. Aman	BRRI, Gazipur
02	BRRI dhan79	BRRI dhan49*6 / BRRI dhan52	2017	T. Aman	BRRI, Gazipur
03	BRRI dhan80	IR65610-105-2-5-2-2 / IR67423-208-6-2-3-3	2017	T. Aman	BRRI, Gazipur
04	BRRI dhan81	Amol-3 / BRRI dhan28	2017	Boro	BRRI, Gazipur
05	BRRI dhan82	Pure line of NERICA	2017	T. Aus	BRRI, Gazipur
06	BRRI dhan83	BR24 / BR1890-12-2-1-1-HR45	2017	B. Aus	BRRI, Gazipur
07	BRRI dhan84	BRRI dhan29 / IR68144 // BRRI dhan28 /// BR11	2017	Boro	BRRI, Gazipur
08	BRRI dhan85	BR4828-54-1-4-9 / IR50 // BR4828-54-1-4-9 / LUHONG ZAO1	2017	T. Aus	BRRI, Gazipur
09	BRRI dhan86	Niamat / BR802-78-2-1-1	2017	Boro	BRRI, Gazipur
10	BRRI dhan87	BRRI dhan29 / *Oryza rufipogon* (IRGC. 103404)	2018	T. Aman	BRRI, Gazipur
11	BRRI dhan88	Somaclonal variant of BRRI dhan29	2018	Boro	BRRI, Gazipur
12	BRRI dhan89	BRRI dhan29 / *Oryza rufipogon* (IRGC. 103404)	2018	Boro	BRRI, Gazipur
13	BRRI dhan90	BR7166-5B-1-RAN-1/ BRRI dhan34// BR7166-5B-1-RAN-1	2019	T. Aman	BRRI, Gazipur
14	BRRI dhan91	Tilakkachari / BRRI dhan41	2019	T. Aman	BRRI, Gazipur
15	BRRI dhan92	Rice/Wheat(RI)/BR319-1-HR2//DH(Mingolo/Suweon290)/Panbira	2019	Boro	BRRI, Gazipur
16	BRRI dhan93	Pure line selection of Swarna-5	2019	T. Aman	BRRI, Gazipur
17	BRRI dhan94	Pure line selection of Ranjit Swarna	2019	T. Aman	BRRI, Gazipur
18	BRRI dhan95	Red Swarna//Barisail/PSBRC2	2019	T. Aman	BRRI, Gazipur

Source: Bangladesh Rice Research Institute (2019)

Table 2. Essential characters along with descriptor

Sl. No.	Characteristics	States of the character (Code)						
01	Leaf sheath: anthocyanin colour	Absent (1)	Present (9)					
02	Leaf colour	Pale green (1)	Green (2)	Dark green (3)	Purple tip (4)	Purple margins (5)	Purple blotch (6)	Purple (7)
03	Penultimate leaf : pubescence of blade	Absent or very weak (1)	Weak or only on the margins (3)	Medium hairs on the lower portion of the leaf (5)	Strong hairs on the leaf blade (7)	Very strong (9)		
04	Penultimate leaf : anthocyanin colourations of auricles & collar	Absent (1)	Present (9)					
05	Penultimate leaf: Ligule	Absent (1)	Present (9)					
06	Penultimate leaf: shape of the ligule	Truncate (1)	Acute (2)	Split or two-cleft (3)				
07	Flag leaf: attitude of blade	Erect (<30) (1)	Intermediate or semi-erect (30-60) (3)	Horizontal (46-90) (5)	Reflexed or descending (>90)(7)			
08	Time of heading (50% of plants with heads)	Very early (1)	Early (3)	Medium (5)	Late (7)	Very late (9)		
09	Lemma and palea: anthocyanin colouration	Absent or very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)		
10	Lemma & palea: anthocyanin colouration below apex	Absent or very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)		
11	Lemma: anthocyanin colouration of apex	Absent or very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)		
12	Spikelet: colour of stigma	White (1)	Light green (2)	Yellow (3)	Light purple (4)	Purple (5)		
13	Culm diameter	Small (1)	Medium (3)	Large (5)	Very Large (7)			
14	Culm: Length	Very short (1)	Short (3)	Medium (5)	Long (7)	Very long (9)		
15	Stem: anthocyanin colouration of nodes	Absent (1)	Present (9)					
16	Stem: Intensity of antho colouration of nodes	Weak (3)	Medium (5)	Strong (7)	Very strong (9)			
17	Stem: anthocyanin colouration of internodes	Absent or very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)		
18	Panicle: length	Short (3)	Medium (5)	Long (7)	Very long (9)			
19	Panicle: curvature of main axis	Absent or very weak (1)	Weak (3)	Medium (5)	Strong (7)			

Sl. No.	Characteristics	States of the character (Code)						
20	Panicle: number of effective tillers in plant	Few (3)	Medium (5)	Many (7)				
21	Spikelet: pubescence of lemma & palea	Absent or very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)		
22	Spikelet: colour of tip of lemma	White (1)	Yellowish (2)	Brownish (3)	Red (4)	Purple (5)	Black (6)	
23	Spikelet: awns in the spikelet	Absent (1)	Present (9)					
24	Spikelet: length of the longest awn	Very short (1)	Short (3)	Medium (5)	Long (7)	Very long (9)		
25	Panicle: distribution of awns	Yellow white (1)	Brown (3)	Reddish (5)	Purple (7)	Black (9)		
26	Panicle: attitude of branches	Erect (1)	Semi-erect (3)	Spreading (5)				
27	Panicle: exertion	Enclosed (1)	Partly exerted (3)	Just exerted (5)	Moderately exerted (7)	Well exerted (9)		
28	Time of maturity	Very early (1)	Early (3)	Medium (5)	Late (7)	Very late (9)		
29	Grain: wt. of 1000 fully developed grains (at 12%)	Very low (1)	Low (3)	Medium (5)	High (7)	Very high (9)		
30	Grain: length (without dehulling)	Very short (1)	Short (3)	Medium (5)	Long (7)	Very long (9)		
31	Spikelet : sterile lemma length	Short (1)	Medium (3)	Long (5)	Very long (7)			
32	Decorticated grain: length (After dehulling, before milling)	Short (1)	Medium (3)	Long (5)	Very long (7)			
33	Leaf senescence	Late and slow (1)	Intermediate (5)	Early and fast (9)				
34	Decorticated grain: shape (Length-breadth ratio)	Round (1)	Bold (3)	Medium (5)	Medium slender (7)	Slender (9)		
35	Decorticated unpolished grain: color	White (1)	Light brown (2)	Variegated brown (3)	Dark brown (4)	Red (5)	Variegated purple (6)	Purple (7)
36	Polished grain: size of white core or chalkiness	Absent or very small (1)	Small (3)	Medium (5)	Large (7)			
37	Endosperm: content of amylose	Low (1)	Intermediate (3)	High (5)				
38	Decorticated grain: aroma	Absent (1)	Lightly present (5)	Strongly present (9)				

Source: Seed Certification Agency (2016)

RESULTS AND DISCUSSION

To establish distinctiveness among the rice cultivars, 38 essential characters were used in this study. Qualitative characters are considered as morphological markers for the identification of newly released BRRI rice varieties because they are less influenced by environmental changes. Among the thirty-eight characters, anthocyanin colouration of leaf sheath was observed in 2 genotypes (BRRI dhan80 and BRRI dhan91) and others (16) were found colourless. Regarding leaf characteristics (Table 3), intensity of leaf colour was dark green found in 3

genotypes (BRRI dhan86, BRRI dhan91 and BRRI dhan95) and 15 genotypes were observed with green colouration. Out of 18 genotypes, 4 genotypes found with strong, 7 with medium and rest of 6 as weak with regards on margins pubescence on leaf blade while 1 genotype (BBR dhan82) had no pubescence or very weak. The leaf pubescence restricts the insect landing on the leaves (Shrivastava *et al.* 2015).

All the 18 genotypes observed with the presence of auricles, of which 17 had colourless auricles and the rest one BRRI dhan80 found to purple colouration, while coming to the shape of the ligule, all the 18 genotypes had split or two-cleft shape. Same results were reported by Chakravorty and Ghosh (2012) and Kalyan *et al.* (2017). Erect type of flag leaf blade was observed in 10 genotypes, semi-erect in 6 and horizontal in 2 genotypes (BRRI dhan82 and BRRI dhan84). Considering the time of heading (50% of plants with panicles), 3 genotypes were found early, 5 genotypes as medium duration, 7 as late and the rest of 3 genotypes (BRRI dhan88, BRRI dhan89 and BRRI dhan92) were found with very late types.

For presence of colouration of lemma and palea on spikelet, 1 genotype (BRRI dhan83) showed strong colouration, 1 genotype (BRRI dhan95) with very strong, and the rest of 16 genotypes with very weak or absent in colour. One cultivar (BRRI dhan95) showed very strong colouration and remaining were shown absence of anthocyanin colouration of area below the apex. Two genotypes (BRRI dhan80 and BRRI dhan95) were shown strong lemma colouration and remaining were found with absence or very weak lemma anthocyanin colouration of apex. For colour of stigma, 17 cultivars shown white and the remaining cultivar BRRI dhan80 was in purple colour. In regards of culm diameter, two cultivars (BRRI dhan81 and BRRI dhan86) shown small, 5 were as large and rest of 11 were found medium in millimeter. For the characterization of stem length (excluding panicle), one cultivar (BRRI dhan80) was of very long, 5 were of medium and rest of 12 were of long. Seventeen cultivars were found with absence of anthocyanin colouration of node and remaining cultivar BRRI dhan80 found with presence for that character. Only one cultivar BRRI dhan80 was showed strong anthocyanin colouration on node.

Panicle lengths for 7 were observed as medium and 12 were of long. For the character panicle (curvature of main axis), 14 were of medium and 4 were of strong. Nine (9) cultivars were found as medium effective tiller producer per plant and the remaining 9 found as many tiller for that character. For density of pubescence of lemma and palea, 17 were of strong and remaining one BRRI dhan82 was weak of pubescence. Colour of tip of lemma, seventeen were of yellowish, two (BRRI dhan91 and BRRI dhan95) were brownish, one (BRRI dhan83) as red and one (BRRI dhan80) was of purple colour. Similar observations were made by Subba Rao *et al.* (2013). For the character sterile lemma length, all the cultivars were found as medium.

Seventeen cultivars were observed with absence of awns and only one BRRI dhan86 was demonstrated with presence of awns appearing mostly at the tips with yellowish white colour. In relation to presence and distribution of awn per panicle, while the awn is present its length should be influenced by the soil fertilization and plant density (Fonseca *et al.* 2002). The awned genotypes are primitive and well adapted to adverse environment factors *viz*., drought, salinity and low temperature as reported by Chandraratna (1964).

Semi erect attitude of branches was observed for 18 cultivars, among them, 4 cultivars were of just exerted, another 4 were of just to moderately exerted, 7 were moderately exerted but 3 (BRRI dhan90, BRRI dhan91 and BRRI dhan93) found as well panicle exertion. Coming to the characters of grain length (without dehulling), 5 cultivars had medium, 7 and 5 cultivars were with one each in long and very long length respectively but only one (BRRI dhan90) was had very short. For the character decorticated grain length (After dehulling before milling), 9 were of medium, 7 cultivars as long and 2 (BRRI dhan90 and BRRI dhan95) were of short. In decorticated unpolished grain shape and color, 7 cultivars with medium grain width, 3 with medium slender width, 8 were had slender type, and 2 (BRRI dhan80 and BRRI dhan89) genotypes with white colour, 15 with light brown and one BRRI dhan84 red in colour. For polished grain, three genotypes (BRRI dhan81, BRRI dhan84 and BRRI dhan89) were found small (around less than 10%) size of white core or chalkiness but others absent. For amylose content in endosperm, 3 were of medium, 15 with high amylose content and 2 (BRRI dhan80 and BRRI dhan90) were of lightly aroma present. For weight of 1000 fully developed grains, 6 genotypes were found high, 9 were medium, two (BRRI dhan93 and BRRI dhan94) with low and one BRRI dhan90 had very low. One genotype BRRI dhan90 was found with very short grain length (without dehulling) while 5 were medium, 5 as long and rest of 7 with very long (BRRI dhan80, BRRI dhan86, BRRI dhan87, BRRI dhan88 and BRRI dhan92).

For the time of maturity, 5 were found medium (116-135days), 3 were of early (101-115 days), 7 as late (136-150 days) and the remaining 3 were of very late (above 150 days). For the character of leaf senescence, 6 were found as late and slow, 11 were of intermediate and one was of early and fast type (e.g. leaves are dead at maturity). For the grain weight, 9 cultivars showed medium weight (20-23gm), 2 were of low (16-19gm), 1 was of very early (<15gm) and rest of 6 cultivars were performed with high grain weight (24-27gm).

Table 3(a). Characterization of the cultivars (total 18) as per DUS guidelines

SN	Cultivar	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
01	BRRI dhan78	1	2	5	1	9	3	1	5	1	1	1	1	3	7	1	-	1	7	5	5	7
02	BRRI dhan79	1	2	3	1	9	3	3	7	1	1	1	1	5	7	1	-	1	5	5	5	7
03	BRRI dhan80	9	2	3	9	9	3	1-3	5	1	1	7	5	5	9	9	7	1	7	5	5	7
04	BRRI dhan81	1	2	3	1	9	3	3	7	1	1	1	1	1	5	1	-	1	5	5	7	7
05	BRRI dhan82	1	2	1	1	9	3	5	3	1	1	1	1	3	5	1	-	1	5	5	7	3
06	BRRI dhan83	1	2	5	1	9	3	1	3	7	1	1	1	3	7	1	-	1	5	5	5	7
07	BRRI dhan84	1	2	3-5	1	9	3	5	7	1	1	1	1	3	7	1	-	1	5	5	7	7
08	BRRI dhan85	1	2	3	1	9	3	3	3	1	1	1	1	3	7	1	-	1	5	5	5	7
09	BRRI dhan86	1	3	3-5	1	9	3	1	7	1	1	1	1	1	5	1	-	1	5	5	5	7
10	BRRI dhan87	1	2	7	1	9	3	1	5	1	1	1	1	3	7	1	-	1	7	5	7	7
11	BRRI dhan88	1	2	7	1	9	3	1	9	1	1	1	1	3	7	1	-	1	7	7	7	7
12	BRRI dhan89	1	2	7	1	9	3	3	9	1	1	1	1	3	5	1	-	1	7	7	7	7
13	BRRI dhan90	1	2	5	1	9	3	3	5	1	1	1	1	3	5	1	-	1	7	7	7	7
14	BRRI dhan91	9	3	5	1	9	3	1	7	1	1	1	1	5	7	1	-	1	7	5	7	7
15	BRRI dhan92	1	2	7	1	9	3	1	9	1	1	1	1	3	7	1	-	1	7	7	7	7
16	BRRI dhan93	1	2	5	1	9	3	1	7	1	1	1	1	5	7	1	-	1	7	5	5	7
17	BRRI dhan94	1	2	5	1	9	3	3	7	1	1	1	1	3	7	1	-	1	7	5	5	7
18	BRRI dhan95	1	3	5	1	9	3	1	5	9	9	7	1	5	7	1	-	1	7	5	5	7

A. Leaf sheath: anthocyanin colour, B. Leaf colour, C. Penultimate leaf : pubescence of blade, D. Penultimate leaf : anthocyanin colour of auricles & collar, E. Penultimate leaf: Ligule, F. Penultimate leaf: shape of the ligule, G. Flag leaf: attitude of blade, H. Time of heading (50% of plants with heads), I. Lemma & palea: anthocyanin colouration, J. Lemma & palea: anthocyanin colouration below apex, K. Lemma: anthocyanin colouration of apex, L. Spikelet: colour of stigma, M. Culm diameter, N. Culm: Length, O. Stem: anthocyanin colouration of nodes, P. Stem: Intensity of anthocyanin colouration of nodes, Q. Stem: anthocyanin colouration of internodes, R. Panicle: length, S. Panicle: curvature of main axis, T. Panicle: number of effective tillers in plant, U. Spikelet: Pubescence of lemma & palea

Table 3(b). Characterization of the cultivars (total 18) as per DUS guidelines

SN	Cultivar	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
01	BRRI dhan78	2	1	-	-	3	5-7	5	5	7	3	3	5	5	2	1	5	1
02	BRRI dhan79	2	1	-	-	3	5-7	7	5	7	3	3	5	7	2	1	5	1
03	BRRI dhan80	5	1	-	-	3	7	5	7	9	3	5	5	9	1	1	3	5
04	BRRI dhan81	2	1	-	-	3	7	7	5	7	3	5	5	9	2	3	5	1
05	BRRI dhan82	2	1	-	-	3	7	3	5	5	3	3	5	5	2	1	5	1
06	BRRI dhan83	4	1	-	-	3	7	3	7	7	3	3	5	7	2	1	5	1
07	BRRI dhan84	2	1	-	-	3	7	7	5	7	3	5	5	9	5	3	5	1
08	BRRI dhan85	2	1	-	-	3	7	3	5	7	3	3	5	7	2	1	5	1
09	BRRI dhan86	2	9	1	1	3	7	7	5	9	3	5	5	9	2	1	3	1
10	BRRI dhan87	2	1	-	-	3	5-7	5	7	9	3	5	5	9	2	1	5	1
11	BRRI dhan88	2	1	-	-	3	5	9	7	9	3	5	1	9	2	1	5	1
12	BRRI dhan89	2	1	-	-	3	5	9	5	7	3	3	1	9	1	3	5	1
13	BRRI dhan90	2	1	-	-	3	9	5	1	1	3	1	1	5	2	1	3	5
14	BRRI dhan91	3	1	-	-	3	9	7	7	5	3	3	9	5	2	1	5	1
15	BRRI dhan92	2	1	-	-	3	5	9	7	9	3	5	1	9	2	1	5	1
16	BRRI dhan93	2	1	-	-	3	9	7	3	5	3	3	1	5	2	1	5	1
17	BRRI dhan94	2	1	-	-	3	5	7	3	5	3	3	5	5	2	1	5	1
18	BRRI dhan95	3	1	-	-	3	5-7	5	5	5	3	1	1	5	2	1	5	1

V. Spikelet: colour of tip of lemma, W. Panicle: awn in spikelet, X. Panicle: length longest awn, Y. Panicle: distribution & colour of awns, Z. Panicle: attitude of branches, AA. Panicle: exertion, AB. Time of maturity, AC. Grain: wt. of 1000 fully developed grains (at 12%), AD. Grain: length (without dehulling), AE. Spikelet: sterile lemma length, AF. Decorticated grain: length (After dehulling, before milling), AG. Leaf senescence, AH. Decorticated grain: shape (Length-breadth ratio), AI. Decorticated unpolished grain: colour, AJ. Polished grain: size of white core or chalkiness, AK. Endosperm: content of amylose, AL. Decorticated grain: aroma.

CONCLUSION

From the above findings, it can be concluded that 33 characters were found to be distinguishable from each other out of 38 essential characters studied. Five characters *viz*., the penultimate leaf of ligule, shape of the ligule, anthocyanin colouration of internodes, panicle attitude of branches and sterile lemma length of spikelets showed no variation and remain same. This study will be useful for breeders, researchers and farmers to identify and select the restoration, conservation and making crosses of beneficial genes for crop improvement and development.

REFERENCES

Aiswariya KS, Thomas GE (2016) Characterization of five rice varieties using morphological traits and seed storage protein profiling. *South Indian Journal of Biological Sciences*. 2(1), 152-161.

Ashrafuzzaman M, Islam MR, Ismail MR, Shahidullah SM, Hanafi MM (2009) Evaluation of six aromatic rice varieties for yield and yield contributing characters. *Int. J Agric. Bio*. 11, 616-620.

Bangladesh Rice Research Institute (2019) Modern Rice Cultivation, 22nd Special Edition, pages 96, Gazipur-1701, Bangladesh. www.brri.gov.bd.

Chakravorty A, Ghosh PD (2012) Characterization of Landraces of rice following DUS guidelines. Research in Plant Biology. 2(6), 30-40.

Chandraratna MF (1964) Genetics and breeding of rice. Longmans Green and Co. Ltd., Grosvenor Street, London. W-1, 143-45.

Chatterjee SD, Adhikari B, Ghosh A, Ahmed J, Satyajit BN, Pandey N (2007) Rice diversity of West Bengal, Edited by D. Konar, West Bengal Biodiversity Board, Department of Environment, Government of West Bengal, pp 47. (e-mail: wbbdb@wbpcb.gov.in).

Debas BS, Mathur PN, Pareek SK (1994) Collection, Characterization and maintenance of plant genetic resources of millets, arid legumes, medicinal plants and aromatic plants. Ex-situ conservation of plant genetic resources, Edited by Rana RS, Saxena PK, Tyagi RK, Saxena Sanjeev and Mitter Vivek, National Bureau of Plant Genetic resources, ICAR, New Delhi-110012, 72-80.

Fonseca JR, Cutrim VA, Rangel PHN (2002) Morpho-Agronomic Descriptors and Phenology of the Lowland Rice Cultivars. Embrapa, Brasília, DF, Brazil (in Portuguese)

Kalyan B, Krishna KVR, Subba RLV (2017) DUS Characterization for Germplasm of Rice. *Int. J. Curr. Microbiol. App. Sci*. 6(10), 3480-3487. doi: https://doi.org/10.20546/ijcmas.2017.610.410

Khush GS, Coffman WR (1977) Review of GEU program, The rice improvement program of the IRRI. Theoretical and Applied Genetics, 51(3), 97-110.

Raut VM (2003) Qualitative genetics of soybean- a review. Soybean Research, 1, 1-28

Seed Certification Agency (2016) Variety Testing Manual, Ministry of Agriculture, Joydebpur, Gazipur-1701. www.sca.gov.bd.

Shrivastava A, Koutu GK, Mishra DK, Singh SK (2015) Characterization of JNPT lines of rice (*Oryza sativa* L.). Plant Archives. 15(1), 397-403.

Subba Rao LV, Prasad GS, Chiranjivi M, Chaitanyam U, Surendhar R (2013) DUS characterization for farmer's varieties of rice. *IOSR Journal of Agriculture and Veterinary Science*, PP. 35-43.

Yang W, Peng S, Laza RC, Visperas RM, Sese MLD (2007) Grain yield and yield attributes of new plant type and hybrid rice. Crop Sci. 47:1393-1400.

Yang XC, Hwa CM (2008) Genetic modification of plant architecture and variety improvement in rice. Heredity, 101:396-404.