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## DUS Characterization for Germplasm of Rice

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### ABSTRACT

#### Keywords

DUS test, Land races, Characterization, PPV & FR Act.

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For the establishment of the distinctness among thirty-five landraces of rice, twenty nine characters were used. Characterization of thirty-five landraces of rice was done using twenty nine agro-morphological traits following Distinctiveness, Uniformity and Stability test (DUS) during kharif season of 2014 at the DRR farm, ICRISAT campus. Out of thirty-five varieties studied, twenty-two were found to be distinctive on the basis of twenty nine essential characters. 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.

### Introduction

Rice is the world's most important food crop and a primary food source for more than one third of world's population (1). 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 (2). 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 (3). 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 (4). 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(5). 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 thirty-five genotypes of rice germplasm for different morphological and agronomic traits and identify the variability available in the collection.

### **Materials and Methods**

Thirty five farmer's varieties of rice (Table 1) were grown in a randomized complete block design with three replications at the IIRR farm, ICRISAT campus, Situated at 17.53°N latitude, 78.27°E longitude and altitude of 545m above mean sea level. The material was grown in a complete randomized block design with five checks in three replications during *Kharif* 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 chosen plants of each genotype per replication for twenty-nine morphological and agronomical traits which are 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, Rajendranagar, Hyderabad (7). The observation of various characteristics was recorded at different stages of growth with appropriate procedures as per the DUS test guidelines of PPV & 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 (8). The traits studied were Basal leaf sheath colour, Leaf pubescence of blade surface, Leaf auricles, Leaf anthocyanin colouration of auricles, Leaf shape of ligule, Leaf colour of ligule, Time of heading (50% of plants with panicles), Flag leaf attitude of blade (early observation), Spikelet density of pubescence of lemma, Lemma anthocyanin colouration of apex, Spikelet colour of stigma, Stem length (excluding panicle; excluding floating rice), Stem anthocyanin colouration of nodes, Panicle length of main axis, Flag leaf attitude of blade (late observation), Panicle curvature of main axis, Spikelet colour of tip of lemma, Panicle awns, Panicle colour of awns (late observation), Panicle distribution of awns, Panicle attitude of branches, Panicle exertion, Sterile lemma colour, Decorticated grain length, Decorticated grain width, Decorticated grain shape (in lateral view), Decorticated grain colour, Endosperm content of amylase and Decorticated grain aroma

### **Results and Discussion**

To establish distinctiveness among rice cultivars, 29 essential 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. Regarding leaf characteristics (Table 3), intensity of green colour of leaf sheath was dark green in 23 genotypes and 12 lines are with purple variation out of the total 35 genotypes and 20 lines with strong and 11 with medium pubescence on leaf blade while 4 lines have no pubescence.

**Table.1** List of genotypes and the place of collection

S.No	Name of the genotype	Place of collection	S.No	Name of the genotype	Place of collection
1	IC-449549X	DRR, Hyderabad	19	IC-75913	DRR, Hyderabad
2	IC-449560X	DRR, Hyderabad	20	IC-75920	DRR, Hyderabad
3	IC-75758	DRR, Hyderabad	21	IC-216693	DRR, Hyderabad
4	IC-75738	DRR, Hyderabad	22	IC-216736	DRR, Hyderabad
5	IC-75747	DRR, Hyderabad	23	IC-216689	DRR, Hyderabad
6	IC-75756	DRR, Hyderabad	24	IC-217783	DRR, Hyderabad
7	IC-75782	DRR, Hyderabad	25	IC-217746	DRR, Hyderabad
8	IC-75789	DRR, Hyderabad	26	IC-217747	DRR, Hyderabad
9	IC-75773	DRR, Hyderabad	27	IC-217748	DRR, Hyderabad
10	IC-75783	DRR, Hyderabad	28	IC-217760	DRR, Hyderabad
11	IC-75786	DRR, Hyderabad	29	IC-217771	DRR, Hyderabad
12	IC-75772	DRR, Hyderabad	30	IC-217749	DRR, Hyderabad
13	IC-75775	DRR, Hyderabad	31	IC-217750	DRR, Hyderabad
14	IC-75779	DRR, Hyderabad	32	IC-217758	DRR, Hyderabad
15	IC-75843	DRR, Hyderabad	33	IC-217762	DRR, Hyderabad
16	IC-75864	DRR, Hyderabad	34	IC-217769	DRR, Hyderabad
17	IC-75855	DRR, Hyderabad	35	IC-217776	DRR, Hyderabad
18	IC-75849	DRR, Hyderabad			

**Table.2** Essential characters along with descriptor

S.No.	Characteristics	States								
1.	Basal leaf: sheath colour	green	light purple	purple lines	purple					
2.	Leaf: pubescence of blade surface	absent	weak	medium	strong	very strong				
3.	Leaf : auricles	absent	present							
4.	Leaf: anthocyanin colouration of auricles	colourless	light purple	purple						
5.	Leaf: shape of ligule	truncate	acute	Split						
6.	Leaf: colour of ligule	green	light purple	purple						
7.	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 (>130 days)				
8.	Flag leaf: attitude of blade (early observation)	erect	semi-erect	horizontal	deflexed					
9.	Spikelet: density of pubescence of lemma	absent	weak	medium	strong	very strong				
10.	Lemma: anthocyanin colouration of apex	absent	weak	medium	strong	very strong				
11.	Spikelet: colour of stigma	white	light green	yellow	light purple	purple				
12.	Stem: length (excluding panicle)	very short (<91 cm)	short (91-110 cm)	medium (111-130 cm)	long (131-150 cm)	very long (>150 cm)				
13.	Stem: anthocyanin colouration of nodes	absent	present							

14.	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)				
15.	Flag leaf: attitude of blade (late observation)	erect	semi-erect	horizontal	Deflexed					
16.	Panicle: curvature of main axis	straight	semi-straight	drooping	deflexed					
17.	Spikelet : colour of tip of lemma	White	Yellowish	Brown	Red,	Purple	Black			
18.	Panicle : awns	Absent	Present							
19.	Panicle: colour of awns (late observation)	Yellowish white	Yellowish brown	Brown	Reddish brown	Light red	Red	Light purple	Purple	Black
20.	Panicle: distribution of awns	tip only	upper half only	whole length						
21.	Panicle: attitude of branches	Erect	Erect to semi-erect	Semi-erect	Semi-erect to spreading	Spreading				
22.	Panicle: exertion	Partly exerted	Exserted well	Exserted						
23.	Sterile lemma: colour	straw	gold	red	purple					
24.	Decorticated grain: length	very short	short	medium	long	very long				
25.	Decorticated grain: width	narrow (<2.0 mm)	medium (2.0-2.5 mm)	broad (>2.5 mm)						
26.	Decorticated grain: shape	short slender	short bold	medium	long slender	long bold	extra long			
27.	Decorticated grain: colour	white	light brown	variegated brown	dark brown	light red	red	variegated purple	purple	dark purple
28.	Endosperm: content of amylase	very low (<10%)	low(10-19%)	medium(20-25%)	high(26-30%)	very high (>30%)				
29.	Decorticated grain: aroma	absent	present							

**Table.3** Characterization of the cultivars (total 35) as per DUS guidelines

S.No	Cultivar	A	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	aa	ab	ac
1	IC-449549X	1	1	9	1	3	1	5	1	5	1	1	1	1	5	3	5	3	1	-	-	9	7	1	5	3	5	4	5	1
2	IC-449560X	1	5	9	1	3	1	5	3	5	7	1	3	1	5	5	7	5	1	-	-	9	7	1	5	3	5	2	5	1
3	IC-75748	1	7	9	1	3	1	7	1	7	1	1	1	1	7	3	7	2	9	1	1	3	5	1	5	3	5	2	7	1
4	IC-75738	1	5	9	1	3	1	7	1	5	1	1	1	1	7	1	7	2	1	-	-	3	5	1	5	3	5	2	5	1
5	IC-75747	1	7	9	1	3	1	7	1	5	1	1	1	1	5	1	3	3	9	1	1	3	5	1	5	5	3	5	5	1
6	IC-75756	1	7	9	1	3	1	5	1	7	1	1	1	1	5	1	3	2	9	1	1	3	3	1	5	7	3	2	7	1
7	IC-75782	1	7	9	3	3	1	7	1	5	5	5	1	1	5	1	7	5	1	-	-	3	5	1	5	5	4	1	5	1
8	IC-75789	1	7	9	1	3	1	7	1	5	1	1	1	1	5	1	7	2	1	1	1	9	5	4	5	3	5	1	7	1
9	IC-75773	1	7	9	1	3	1	7	1	5	1	5	3	1	5	1	7	2	1	-	-	3	5	1	5	5	5	2	5	1
10	IC-75783	3	7	9	3	3	2	5	1	5	5	5	1	9	5	1	7	5	9	1	3	3	5	1	5	3	5	1	5	1
11	IC-75786	1	7	9	1	3	1	5	1	5	1	1	1	1	7	1	5	3	1	-	-	9	5	1	5	3	5	2	5	1
12	IC-75772	1	7	9	1	3	1	7	1	5	1	1	3	1	7	1	7	2	9	1	1	3	5	1	5	3	5	1	5	1
13	IC-75775	1	7	9	1	3	1	7	1	5	1	1	1	1	5	1	7	2	1	-	-	9	5	1	5	5	3	1	5	1
14	IC-75779	1	7	9	1	3	1	5	1	5	1	1	1	1	7	1	7	2	1	-	-	3	5	1	5	3	5	2	7	1
15	IC-75843	1	5	9	1	3	1	3	1	5	1	1	1	1	5	1	7	2	1	-	-	9	7	4	5	3	5	2	7	1
16	IC-75864	1	7	9	1	3	1	5	1	5	1	1	1	1	7	1	7	1	1	-	-	3	5	1	5	3	5	1	5	1
17	IC-75855	2	7	9	3	3	2	7	1	5	5	5	1	1	5	1	7	5	1	-	-	9	5	4	5	5	3	1	7	1
18	IC-75849	1	5	9	1	3	1	7	1	5	1	1	1	1	7	3	7	3	1	-	-	3	5	1	5	3	2	1	5	1
19	IC-75913	1	7	9	1	3	1	5	1	5	1	1	1	1	5	1	7	3	1	-	-	9	5	4	5	3	3	1	5	1
20	IC-75920	1	5	9	1	3	1	3	3	5	1	1	1	1	5	3	7	3	1	-	-	3	5	1	5	5	3	1	5	1
21	IC-216693	1	5	9	1	3	1	5	1	7	1	1	5	1	7	3	5	2	9	1	3	9	7	1	5	7	4	2	5	1
22	IC-216736	2	7	9	3	3	2	5	1	7	1	5	5	9	7	3	5	5	1	-	-	9	7	1	5	3	5	4	5	1
23	IC-216689	4	5	9	3	3	2	5	1	5	5	5	5	1	9	1	5	5	1	-	-	9	7	4	5	3	5	2	5	1
24	IC-217783	1	7	9	1	3	1	3	1	7	1	1	3	1	5	3	5	2	1	-	-	9	7	4	5	7	4	2	7	1
25	IC-217746	4	5	9	3	3	2	5	1	5	5	5	1	9	7	3	3	3	1	-	-	3	7	1	5	5	5	5	5	1
26	IC-217747	4	7	9	3	3	2	5	1	3	5	5	3	9	9	5	5	3	1	-	-	9	7	1	5	5	2	5	5	1
27	IC-217748	4	7	9	3	3	2	5	1	7	7	5	1	1	5	1	3	3	1	-	-	1	5	4	7	3	5	2	7	1
28	IC-217760	1	5	9	1	3	1	3	3	5	1	1	1	1	5	1	5	2	1	-	-	9	7	1	5	7	5	2	9	1
29	IC-217771	1	7	9	1	3	1	5	1	5	1	1	3	1	5	3	7	2	1	-	-	7	7	1	3	7	2	4	9	1
30	IC-217749	4	1	9	3	3	2	5	1	7	7	5	1	9	7	3	5	5	1	-	-	7	5	4	5	5	3	1	7	1
31	IC-217750	1	7	9	1	3	1	5	1	7	7	1	3	1	5	1	5	2	1	-	-	7	5	4	5	5	4	2	5	1
32	IC-217758	4	1	9	3	3	2	5	1	5	7	5	1	9	5	3	7	6	1	-	-	3	5	4	5	3	5	2	5	1
33	IC-217762	4	1	9	3	3	2	5	1	7	7	5	1	9	5	1	7	5	1	-	-	3	5	4	5	5	4	2	5	1
34	IC-217769	4	5	9	3	3	2	5	3	7	7	5	1	9	5	1	3	2	1	-	-	1	5	4	5	5	3	2	5	1
35	IC-217776	4	5	9	3	3	2	3	3	5	7	5	1	9	7	1	7	3	1	-	-	7	5	4	5	7	4	1	5	1

a. Basal leaf sheath colour, b. Leaf pubescence of blade surface, c. Leaf auricles, d. Leaf anthocyanin colouration of auricles, e. Leaf shape of ligule, f. Leaf colour of ligule, g. Time of heading (50% of plants with panicles), h. Flag leaf attitude of blade (early observation), i. Spikelet density of pubescence of lemma, j. Lemma anthocyanin colouration of apex, k. Spikelet colour of stigma, l. Stem length (excluding panicle; excluding floating rice), m. Stem anthocyanin colouration of nodes, n. Panicle length of main axis, o. Flag leaf attitude of blade (late observation), p. Panicle curvature of main axis, q. Spikelet colour of tip of lemma, r. Panicle awns, s. Panicle colour of awns (late observation), t. Panicle distribution of awns, u. Panicle attitude of branches, v. Panicle exertion, w. Sterile lemma colour, x. Decorticated grain length, y. Decorticated grain width, z. Decorticated grain shape (in lateral view), aa. Decorticated grain colour, ab. Endosperm content of amylase and ac. Decorticated grain aroma

All the 35 genotypes have auricles of which 22 have colourless auricles and 13 lines have purple colouration, while coming to the shape of the ligule all the 35 lines have split shape of which 23 lines have green colour ligules while 12 others have purple ones. The time of heading (50% of plants with panicles) were observed and noticed that 5 genotypes are early, 20 genotypes are medium duration and 10 lines are late duration types. Erect type of flag leaf blade is observed in 30 genotypes and semi-erect in 5 lines.

For density of pubescence of lemma on spikelet 24 lines showed medium, 10 lines with strong and 1 line with very weak pubescence. It is important to note that no cultivar exhibited male sterility. 8 cultivars showed strong coloration 6 lines with medium colouration and remaining were shown absence anthocyanin coloration of area below the apex. For colour of stigma 21 cultivars shown white, 14 were of purple colour. For the stem length (excluding panicle) 25 cultivars were of very short 7 were of short 3 were of medium. 26 cultivars were shown absence for anthocyanin colouration of node and remaining 9 found presence for the character. Panicle lengths for 21 were of medium, 12 were of long but only two was of very long. Flag leaf (attitude of blade) 22 were of erect, 11 were of semi erect and 2 are of horizontal (Table 2).

For the character panicle (curvature of main axis) 20 were of deflexed, 10 were of drooping and 5 were of semi straight. Colour of tip of lemma 17 were of yellowish 10 were brown, 8 lines were of purple colour. For the character sterile lemma colour 22 cultivars were of straw colour 13 with purple colour. 29 cultivars were shown absence of awns and 6 were shown presence of awns appearing mostly at the tips only with yellowish white colour most commonly. Semi erect to spreading was observed for 15 cultivars 2

were of erect to semi erect but 14 were of spreading type. Mostly that is 23 cultivars were of exerted panicle exertion, 11 were of well exerted type, but only one cultivar is of partly exerted type.

Coming to the characters of decorticated grain 33 lines have medium length with one each in short and long length and 17 lines with narrow grain width, 12 with medium width and 6 were broad types with an overall shape of 3 short bold, 8 medium slender, 6 long slender and 18 long bold, 11 lines with white colour, 17 with light brown 3 with dark brown and 4 red in colour. For amylase content in endosperm 24 were of medium amylase content, 9 with high and 2 were of very high with no aroma for all the 35 genotypes.

Thus, it is concluded that out of 35 landraces of rice, 22 cultivars were found to be distinctive on the basis of 29 essential characters. This study will be useful for breeders, researchers and farmers to identify and choose the restoration and conservation of beneficial genes for crop improvement.

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