CHARACTERIZATION OF JNPT LINES OF RICE (*ORYZA SATIVA* L.)

Arpita Shrivastava*, G. K. Koutu, D. K. Mishra and S. K. Singh

Department of Plant Breeding and Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482 004 (M.P.), India.

Abstract

Characterization is the most basic and important step in process of evaluation and cataloguing of germplasm. Characterization of thirty lines of rice derived from *Indica* into *Japonica* derived crosses was done using DUS test guidelines for rice (2006) during *kharif* 2014 at Seed Breeding Farm, J.N.K.V.V., Jabalpur (M.P.), India. A total of thirty seven morphological and agronomical characters were observed. Out of this, for the trait leaf-pubescence on blade surface, culm attitude, time of heading, spikelet-density of pubescence of lemma, spikelet: colour of stigma, stem length, panicle: length of main axis, flag leaf attitude of blade (late observation), panicle: curvature of main axis, panicle-number per plant, spikelet-colour of tip of lemma, lemma and palea colour, panicle awns, panicle: colour of awns, panicle: distribution of awns, panicle-secondary branching, panicle: attitude of branches, panicle exertion, time-maturity, grain-weight of 1000 fully developed grains, grain length and grain width genotypes showed distinctiveness. This study will be useful for breeders, researchers and farmers to identify and choose for the restoration and conservation of beneficial genes for crop improvement. This study is useful for development of climate resilient varieties for sustainable production.

Key words : Characterization, DUS, rice, morphological and agronomical traits, complete randomized block design (CRBD).

Introduction

Rice (*Oryza sativa* L.) is the central to the lives of billion of people around the world. It is an important cereal crop across the globe and India. Growing rice is largest single use of land producing food covering 9% of earth arable land. Rice provides 21% per capita energy and 15% per capita protein. There are 24 species of which 22 are wild and 2 (*Oryza sativa* and *Oryza glaberrima*) are cultivated species grown worldwide. According to one estimate, global rice production must reach 800 million tones to meet demand in 2050 (Peng *et al*., 1994). The current world population, if 7.0 billion is expected to reach 8.0 billion by 2030 and rice production must increase by 50% in order to meet the growing demand.

Enhancing crop yield is one of the most top priorities in crop breeding programme. 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 in past half century, rice yield has benefited from two major genetic improvements: improved harvest

index and plant architecture through use of semi dwarf genes and production of hybrid that exploit heterosis. Result have indicated that an effective way to develop super lines first in developing the new plant type and strong vigor by crossing *Indica* with *Japonica* subspecies and then consolidating the two advantages by optimizing the combination of desirable traits via multiple crossing and backcrossing (Cheng *et al.*, 2001).

Characterization is the most basic and important step in the process of evaluation and cataloguing of germplasm. It is essential for its evaluation, judicious use and protection against illegal utilization. Generally, germplasm accessions are evaluated for morphological, physiological and biochemical, plant pathological, entomological and other features. Characterization of several agro morphological traits is helpful to develop distinctiveness among the genotypes. Qualitative characters are considered as morphological markers in the identification of landraces of rice, because they are less influenced by environmental changes (Raut, 2003). The characters assessed must be related to the need of the breeders for its proper utilization in breeding programme. Keeping in view the above perspectives, the present investigation is carried out to characterize thirty lines of rice for different morphological and agronomical

*Author for correspondence : E-mail : arpita.jnkvv@gmail.com

traits and to identify the variability available in the collection.

Materials and Methods

Thirty lines of rice developed from Indica Japonica sub-species crossed were planted during *kharif* 2014 at the Seed Breeding Farm, Department of Plant Breeding and Genetics, J.N.K.V.V., Jabalpur (M.P.), India. The material was grown in a complete randomized block design with three replications. Each entry was sown in three rows of 2m length at spacing of 20 cm between rows and 20 cm between plants. Crop was raised following recommended package of practices. Thirty seven morphological and agronomical traits on ten randomly chosen plants of each line per replication were observed according to the National Test Guidelines for DUS test in rice, which was developed by Directorate of Rice Research, Rajendranagar, Hyderabad (Shobha Rani *et al.*, 2006). The traits under study were basal leaf : sheath colour (BLSC), leaf sheath anthocyanin colouration (LSAC), leaf pubescence on blade surface (LPBS), leaf: auricle (LA), leaf : anthocyanin colouration of auricle (LACA), leaf: collar (LC), leaf: ligule (LL), leaf: shape of ligule (LSL), leaf: colour of ligule (LCL), culm attitude (CA), time of heading (TH) and flag leaf: attitude of blade (early observation) {FLAB(EO)}, spikelet: density of pubescence of lemma (SDPL), lemma: anthocyanin colouration of keel (LACK), lemma: anthocyanin colouration of area below apex (LACABA), lemma: anthocyanin colouration of apex (LACA), spikelet: colour of stigma (SCS), stem: length (SL) and stem: anthocyanin colouration of nodes (SACN), panicle: length of main axis (PL), flag leaf: attitude of blade {FLAB(LO)}, panicle curvature of main axis (PCMA), panicle: number per plant (PNPP), spikelet: colour of tip of lemma (SCTL), lemma and palea colour (LPC), panicle : awns (PA), panicle: colour of awns (PCA), panicle : distribution of awns (PDA), panicle: presence of secondary branches (PPSB), panicle: secondary branching (PSB), panicle: attitude of branches (PAB), panicle exertion (PE) and time: maturity (TM), sterile: lemma colour (SLC), grain: weight of 1000 fully developed grains (1000GW), grain: length (GL) and grain: width (GW).

Results and Discussion

Morphological and agronomical characterization is an important and basic methodology to establish distinctiveness among the genotypes. In the present study, no variation showed by the traits-basal leaf sheath colour, leaf sheath: anthocyanin colouration, leaf: auricles, leaf: anthocyanin colouration of auricle, leaf: collar, leaf: ligule, leaf: shape of ligule, leaf: colour of ligule, flag leaf: attitude

of blade (early observation), lemma: anthocyanin colouration of keel, lemma: anthocyanin colouration of area below apex, lemma: anthocyanin colouration of apex, stem: anthocyanin colouration of nodes, panicle presence of secondary branches and sterile lemma: colour among the thirty lines of rice.

Among the basal leaf sheath characters, all the lines showed green basal leaf sheath colour without pigmentation. With respect to leaf collar, all the lines showed its presence and absence of anthocyanin colouration. Anthocyanin colouration is absent in all the lines in keel, area below apex, apex and stem nodes. For stigma colour, all the lines expressed white colour except the line JNPT 767, which showed purple colour of stigma. Variations in degree of pigmentation suggest few or more gene controlling above traits. Chang (1979) also suggest that purple pigmentation of rice plants had been lost during the process of evolution and genotypes with green types were evolved ones.

For leaf: pubescence on blade surface, 15 lines distinct for weak pubescence and 15 for medium pubescence. For density of pubescence of lemma, most of the lines (23) exhibited medium followed by weak (05) and strong (02). The seed coat and penultimate leaf pubescence restrict the insect to feed on the grains and its landing on the leaves. All 30 lines of rice expressed presence of colourless auricle. All 30 lines expressed presence of leaf auricle with split shape and white colour. For character culm attitude, 24 lines were semi erect type and 6 were semi erect type. Early time of heading expressed by 13 lines, while 10 lines showed medium and 7 lines showed late time of heading. Erect flag leaf attitude of blade (early observation) expressed by all the lines.

Very short stem length expressed by 25 lines, 02 were short, 02 were medium and 01 were long (NPT 14-17). For panicle: length of main axis, 19 lines were medium and 11 were long. For the character flag leaf attitude of blade (late observation) 14 were of semi erect, 13 were of erect and only 03 lines were of horizontal type. Panicle curvature of main axis for 16 lines was deflexed and for 14 lines was drooping type. With respect to panicle number per plant 16 lines expressed few and 14 lines expressed medium number.

For colour of tip of lemma 11 were of white, 09 were of brown, 07 were of yellowish, 02 were of red and only 01 (JNPT 767) were of purple colour. Similarly for lemma and palea colour, 11 were gold and gold furrow on straw background, 11 were brown furrow on straw, 04 were brown (tawny) and 03 were brown spot on straw. All the

Table 1 : Essential characters along with descriptor.

S. no.	Characteristics	Strategies				
1.	Basal leaf: sheath colour	Green (1)	Light purple (2)	Purple lines (3)	Uniform purple (4)	
2.	Leaf sheath: anthocyanin colouration	Absent (1)	Present (9)			
3.	Leaf: pubescence of blade surface	Absent (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)
4.	Leaf: auricle	Absent (1)	Present (9)			
5.	Leaf : anthocyanin colouration of auricle	Colourless (1)	Light purple (2)	Purple (3)		
6.	Leaf: collar	Absent (1)	Present (9)			
7.	Leaf: anthocyanin colouration of collar	Absent (1)				
8.	Leaf: ligule	Absent (1)	Present (9)			
9.	Leaf: shape of ligule	Truncate (1)	Acute (2)	Split (3)		
10.	Leaf: colour of ligule	White (1)	Light purple (2)	Purple (3)		
11.	Culm: attitude	Erect (1)	Semi erect (3)	Open (5)	Spreading (7)	
12.	Time of heading	Very early (1)	Early (3)	Medium (5)	Late (7)	Very late (9)
13.	Flag leaf : attitude of blade (early observation)	Erect (1)	Semi erect (3)	Horizontal (5)	Drooping (7)	
14.	Spikelet : density of pubescence of lemma	Absent (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)
15.	Lemma : anthocyanin colouration of keel	Absent/ very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)
16.	Lemma: anthocyanin colouration of area below apex	Absent/ very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)
17.	Lemma : anthocyanin colouration of apex	Absent/ very weak (1)	Weak (3)	Medium (5)	Strong (7)	Very strong (9)
18.	Spikelet: colour of stigma	White (1)	Light green (2)	Yellow (3)	Light purple (4)	Purple (5)

Table 1 continued....

Table 1 continued....

No.	Characteristic									
19.	Stem : length	Very short (1)		Short (3)		Medium (5)		Long (7)		Very long (9)
20.	Stem : anthocyanin colouration of nodes	Absent (1)		Present (9)						
21.	Panicle : length of main axis	Very short (1)		Short (3)		Medium (5)		Long (7)		Very long (9)
22.	Flag leaf: attitude of blade (late observation)	Erect (1)		Semi erect (3)		Horizontal (5)		Drooping (7)		
23.	Panicle: curvature of main axis	Straight (1)		Semi straight (3)		Deflexed (5)		Drooping (9)		
24.	Panicle: number per plant			Few (3)		Medium 95)		Many (7)		
25.	Spikelet: colour of tip of lemma	White (1)	Yellowish (2)	Brown (3)	Red (4)	Purple (5)	Black (6)			
26.	Lemma and palea; colour	Straw (1)	Gold and gold furrow on straw back-ground (2)	Brown spot on straw (3)	Brown furrow on straw (4)	Brown (tawny) (5)	Reddish to light purple (6)	Purple spot/ furrow on straw (7)		Black (9)
27.	Panicle : awns	Absent (1)		Present (9)						
28.	Panicle : colour of awns	Yellowish white (1)	Yellowish brown (2)	Brown (3)	Reddish brown (4)	Light red (5)	Red (6)	Light purple (7)	Purple (8)	Black (9)
29.	Panicle: distribution of awns	Tip only (1)		Upper half only (3)		Whole length (5)				
30.	Panicle: presence of secondary branches	Absent (1)		Present (9)						
31.	Panicle: secondary branches	Weak (1)	Strong (2)	Clustered (3)						
32.	Panicle: attitude of branches	Erect (1)		Erect to semi erect (3)		Semi erect (5)		Semi erect to spreading (7)		Spreading (7)
33.	Panicle: exsertion exserted (3)	Partly exsserted (3)		Mostly exsserted (5)		Well exsserted (7)				
34.	Time maturity	Very early (1)		Early (3)		Medium (5)		Late (7)		Very late (9)
35.	Sterile lemma : colour	Straw (1)	Gold (2)	Red (3)	Purple (4)					
36.	Grain: weight of 1000 fully developed grains	Very low (1)		Low (3)		Medium (5)		High (7)		Very high (9)
37.	Grain: length	Very short (1)		Short (3)		Medium (5)		Long (7)		Very long (9)
38.	Grain: width	Very narrow (1)		Narrow (3)		Medium (5)		Broad (7)		Very broad (9)

Table 2 : Characterization of JNPT lines as per the DUS guidelines.

S. no.	Lines	BLSC	LSAC	LPBS	LA	LACA	LC	LACC	LL	LSL	LCL	CA	TH	FLAB(EO)	SDPL
1.	NPT 14-1	1	1	5	9	1	9	1	9	3	1	3	7	1	5
2.	NPT 14-2	1	1	5	9	1	9	1	9	3	1	1	7	1	5
3.	NPT 14-3	1	1	3	9	1	9	1	9	3	1	1	7	1	5
4.	NPT 14-4	1	1	3	9	1	9	1	9	3	1	1	7	1	3
5.	Chinnor	1	1	3	9	1	9	1	9	3	1	3	7	1	7
6.	NPT 14-5	1	1	3	9	1	9	1	9	3	1	3	7	1	5
7.	NPT 14-6	1	1	5	9	1	9	1	9	3	1	3	5	1	5
8.	NPT 14-7	1	1	3	9	1	9	1	9	3	1	1	7	1	5
9.	NPT 14-8	1	1	3	9	1	9	1	9	3	1	1	5	1	5
10.	NPT 14-9	1	1	3	9	1	9	1	9	3	1	1	5	1	3
11.	NPT 14-10	1	1	3	9	1	9	1	9	3	1	1	5	1	5
12.	JRH-19	1	1	3	9	1	9	1	9	3	1	1	3	1	5
13.	NPT 14-11	1	1	3	9	1	9	1	9	3	1	3	5	1	5
14.	NPT 14-12	1	1	3	9	1	9	1	9	3	1	1	5	1	5
15.	NPT 14-16	1	1	3	9	1	9	1	9	3	1	1	3	1	7
16.	NPT 14-17	1	1	5	9	1	9	1	9	3	1	3	5	1	5
17.	NPT 14-18	1	1	5	9	1	9	1	9	3	1	1	3	1	5
18.	JNPT 1004	1	1	5	9	1	9	1	9	3	1	1	3	1	3
19.	JNPT 1005	1	1	3	9	1	9	1	9	3	1	1	5	1	5
20.	JNPT 1009	1	1	3	9	1	9	1	9	3	1	1	5	1	5
21.	JNPT 1101	1	1	5	9	1	9	1	9	3	1	1	3	1	3
22.	JNPT 1107	1	1	5	9	1	9	1	9	3	1	1	5	1	3
23.	JNPT 1115	1	1	5	9	1	9	1	9	3	1	1	3	1	5
24.	JRH-8	1	1	5	9	1	9	1	9	3	1	1	3	1	5
25.	JNPT 1124	1	1	5	9	1	9	1	9	3	1	1	3	1	5
26.	JNPT 1126	1	1	3	9	1	9	1	9	3	1	1	3	1	5
27.	JNPT 1103	1	1	5	9	1	9	1	9	3	1	1	3	1	5
28.	JNPT 966	1	1	5	9	1	9	1	9	3	1	1	3	1	5
29.	JNPT 767	1	1	5	9	1	9	1	9	3	1	1	3	1	5
30.	JNPT 64	1	1	5	9	1	9	1	9	3	1	1	3	1	5

Table 3 : Characterization of JNPT lines as per the DUS guidelines.

S no.	Lines	LACK	LACABA	LACA	SCS	SL	SACN	PL	FLAB(LO)	PCMA	PNPP	SCTL	LPC
1.	NPT 14-1	1	1	1	1	1	1	5	1	7	5	3	5
2.	NPT 14-2	1	1	1	1	1	1	3	1	7	3	3	5
3.	NPT 14-3	1	1	1	1	1	1	5	1	5	3	3	5
4.	NPT 14-4	1	1	1	1	1	1	5	3	7	3	2	2
5.	Chinnor	1	1	1	1	5	1	5	3	7	5	2	5
6.	NPT 14-5	1	1	1	1	1	1	3	1	5	5	3	4
7.	NPT 14-6	1	1	1	1	1	1	5	1	7	3	3	4
8.	NPT 14-7	1	1	1	1	1	1	5	1	5	3	1	1
9.	NPT 14-8	1	1	1	1	1	1	7	5	5	3	3	4
10.	NPT 14-9	1	1	1	1	1	1	5	3	7	3	3	3
11.	NPT 14-10	1	1	1	1	1	1	5	3	7	5	1	2
12.	JRH-19	1	1	1	1	1	1	5	1	7	5	1	4
13.	NPT 14-11	1	1	1	1	1	1	5	3	7	5	2	4
14.	NPT 14-12	1	1	1	1	1	1	9	3	5	3	2	4
15.	NPT 14-16	1	1	1	1	3	1	7	1	7	3	1	2

Table 3 continued...

Table 3 continued...

16.	NPT 14-17	1	1	1	1	7	1	9	5	7	3	2	3
17.	NPT 14-18	1	1	1	1	5	1	9	5	5	3	2	4
18.	JNPT 1004	1	1	1	1	1	1	5	1	5	5	3	4
19.	JNPT 1005	1	1	1	1	1	1	3	3	5	5	4	2
20.	JNPT 1009	1	1	1	1	1	1	7	3	5	5	1	3
21.	JNPT 1101	1	1	1	1	1	1	3	3	5	5	1	2
22.	JNPT 1107	1	1	1	1	3	1	5	3	5	5	3	2
23.	JNPT 1115	1	1	1	1	1	1	5	1	5	5	1	2
24.	JRH-8	1	1	1	1	1	1	5	3	7	5	1	2
25.	JNPT 1124	1	1	1	1	1	1	5	1	5	3	1	4
26.	JNPT 1126	1	1	1	1	1	1	5	1	7	3	1	4
27.	JNPT 1103	1	1	1	1	1	1	5	1	5	5	1	2
28.	JNPT 966	1	1	1	1	1	1	3	3	5	3	4	4
29.	JNPT 767	1	1	1	5	1	1	5	3	7	3	5	2
30.	JNPT 64	1	1	1	1	1	1	7	3	5	3	2	2

Table 4 : Characterization of JNPT lines as per the DUS guidelines.

S. no.	Lines	PA	PCA	PDA	PPSB	PSB	PAB	PE	TM	SLC	1000GW	GL	GW
1.	NPT 14-1	9	1	1	9	3	7	7	9	1	1	3	3
2.	NPT 14-2	1	-	-	9	2	7	7	9	1	1	3	5
3.	NPT 14-3	1	-	-	9	2	7	5	9	1	1	3	3
4.	NPT 14-4	1	-	-	9	3	7	7	9	1	3	3	3
5.	Chinnor	9	1	5	9	2	7	7	9	1	1	3	3
6.	NPT 14-5	1	-	-	9	2	7	7	7	1	1	3	3
7.	NPT 14-6	9	1	5	9	3	7	7	7	1	3	3	3
8.	NPT 14-7	1	-	-	9	2	7	7	9	1	3	3	3
9.	NPT 14-8	9	1	3	9	3	5	3	7	1	5	3	3
10.	NPT 14-9	9	1	3	9	3	7	7	5	1	3	7	3
11.	NPT 14-10	1	-	-	9	2	7	7	5	1	5	5	3
12.	JRH-19	1	-	-	9	3	7	7	5	1	7	5	5
13.	NPT 14-11	9	1	3	9	2	7	7	5	1	3	5	3
14.	NPT 14-12	9	1	1	9	2	7	3	7	1	3	5	5
15.	NPT 14-16	9	1	5	9	3	9	7	5	1	7	5	3
16.	NPT 14-17	9	1	3	9	2	7	7	7	1	7	7	5
17.	NPT 14-18	9	4	3	9	3	7	7	5	1	7	5	3
18.	JNPT 1004	9	3	1	9	2	7	5	5	1	5	5	3
19.	JNPT 1005	1	-	-	9	1	7	7	5	1	5	3	5
20.	JNPT 1009	9	1	1	9	2	7	7	7	1	5	5	3
21.	JNPT 1101	1	-	-	9	2	7	7	5	1	3	3	5
22.	JNPT 1107	1	-	-	9	3	7	7	5	1	7	5	5
23.	JNPT 1115	9	1	1	9	3	9	7	5	1	7	5	3
24.	JRH-8	1	-	-	9	3	7	5	3	1	5	5	5
25.	JNPT 1124	1	-	-	9	2	7	7	5	1	1	5	5
26.	JNPT 1126	1	-	-	9	3	7	7	5	1	5	5	5
27.	JNPT 1103	1	-	-	9	2	7	7	5	1	7	5	5
28.	JNPT 966	9	4	3	9	2	5	5	5	1	5	5	5
29.	JNPT 767	9	1	1	9	3	7	7	5	1	5	5	5
30.	JNPT 64	1	-	-	9	2	9	5	5	1	7	5	5

genotypes showed straw apiculus colour. During the process of evolution, the coloured genotypes evolved to lighter colour like straw and yellow. Further as the process of evolution goes on the coloured genotypes changes to white type (Watt, 1892).

Panicle awns present in 15 lines. Out of which 12 expressed yellowish white colour of awns whereas 02 and 01 lines expressed reddish brown and brown colour respectively. Tip only distribution of awns showed by 6 lines followed by 06 was upper half only and 03 were whole length. The awned genotypes are primitive and well adapted to adverse environment factors *viz.*, drought, salinity and low temperature as reported by Chandraratna (1964). As regards the colour of the awns purple colour may be primitive traits which gradually changed during the course of evolution from red to gold and straw (Chang, 1979).

All the lines exhibited presence of secondary branching. Most of the lines (16) were of strong secondary branching, 13 were of clustered secondary branching and only one lines showed weak secondary branching of panicle. Semi erect to spreading attitude of branches exhibited by 25 lines, 03 were of semi erect and only 02 lines showed spreading attitude of branches. For panicle exertion, 23 were of well exerted, 05 were of mostly exerted and only 02 were partly exerted. About 17 lines expressed medium time maturity, 06 were late and only JRH- 8 showed early time maturity.

Straw sterile lemma colour showed by all the lines. For grain weight of 1000 fully developed grains, 09 were of medium, 08 were of high, 07 were of low and 06 were of very low grain weight. Medium grain length expressed by 17 lines followed by short (11 lines) and long (02 lines). For about 16 lines, the grain width was narrow and 14 lines were of medium.

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