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ASSESSMENT OF DISTINCTIVENESS, UNIFORMITY AND STABILITY OF BORO RICE (*Oryza sativa* L.) BASED ON MORPHOLOGICAL DESCRIPTORS

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ABSTRACT

For the establishment of the distinctness among Fifty genotypes of boro rice sixty characters were used. Characterization of fifty genotypes of boro rice was done using forty three agro-morphological traits following Distinctiveness, Uniformity and Stability test (DUS) at the IIRR farm, ICRISAT campus. Out of total sixty two morphological visually assessed DUS descriptors studied, 8 were found to monomorphic and 15 characters were dimorphic and remaining characters are polymorphic. 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 seek protection under Protection of Plant Varieties and Farmer's Rights Act. Among the study genotypes IC-67586, IC-67638, IC-67729, IC-70855, IC-85969, IC-86011, IC-86143, IC-89079, IC-99437, IC-99512, IC-99513, IC-99520, IC-137335, IC-145634, IC-145639, IC-145651 and IC-203562 shows promising variation. These genotypes can be further actively used in crop improvement programmes.

KEY WORDS
DUS test
Boro Rice
Characterization, PPV & FR Act

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INTRODUCTION

Rice is a popular cereal crop and a primary food source for more than one third of world's population (Singh and Singh, 2008). Boro rice produces more yields than the kharif rice in the same ecology. In fact, the yields recorded from experiments, both at research station and at farmers fields show that yields from boro rice are manifolds compared to kharif rice. Boro rice matures before on-set of monsoon and get sufficient time for harvesting as compared to chaite rice (spring). Good market price of boro rice due to offseason production. Reduces risk of natural calamities like flood for main season under flood prone areas using boro rice cultivation. *Boro* rice is a low risk option with yield 30 to 40 percent higher than the normal yield. It has increased cropping intensity, leading to a situation of surplus production in Assam. This successful venture should be replicated in other states also.The essence of plant breeding lies in the creation of genetic variation which is a prerequisite for any improvement in crop. 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 (Siddiq, 2002). India has a rich and wide range of genetic wealth of rice. It has been estimated from various surveys that nearly 50,000 of rice is still being grown in the country (Roy *et al*., 1985). With the introduction of high yielding varieties and new technologies become 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 (Song *et al*., 1990). As the existing UPOV models of plant variety protection were not suitable for Indian requirements, the Government of India enacted our own legislation on the "Protection of Plant Varieties and Farmers Act" (PPV&FRA) in 2001 for providing protection to plant varieties based on distinctiveness, uniformity and stability (DUS) test apart from novelty. which is a unique and model act which gives equal importance to the farmers and breeders and treats them as partners in their efforts for sustainable food security(Patra, 2000). Thus the process of variety identification includes several steps were identification of a variety, confirmation of the variety, distinctness of the variety from all other in common knowledge, purity of the variety and characterization of the variety which enumerates its full descriptors.The concept of distinctness, uniformity and stability are thus fundamental to the characterization of a variety as a unique creation. Registration is allowed for three types of plant varieties new varieties bred by breeders, extant varieties and farmer's varieties subject to their fulfilling the conditions of distinctness, uniformity and stability and novelty in case of breeder's variety. The uniqueness of a particular variety is to be established by the test called DUS. The first step to implement our PPV&FR Act provisions is formulation of National Test Guidelines for conducting DUS tests. In this context, an attempt was made to characterize a set of fifty genotypes of boro rice germplasm

for different morphological and agronomic traits and identify the variability available in the collection

MATERIALS AND METHODS

Fifty genotypes of boro rice (Table 1) were grown in a randomized block design with three replications at the IIRR farm, ICRISAT campus during *Rabi* 2014. Each entry was sown in three rows of 2m length at spacing of 20 cm between rows and 15 cm between plants. Crop was raised following recommended package of practices. Observations were recorded on five randomly choosen plants of each genotype per replication for thirty-two morphological and agronomical traits. Among the qualitative trait, sixty (32 essential and 28 additional) visually assessed characteristics were observed according to the National Test Guidelines for DUS test in rice which was developed by Indian Institute of Rice Research Rajendarnagar, Hyderabad (Shobha Rani *et al*., 2004). The observation of various characteristics was recorded at different stages of growth with appropriate procedures as per the DUS test guidelines of PPV and FR Act, 2001. Like UPOV, in PPV and FR Act, a variety must fulfil the criteria of Distinctiveness, Uniformity, Stability and novelty (if new) so as to get protection under this act (Anonymous, 2001). The traits studied were Coleoptile colour, Basal leaf Sheath colour, Intensity of green colour of leaf , Anthocyanin colouration, Pubescence of Leaf blade surface, Auricles, Anthocyanin colouration of auricles, Leaf collar, Anthocyanin colouration of colla, Shape of ligule, Colour of ligule,Length leaf of blade, Width of Leaf blade, Culm attitude,Time of heading,: Attitude of Flag leaf blade, Spikelet, Density of pubescence of lemma, Male sterility, Anthocyanin colouration of keel, Anthocyanin colouration of area below apex, Anthocyanin colouration of apex, Colour of stigma, Stem thickness, Stem Length, Anthocyanin colouration of nodes, Anthocyanin colouration of internodes, Panicle length of main axis, Curvature of Panicle main axis, Number of panicle per plant, Colour of tip of lemma, Lemma and Palea Colour, Panicle awns, Presence of secondary branching, Attitude of branches, Panicle exertion, Time maturity (days), Leaf Senescence, Sterile lemma colour, 1000 grain Weight.

RESULTS AND DISCUSSION

The evaluation of phenotypic variability and diversity in germplasm collections is important for both plant breeders and germplasm curators to optimize the use of the variability available (Anjay Tripathi *et al*., 2013). Currently, the documentation and characterization of plant genetic resources has assumed great significance especially for the germplasm collections and notified/extant cultivars that are in active commerce in different parts of India. Immense attention is being paid towards comprehensive characterization and identification of these resources, which would constitute the base material to establish sovereign rights of genetic wealth. Standard criteria for grant of protection, based on morphological DUS criteria (Distinctiveness, Uniformity and Stability) are indispensible in this endeavor. Keeping this in view, the study was undertaken to characterize fifty boro rice genotypes on the basis of DUS morphological descriptors. In our present investigation an attempt was made to characterize fifty boro rice genotypes using plant morphological traits developed for DUS guidelines. The DUS guidelines for rice are available in the schedule released by Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA). Hence, the characteristics and their states were formed using PPV & FRA and National guidelines for DUS testing in Rice. The fifty

Table 1: Details of 50 genotypes of boro rice

S.No	Name of the genotype	Place of collection	S.No	Name of the genotype	Place of collection
1	IC-65889	DRR, Hyderabad	26	IC-99143	DRR, Hyderabad
2	IC-67586	DRR, Hyderabad	27	IC-99288	DRR, Hyderabad
3	IC-67589	DRR, Hyderabad	28	IC-99437	DRR, Hyderabad
4	IC-67626	DRR, Hyderabad	29	IC-99445	DRR, Hyderabad
5	IC-67638	DRR, Hyderabad	30	IC-99487	DRR, Hyderabad
6	IC-67729	DRR, Hyderabad	31	IC-99510	DRR, Hyderabad
7	IC-67935	DRR, Hyderabad	32	IC-99512	DRR, Hyderabad
8	IC-70855	DRR, Hyderabad	33	IC-99513	DRR, Hyderabad
9	IC-85969	DRR, Hyderabad	34	IC-99518	DRR, Hyderabad
10	IC-86011	DRR, Hyderabad	35	IC-99520	DRR, Hyderabad
11	IC-86123	DRR, Hyderabad	36	IC-99527	DRR, Hyderabad
12	IC-86142	DRR, Hyderabad	37	IC-137335	DRR, Hyderabad
13	IC-86143	DRR, Hyderabad	38	IC-145194	DRR, Hyderabad
14	IC-86154	DRR, Hyderabad	39	IC-145239	DRR, Hyderabad
15	IC-89079	DRR, Hyderabad	40	IC-145408	DRR, Hyderabad
16	IC-89115	DRR, Hyderabad	41	IC-145632	DRR, Hyderabad
17	IC-89125	DRR, Hyderabad	42	IC-145633	DRR, Hyderabad
18	IC-89138	DRR, Hyderabad	43	IC-145634	DRR, Hyderabad
19	IC-89143	DRR, Hyderabad	44	IC-145635	DRR, Hyderabad
20	IC-98731	DRR, Hyderabad	45	IC-145639	DRR, Hyderabad
21	IC-98734	DRR, Hyderabad	46	IC-145640	DRR, Hyderabad
22	IC-98938	DRR, Hyderabad	47	IC-145643	DRR, Hyderabad
23	IC-98974	DRR, Hyderabad	48	IC-145645	DRR, Hyderabad
24	IC-98997	DRR, Hyderabad	49	IC-145651	DRR, Hyderabad
25	IC-99132	DRR, Hyderabad	50	IC-203562	DRR, Hyderabad

Table 2: Essential characters along with descriptor

S.No	Characteristics	1	3	5	7	9	11	13	15	17
1	Coleoptile: Colour	Colourless	Green	Purple						
2	Basal leaf: Sheath colour	Green	Light purple	Purple lines	Uniform purple					
3	Leaf: Intensity of green colour	Light	Medium	Dark						
4	Leaf: Anthocyanin colouration	Absent	Present							
5	Leaf sheath: Anthocyanin colouration	Absent	Present							
6	Leaf: Pubescence of blade surface	Absent	Weak	Medium	Strong					
7	Leaf: Auricles	Absent	Present							
8	Leaf: Anthocyanin colouration of auricles	Colourless	Light purple	Purple						
9	Leaf: Collar	Absent	Present							
10	Leaf: Anthocyanin colouration of collar	Absent	Present							
11	Leaf: Ligule	Absent	Present							
12	Leaf: Shape of ligule	Truncate	Acute	Split						
13	Leaf: Colour of ligule	White	Light purple	Purple						
14	Leaf:Length of blade	Short (< 30 cm)	Medium (30-45 cm)	Long (> 45 cm)						
15	Leaf: Width of blade	Narrow (< 1 cm)	Medium (1-2 cm)	Broad (> 2cm)						
16	Culm: Attitude	Erect	Semi-erect	Open	Spreading					
17	Time of heading (50 % of plants with panicles)	Very early (< 71 days)	Early (71-90 days)	Medium (91-110 days)	Late (111-130 days)	Very late(> 131 days)				
18	Flag leaf: Attitude of blade (early observation)	Erect	Semi-erect	Horizontal	Drooping					
19	Spikelet: Density of pubescence of lemma	Absent	Weak	Medium	Strong	Very strong				
20	Male sterility	Absent	Present							
21	Lemma: Anthocyanin colouration of keel	Absent/Very weak	Weak	Medium	Strong	Very strong				
22	Lemma: Anthocyanin colouration of area below apex	Absent	Weak	Medium	Strong	Very strong				
23	Lemma: Anthocyanin colouration of apex	Absent	Weak	Medium	Strong	Very strong				
24	Spikelet: Colour of stigma	White	Light green	Yellow	Light purple	Purple				
25	Stem: Thickness	Thin (< 0.40cm)	Medium (0.40-0.55 cm)	Thick (> 0.55cm)						
26	Stem: Length (excluding panicle; excluding floating rice)	Very short (< 91cm)	Short (91-110 cm)	Medium (111-130 cm)	Long (131-150 cm)	Very long (> 150 cm)				
27	Stem: Anthocyanin colouration of nodes	Absent	Present							
28	Stem: Anthocyanin colouration of internodes	Absent	Present							
29	Panicle: Length of main axis	Very short (< 16 cm)	Short (16-20 cm)	Medium (21-25 cm)	Long (26-30 cm)	Very long (> 30 cm)				
30	Flag leaf: Attitude of blade (late observation)	Erect	Semi-erect	Horizontal	Deflexed					
31	Panicle: Curvature of main axis	Straight	Semi-straight	Deflexed	Dropping					
32	Panicle: Number per plant	Few (< 11)	Medium (11-20)	Many (> 20)						
33	Spikelet: Colour of tip of lemma	White	Yellowish	Brown	Red	Purple	Black			
34	Lemma and Palea: Colour	Straw	Gold and gold furrows on straw background	Brown spots on straw	Brown furrows on straw	Brown (tawny) light purple	Reddish to Purple spots / furrows on straw		Purple	Black
35	Panicle: Awns	Absent	Present							
36	Panicle:Presence of secondary branching	Absent	Present							
37	Panicle: Secondary branching	Weak	Strong	Clustered						
38	Panicle: Attitude of branches	Erect	Erect to semi-Erect	Semi-erect	Semi-erect to spreading	Spreading				
39	Panicle: Exertion	Partly exerted	Mostly exerted	Well exerted						
40	Time maturity (days)	Very early (< 100)	Early (101-120)	Medium (121-140)		Late (141-160)	Very late (> 160)			
41	Leaf: Senescence	Early	Medium	Late						
42	Sterile lemma: Colour	Straw	Gold	Red	Purple					
43	Grain: Weight of 1000 fully developed grains	Very low (< 15 g)	Low (15-20 g)	Medium (21-25 g)	High (26-30 g)	Very high (> 30 g)				

Table 3:

S. No	Genotype	Descriptors/Characters														
		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
1	IC-65889	1	5	1	1	1	7	3	5	3	3	3	5	1	3	3
2	IC-67586	1	5	5	3	3	5	3	1	3	3	3	5	5	5	3
3	IC-67589	1	1	1	1	1	5	3	1	3	1	3	5	1	3	3
4	IC-67626	1	1	3	1	3	5	3	1	3	1	3	5	1	5	3
5	IC-67638	1	5	3	3	1	7	3	5	3	3	3	5	5	5	3
6	IC-67729	1	1	3	1	1	7	3	1	3	1	3	5	1	3	3
7	IC-67935	1	1	1	1	1	7	3	1	3	1	3	5	1	5	3
8	IC-70855	1	1	3	1	1	5	3	1	3	1	3	5	1	3	3
9	IC-85969	1	1	1	3	3	5	3	5	3	1	3	5	1	3	3
10	IC-86011	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3
11	IC-86123	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3
12	IC-86142	1	1	3	1	1	3	3	1	3	1	3	5	1	5	3
13	IC-86143	1	1	1	3	1	5	3	1	3	1	3	5	1	3	3
14	IC-86154	1	1	1	1	1	5	3	1	3	1	3	5	1	5	3
15	IC-89079	1	3	5	1	1	7	3	1	3	3	3	5	5	5	3
16	IC-89115	1	1	1	1	1	3	3	1	3	1	3	5	1	5	3
17	IC-89125	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3
18	IC-89138	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3
19	IC-89143	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3
20	IC-98731	1	1	1	1	1	5	3	1	3	1	3	5	1	5	3
21	IC-98734	1	1	3	1	1	3	3	1	3	1	3	5	1	5	3
22	IC-98938	1	1	3	1	1	7	3	1	3	1	3	5	1	5	3
23	IC-98974	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3
24	IC-98997	1	5	3	1	1	5	3	1	3	1	3	5	1	5	3
25	IC-99132	1	1	3	1	1	5	3	1	3	3	3	5	1	5	3
26	IC-99143	1	1	3	1	1	7	3	1	3	1	3	5	1	3	3
27	IC-99288	1	1	3	1	1	3	3	1	3	1	3	5	1	5	3
28	IC-99437	1	7	5	3	3	3	3	1	3	3	3	5	5	5	3
29	IC-99445	1	1	3	1	3	5	3	5	3	1	3	5	1	5	3
30	IC-99487	1	3	3	1	1	5	3	1	3	1	3	5	1	5	3
31	IC-99510	1	5	3	1	1	3	3	5	3	1	3	5	1	3	3
32	IC-99512	1	5	3	1	3	3	3	5	3	3	3	5	3	5	3
33	IC-99513	1	5	3	1	3	3	3	5	3	3	3	5	1	5	3
34	IC-99518	1	1	3	1	3	3	3	5	3	1	3	5	1	5	3
35	IC-99520	1	7	5	3	3	3	3	1	3	3	3	5	5	5	3
36	IC-99527	1	5	3	1	3	5	3	5	3	3	3	5	3	5	3
37	IC-137335	1	1	3	1	3	3	3	5	3	1	3	5	1	3	3
38	IC-145194	1	1	1	1	3	3	3	1	3	1	3	5	1	5	3
39	IC-145239	1	1	3	1	1	7	3	1	3	1	3	5	1	5	3
40	IC-145408	1	1	3	1	1	7	3	1	3	1	3	5	1	5	3
41	IC-145632	1	1	3	1	3	5	3	1	3	1	3	5	1	5	3
42	IC-145633	1	1	1	1	3	3	3	1	3	1	3	5	1	5	3
43	IC-145634	1	3	3	1	1	3	3	5	3	1	3	5	1	5	3
44	IC-145635	1	5	3	1	3	3	3	5	3	1	3	5	1	5	3
45	IC-145639	1	1	3	1	3	3	3	1	3	3	3	5	1	5	3
46	IC-145640	1	1	3	1	1	3	3	1	3	1	3	5	1	5	3
47	IC-145643	1	1	5	1	3	3	3	1	3	3	3	5	1	5	3
48	IC-145645	1	1	3	1	3	5	3	1	3	1	3	5	1	5	3
49	IC-145651	1	1	1	1	1	5	3	1	3	1	3	5	1	5	3
50	IC-203562	1	1	3	1	1	5	3	1	3	1	3	5	1	5	3

Coleoptile: Colour-a, Basal leaf: Sheath colour-b, Leaf: Intensity of green colour-c,Leaf: Anthocyanin colouration-d, Leaf sheath: Anthocyanin colouration-e, Leaf: Pubescence of blade surface-f, Leaf: Auricles-g, Leaf: Anthocyanin colouration of auricles-h, Leaf: Collar-i, Leaf: Anthocyanin colouration of colla-j; Leaf: Ligule-k; Leaf: Shape of ligule-l, Leaf: Colour of ligule-m, Leaf:Length of blade-n, Leaf: Width of blade-o,

boro rice genotypes were characterized with sixty two morphological characters including both qualitative and quantitative characters To establish distinctiveness among rice cultivars, 43 characters have been used. Qualitative characters are considered as morphological markers in the identification of landraces of rice, because they are less influenced by environmental changes (Raut, 2003). Morphological characters have been widely used for descriptive purposes and are commonly used to distinguish plant varieties. Use of morphological descriptors in sequential fashion is useful and convenient to discriminate the different varieties. Out of total sixty two morphological visually assessed DUS descriptors studied, 8 were found to monomorphic and 15 characters were dimorphic and remaining characters are polymorphic. The characters coleoptile colour, leaf auricles, leaf collar, leaf ligule presence and shape, leaf width of blade, male sterility, panicle-presence of secondary branching were monomorphic. The characters viz., leaf-anthocyanin

Table 3: Contt.....

S. No	Genotype	Descriptors/Characters													
		p	q	r	s	t	u	v	x	y	z	aa	ab	ac	ad
1	IC-65889	1	5	3	5	1	1	3	1	9	3	1	1	1	5
2	IC-67586	3	7	1	7	1	1	1	1	9	5	1	3	3	5
3	IC-67589	5	5	3	3	1	1	1	7	9	5	1	1	1	5
4	IC-67626	3	5	3	3	1	1	1	1	1	1	1	1	1	5
5	IC-67638	5	5	3	7	1	1	1	1	9	1	1	1	1	5
6	IC-67729	3	5	1	7	1	1	1	1	1	1	1	1	1	5
7	IC-67935	3	5	1	7	1	1	1	3	1	1	1	1	1	5
8	IC-70855	3	3	1	7	1	1	1	1	7	5	1	1	1	5
9	IC-85969	3	5	1	7	1	1	1	1	1	5	1	1	1	5
10	IC-86011	3	5	1	7	1	1	1	1	9	5	7	1	1	5
11	IC-86123	3	5	3	7	1	1	7	7	1	5	7	1	1	5
12	IC-86142	5	5	5	5	1	1	7	7	1	5	1	1	1	5
13	IC-86143	5	5	3	5	1	1	1	1	7	5	1	1	1	5
14	IC-86154	3	5	1	7	1	1	1	1	1	5	1	1	1	5
15	IC-89079	5	7	3	5	1	7	5	7	1	5	1	3	3	3
16	IC-89115	5	5	3	5	1	1	1	1	1	5	1	3	3	5
17	IC-89125	3	5	1	3	1	1	1	1	1	5	1	1	1	5
18	IC-89138	3	5	5	5	1	1	1	1	1	5	1	1	1	5
19	IC-89143	3	5	1	7	1	1	1	1	1	5	1	1	1	5
20	IC-98731	3	7	1	7	1	1	1	1	1	5	1	1	1	7
21	IC-98734	3	7	1	7	1	1	1	1	1	5	1	1	1	5
22	IC-98938	3	5	3	7	1	1	1	1	1	1	1	1	1	5
23	IC-98974	3	5	5	7	1	1	1	1	9	1	1	1	1	5
24	IC-98997	3	5	5	7	1	1	1	1	1	1	1	1	1	5
25	IC-99132	3	5	3	7	1	3	1	5	1	5	1	1	1	5
26	IC-99143	3	5	3	5	1	1	1	1	1	5	1	3	1	7
27	IC-99288	3	7	1	7	1	1	1	1	9	5	1	1	1	5
28	IC-99437	3	5	1	7	1	7	5	7	9	5	1	1	1	5
29	IC-99445	3	7	1	7	1	1	1	1	1	5	1	1	1	5
30	IC-99487	3	5	3	7	1	1	1	1	9	5	1	1	1	5
31	IC-99510	3	5	3	7	1	1	1	1	9	5	1	1	1	5
32	IC-99512	5	5	1	3	1	5	1	5	9	5	1	1	3	5
33	IC-99513	5	5	1	5	1	1	1	7	9	5	7	1	3	5
34	IC-99518	3	7	1	7	1	1	1	1	1	5	7	1	1	5
35	IC-99520	7	5	1	7	1	7	7	1	9	5	1	1	1	5
36	IC-99527	5	5	1	3	1	1	1	7	9	5	1	1	1	7
37	IC-137335	3	5	3	5	1	7	1	1	1	5	1	1	1	5
38	IC-145194	5	7	1	7	1	5	1	7	1	5	1	1	1	5
39	IC-145239	5	7	1	5	1	1	1	3	1	5	1	1	1	5
40	IC-145408	1	7	1	5	1	7	1	5	1	5	1	1	1	5
41	IC-145632	5	7	3	5	1	1	1	1	1	5	1	3	3	5
42	IC-145633	3	7	1	3	1	1	1	1	1	5	1	1	1	5
43	IC-145634	5	7	1	7	1	5	1	1	1	5	1	1	1	5
44	IC-145635	5	7	1	7	1	7	1	1	9	5	1	3	3	5
45	IC-145639	1	7	1	5	1	7	1	1	1	5	1	1	1	7
46	IC-145640	3	7	1	5	1	1	1	1	1	5	1	1	1	5
47	IC-145643	1	7	1	7	1	7	1	1	1	5	1	1	1	5
48	IC-145645	3	7	3	7	1	5	1	1	1	5	1	1	1	5
49	IC-145651	3	7	1	7	1	5	3	3	1	5	1	1	1	5
50	IC-203562	5	7	3	5	1	1	1	1	1	5	1	1	1	5

Culm: Attitude-p, Time of heading (50 % of plants with panicles)-q, Flag leaf: Attitude of blade (early observation)-r Spikelet: Density of pubescence of lemma-s, Male sterility-t, Lemma: Anthocyanin colouration of keel-u, Lemma: Anthocyanin colouration of area below apex-v,Lemma: Anthocyanin colouration of apex-x, Spikelet: Colour of stigma-y,Stem: Thickness-z, Stem: Length (excluding panicle; excluding floating rice)-aa, Stem: Anthocyanin colouration of nodes-ab, Stem: Anthocyanin colouration of internodes-ac, Panicle: Length of main axis-ad,

colouration, leaf sheath-anthocyanin colouration, leaf-anthocyanin colouration of auricles, leaf-anthocyanin colouration of collar, leaf-length of blade, stem length(excluding panicle, excluding floatin rice), stem-anthocyanin coloration of nodes, stem-anthocyanin coloration of internodes, flag leaf-attitude of main blade, panicle number per plant, panicle-awns, panicle-secondary branching, time maturity(days), leaf senescence, sterile lemma color were dimorphic. The characters viz., basal leaf-sheath colour, leaf-intensity of green colour, leaf- distribution of anthocyanin colouration, leaf sheath-intensity of anthocyanin colouration, leaf-pubescence of blade surface, leaf-colour of ligule, culm-attitude, time of heading(50% of plants with panicle), flag leaf-attitude of blade(early observation), spikelet-density of pubescence of lemma, lemma-anthocyanin coloration of keel, lemma-anthocyanin coloration of area below apex, lemma-anthocyanin coloration of apex, spikelet-colour of stigma, stem-thickness, stem-intensity of anthocyanin coloration of nodes,

Table 3: Contt.....

S. No	Genotype	ae	af	ag	ah	ai	aj	ak	al	am	an	ao	ap	aq	ar
1	IC-65889	5	5	5	9	1	3	3	3	3	1	5	3	1	5
2	IC-67586	3	7	5	1	7	1	3	1	3	5	7	5	1	1
3	IC-67589	3	5	5	9	1	3	3	1	3	5	5	3	1	3
4	IC-67626	3	5	5	1	1	1	3	1	3	1	5	3	1	7
5	IC-67638	5	5	3	9	1	1	3	1	7	1	5	3	1	5
6	IC-67729	5	5	3	1	1	1	3	3	7	5	5	3	1	5
7	IC-67935	5	5	3	9	5	1	3	3	3	3	5	3	1	5
8	IC-70855	5	5	1	9	7	1	3	1	7	3	5	3	1	3
9	IC-85969	3	5	1	9	5	3	3	3	3	5	5	3	1	3
10	IC-86011	3	5	1	9	7	1	3	3	7	5	5	5	1	3
11	IC-86123	3	5	1	9	7	3	3	1	3	5	5	5	1	3
12	IC-86142	5	5	1	9	7	3	3	1	3	5	5	3	1	3
13	IC-86143	5	5	3	9	1	3	3	1	3	5	5	3	1	3
14	IC-86154	5	3	1	3	1	1	3	1	3	5	5	3	1	3
15	IC-89079	5	5	1	11	7	3	3	1	3	5	5	3	7	1
16	IC-89115	5	5	3	1	1	3	3	1	3	5	5	3	1	1
17	IC-89125	5	3	3	3	7	1	3	1	3	5	5	3	1	3
18	IC-89138	5	3	3	9	7	1	3	1	3	5	5	3	1	3
19	IC-89143	5	5	1	9	7	1	3	1	3	5	5	3	1	3
20	IC-98731	5	3	3	9	7	1	3	1	3	5	5	3	1	3
21	IC-98734	3	5	1	9	7	1	3	1	3	5	7	3	1	3
22	IC-98938	3	5	1	9	7	3	3	1	3	5	7	3	1	1
23	IC-98974	3	5	1	9	7	1	3	1	3	5	5	3	1	3
24	IC-98997	3	5	1	9	7	1	3	1	3	5	5	3	1	5
25	IC-99132	3	3	1	11	7	1	3	1	3	5	5	3	1	5
26	IC-99143	3	3	1	1	5	1	3	1	3	5	5	3	1	3
27	IC-99288	5	5	1	9	7	1	3	1	3	5	7	3	1	3
28	IC-99437	5	5	1	9	7	1	3	1	3	5	5	3	7	3
29	IC-99445	5	5	1	1	1	3	3	1	7	5	7	3	1	5
30	IC-99487	5	5	1	9	7	3	3	1	3	5	5	3	7	5
31	IC-99510	5	5	1	9	7	3	3	1	3	5	5	3	1	3
32	IC-99512	5	5	1	9	1	3	3	1	3	5	7	3	1	3
33	IC-99513	5	5	1	9	7	3	3	1	3	5	7	3	1	3
34	IC-99518	5	5	1	9	7	1	3	1	3	5	7	3	1	2
35	IC-99520	5	5	1	9	7	1	3	1	7	5	5	3	7	2
36	IC-99527	3	5	1	9	7	1	3	1	7	5	5	3	1	2
37	IC-137335	3	5	1	3	7	1	3	1	3	5	5	3	1	3
38	IC-145194	3	3	1	9	1	1	3	1	3	5	7	3	1	5
39	IC-145239	3	5	1	3	7	1	3	3	3	5	7	3	1	5
40	IC-145408	3	3	1	1	7	3	3	3	3	5	7	3	1	5
41	IC-145632	5	5	1	9	7	1	3	1	7	5	7	3	1	5
42	IC-145633	5	3	1	9	7	1	3	1	7	5	7	3	1	3
43	IC-145634	5	5	1	11	7	1	3	1	3	5	7	3	1	5
44	IC-145635	5	5	1	9	5	1	3	1	1	5	7	3	1	3
45	IC-145639	5	3	1	1	7	1	3	1	3	5	7	3	1	3
46	IC-145640	5	3	1	1	1	1	3	3	3	5	7	3	1	3
47	IC-145643	5	3	1	11	5	3	3	3	3	5	7	3	7	3
48	IC-145645	3	5	1	3	7	3	3	3	3	5	7	3	1	7
49	IC-145651	3	5	1	1	7	1	3	3	3	5	7	3	1	3
50	IC-203562	3	5	1	9	5	1	3	1	3	5	7	3	1	3

Flag leaf: Attitude of blade (late observation)-**ae**, Panicle: Curvature of main axis-**af,** Panicle: Number per plant-**ag,** Spikelet: Colour of tip of lemma-**ah,** Lemma and Palea: Colour-**ai**, Panicle: Awns-**aj,** Panicle:Presence of secondary branching-**ak**, Panicle: Secondary branching -**al,** Panicle: Attitude of branches-**am,** Panicle: Attitude of branches-**an**, Panicle: Exertion, Timematurity (days)-**ao,** Leaf: Senescence-**ap,** Sterile lemma: Colour-**aq,** Grain: Weight of 1000 fully developed grains-**ar**.

panicle length of main axis, panicle-curvature of main axis, spikelet-color of tip of lemma, lemma and palea-color, panicle-attitude of branches, panicle-exertion, grain-weight of 1000 fully developed grains were polymorphic. Morphological variability in any crop is pre-requisite for selection of superior genotypes over the existing cultivars (Singh *et al*., 2013). Studies on morphological characterization have earlier been made by (Kumar *et al*., 2013). Recognizing the importance of genetic variability in plant breeding experiments, the main objective of present research work was to assess the morphological variability. Studies on leaf characters have earlier been made by Richharia (1979). Regarding leaf characteristics intensity of green colour was dark in 4 genotypes (IC-67586, IC-89079, IC-99520 and IC-145643). Out of 50 genotypes, 6 genotypes had leaf anthocyanin colouration(IC-67586, IC-67638, IC-85969, IC-86143, IC-99437 and IC-99520). Among 6,

genotype IC-99437 is distinct for having uniform distribution of anthocyanin colouration. Anthocyanin colouration in leaf sheath was present in 18 genotypes, out of which, 3 cultivars (IC-67586, IC-85969 and IC-99437) had medium, 5 cultivars (IC-99445, IC-99512, IC-99513, IC-137335 and IC-145194) had weak intensity of anthocyanin colouration.

Nine cultivars (IC-65889, IC-67638, IC-67229, IC-67935, IC-89079, IC-98938, IC-99143, IC-145239 and IC-145408) were found to be distinct for having strong pubescence in leaf blade. Out of 50 genotypes, 12 were (IC-65889, IC-67638, IC-85969, IC-99445, IC-99510, IC-99512, IC-99513, IC-99518, IC-99527, IC-137335, IC-145634 and IC-145635 marked for having purpled coloured auricle. The similar results were reported by Ghosh *et al*. (2012).

Leaf collar was present in all cultivars. Out of 50 cultivars, 4 cultivars (IC-67638, IC-67229, IC-67935 and IC-89079) were distinguished for having anthocyanin colouration both in leaf auricle and leaf collar Regarding leaf ligule shape,all genotypes had split shaped ligule. among 50 genotypes. Five cultivars(IC-67586, IC-67638, IC-89079, IC-99437 and IC-99520) were distinguished for having purple coloured ligule. The similar results were reported by Roy *et al*. (1985).

Cultivars viz., IC-67586, IC-67935, IC-86011, IC-86154, IC-89125, IC-89143, IC-98731, IC-98734, IC-99437, IC-99512, IC-99513, IC-99518, IC-99520, IC-99527, IC-145633, IC-145634, IC-145635, IC-145639, IC-145640, IC-145643 and IC-145651 were distinguished for having long leaf length along with erect early flag leaf attitude. There was not any deflexed flag leaf at early observations but 5 cultivars (IC-99520, IC-99527, IC-145633, IC-145634 and IC-145635) showed deflexed flag leaf attitude at the late observations. In case of time of heading, one cultivars (IC-70855) were distinguished for early category while 7 cultivars viz., IC-89079, IC-98731, IC-98734, IC-99288, IC-99445, IC-99518, IC-145194, IC-145239, IC-145408 IC-145632, IC-145633, IC-145634, IC-145635, IC-145639, IC-145640, IC-145643, IC-145645, IC-145651 and IC-203562 showed very late time of heading. The result is conformity with Manoj Kumar prajapati (2011).

Studies on culm attitiude and anthocyanin colouration have earlier been made by Subudhi *et al*. (2012). It was very interesting to find out that varieties IC-99520 with spreading culm attitude showed nearly late time of heading while cultivars viz., IC-145408, IC-145639 and IC-145643 having very late time of heading showed erect culm attitude. Regarding anthocyanin colouration in lemma of spikelet, 8 cultivars *viz*., IC-89079, IC-99437, IC-99520, IC-137335, IC-145408, IC-145635, IC-145639 and IC-145643 had strong colouration in keel, three cultivars viz., IC-86123, IC-86142 and IC-99520 had strong colouration at the area below apex and eight genotypes viz., IC-67589, IC-86123, IC-86142, IC-89079, IC-99437, IC-99513, IC-99527 and IC-145194 had strong anthocyanin colouration at the apex. Cultivars IC-65889, IC-67586, IC-67589, IC-67638, IC-86011, IC-98974, IC-99228, IC-99437, IC-99487, IC-99510, IC-99512, IC-99513, IC-99520, IC-99527 and IC-145635 were distinguished for having purple coloured stigma.

In case of stem, cultivars IC-86011, IC-86123, IC-99513 and IC-99518 were distinguished for having thick stem with long stem length. Anthocyanin colouration was found in node of three cultivars viz IC-67586, IC-89079, IC-89115, IC-99143, IC-145632 and IC-145635, among which IC-89115 had strong colouration. Cultivars IC-67586, IC-89079, IC-89115, IC-99512, IC-99513, IC-145632 and IC-145635 have anthocyanin colouration in internode. In explaining the panicle features, cultivars IC-98731, IC-99143, IC-99527, IC-145639 were distinguished for having very long panicle length, IC-65889, IC-67586, IC-67589 and IC-67626 many panicle numbers per plant with deflexed curvature on the main axis. The similar results were reported by Das *et al*. (2010)

In case of density of pubescence on lemma on spikelets, it was strong in cultivars like IC-67586, IC-IC-67729, IC-70855 and IC-86123 which are very much distinct from the rest varieties. Also, colour of tip of the lemma was purple in genotypes like IC-65889, IC-67589, IC-67638 and IC-86142 but black in IC-89079, IC-99132, IC-145634 and 1C-145643. The similar results were reported by Patra *et al*. (2003)

A large amount of variations in colour have been found in the colouration of lemma and palea. Awn was present in 17 cultivars, out of which, very long awn was found IC-89115 and IC-98938. The rest 33 cultivars were lacking this awn. Secondary branching was present in all the cultivars but strong branching was found in 11 cultivars. Leaf senescence was intermediate in many cultivers, while IC-67586, IC-86011 and IC-86123 had late leaf senescence. Studies on quantitative traits have earlier been made by Chakravorty and Ghosh (2011). Data on 1000 grain weight among varieties varied from 11.18g (in IC-67586) to 27.78g (in IC-67626). IC-67586 was recorded the late maturity in days (148days). Among the study genotypes IC-67586, IC-67638, IC-67729, IC-70855, IC-85969, IC-86011, IC-86143, IC-89079, IC-99437, IC-99512, IC-99513, IC-99520, IC-137335, IC-145634, IC-145639, IC-145651 and IC-203562 shows promising variation. These genotypes can be further actively used in crop improvement programmes.

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