Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2624

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (4):** 466-475 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Agro-Morphological Characterization of Rice (*Oryza sativa* L.) Landraces Based on DUS Descriptors

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Received: 22.02.2017 | Revised: 4.03.2017 | Accepted: 6.03.2017

ABSTRACT

In the present investigation, characterization of seventy landraces of rice was carried out based on fourteen DUS characters. Out of fourteen characters under study, stem anthocyanin colouration of node was dimorphic. Three traits viz., spikelet colour of stigma, stem length and panicle exsertion were trimorphic. Basal leaf sheath colour, time of heading (50 % plants with panicles), flag leaf attitude (late observation), panicle length, decorticated grain length and shape were tetramorphic and lemma anthocyanin colouration of apex and amylose content showed five states of expression and based on decorticated grain colour six groups were made.

Key words: *Agro-morphological, Characterization, DUS descriptors, Rice, Landraces.*

INTRODUCTION

Rice has the largest germplasm collections in the world. This accessible collection of diverse cultivated varieties, landraces and related wild species has made great contributions to rice breeding and they played a very important role in the local food security and sustainable development of agriculture, in addition to their significance as genetic resource for rice genetic improvement[7].

Being signatory to the General Agreement on Trade and Tariffs (GAAT), Government of India has enacted its *Sui generis* system, Protection of Plant Varieties and Farmers' Right Act (PPV&FRA), 2001 for providing protection to plant varieties based on Distinctiveness, Uniformity and Stability (DUS) test, apart from novelty. Therefore, the characterization of a variety is a prerequisite and identification of plant varieties of common knowledge is essential for the protection of new plant varieties and determining varietal purity. The uniqueness of a variety from existing varieties is to be established by following standard DUS testing guidelines.

Agro-Morphological 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. Keeping in view the importance of aforesaid aspects, the present investigation was undertaken to characterize the seventy landraces of rice.

Cite this article: Umarani, E., Radhika, K., Padma, V. and Subbarao, L.V., Agro-Morphological Characterization of Rice (*Oryza sativa* L.) Landraces Based on DUS Descriptors, *Int. J. Pure App. Biosci.* **5(4):** 466-475 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2624

MATERIAL AND METHODS

The field experiment was conducted during *kharif*, 2013 at Directorate of Rice Research Farm, ICRISAT campus, Patancheru, Hyderabad, India. Seventy landraces of rice, collected from various places were sown separately in raised bed nursery. Thirty days old seedlings of each genotype were transplanted in 5 rows of 3 m length by adopting a spacing of 20 cm between rows and 15 cm between plants with in a row in Randomized Block Design replicated thrice. All the necessary precautions were taken to maintain uniform plant population of each genotype per replication. All the recommend package of practices was adopted besides providing necessary prophylactic plant protection measures to raise a good crop.

Morphological characterization of seventy landraces of rice was carried out using fourteen DUS characters. Visual observations were recorded on single plant basis on ten randomly selected plants in each genotype at appropriate growth stages according to Rao *et al.*[4] on six qualitative characters *viz.*, basal leaf sheath colour, flag leaf attitude (late obseravtion), lemma anthocyanin colouration of apex, stigma colour, stem anthocyanin colouration of node and panicle exsertion**.** Data on stem length and panicle length were recorded on five randomly selected plants in each plot, while the data on time of heading (50 % plants with panicles) was noted on plot basis. Grain quality traits including decorticated grain length, decorticated grain width, decorticated grain L/B ratio, decorticated grain shape, decorticated grain colour, amylose content were also recorded as per the standard procedures.

RESULTS AND DISCUSSION

In the present study, seventy landraces were characterized by using nine agro-morphological characters including six qualitative and three quantitative traits (Table 1) and five grain quality characters (Table 2) as per the norms of national DUS test guide lines. The rice landraces under study showed wide range of variability for all the morphological traits studied. Frequency distribution for all the characters under study were computed (Table 3).

Characterization of seventy landraces, on the basis of basal leaf sheath colour revealed that 50 landraces exhibited green basal leaf sheath colour, eight showed light purple, eight were having purple lines and remaining four had uniform purple basal leaf sheath colour. Among the seventy landraces under study, nineteen were having erect flag leaf attitude, thirty two were having semi-erect state, while horizontal flag leaf attitude was exhibited by eighteen landraces and finally only single landrace expressed deflexed flag leaf attitude. Majority of the genotypes were grouped under medium (35) followed by early (26) categories, while eight and one genotypes were categorized as late and very early types, respectively based on time of heading. Based on lemma: anthocyanin colouration of apex, all the landraces were grouped into five groups namely absent, weak, medium, strong and very strong with each group having 38, 1, 3, 12 and 16 landraces, respectively. Forty two rice landraces exhibited white stigma colour, three showed light purple stigma and twenty five landraces had purple stigma. Based on stem length seventy landraces were characterized into three groups namely very short (<91 cm), short (91-110 cm) and medium (111-130 cm), which comprised of thirty two, twenty eight and ten landraces, respectively. Majority (53) of the landraces expressed absence of node anthocyanin colouration and while 17 landraces exhibited anthocyanin colouration of node. Four landraces showed partially exserted panicles, mostly exserted panicles were found in 8 landraces and 58 had well exserted panicles. Most of landraces fall into medium (52), followed by long (11), short (5) and very long (2) panicle length categories.

Based on the decorticated grain: length entire experimental material was characterized as short (29), medium (39), long (1) and extra long (1). While decorticated grain: width did not show any variation visually as the entire set of experimental material, exhibited only narrow type (< 2.0

mm) of decorticated grain width. Based on L/B ratio and decorticated grain length most of the landraces were classified as short slender (54) followed by long slender (11), then medium slender (4) and short bold (1). On the basis of decorticated grain colour, the experimental material was grouped into five categories *viz.,* white (10), light brown (17), brown (5), light red (10) and red (27). However a special grain colour, which was not mentioned in DUS guidelines, i.e., black, was exhibited by a single landrace. 33 landraces had high, 22 landraces exhibited medium, 9 showed low, 4 had in very high and 2 showed very low amylose content. Similar studies were conducted by Subbarao *et al.*[6], Joshi *et al.*[2], Chakrabarty *et al.*[1], Parikh *et al.*[3], Tirkey *et al*.[8] and Sinha and Mishra[5].

Table 1: Agro-morphological characterization of landraces of rice

Name of the landrace	Basal: leaf sheath colour	Flag leaf: attitude of blade	Time of heading	Lemma: anthocyanin colouration of apex	Spikelet: colour of stigma	Stem length	Stem: anthocyanin colouration of node	Panicle length	Panicle: exsertion
Nimisaal	Uniform purple	Horizontal	Medium	Strong	Purple	Short	Absent	Medium	Well exserted
Thuroodi	Green	Semi-erect	Medium	Strong	Purple	Short	Absent	Medium	Mostly exserted
Danaguri	Green	Horizontal	Medium	Absent	White	Short	Absent	Medium	Well exserted
Kottathondi	Green	Semi-erect	Medium	Very strong	Purple	Short	Absent	Medium	Well exserted
Kankri	Green	Semi-erect	Early	Absent	White	Very short	Absent	Short	Well exserted
Chandrakanta	Green	Erect	Medium	Absent	White	Short	Absent	Long	Well exserted
Krishna Kamod	Green	Deflexed	Early	Very strong	White	Short	Absent	Medium	Well exserted
Banshpati	Purple lines	Erect	Early	Strong	Purple	Short	Absent	Medium	Well exserted
Chakhao Poiretion	Uniform purple	Semi-erect	Early	Very strong	Light purple	Medium	Present	Medium	Well exserted
Batiasora	Green	Horizontal	Early	Absent	White	Medium	Absent	Medium	Well exserted
Moirangphou Yenthik	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Medium	Well exserted
Srabanti Sal	Purple lines	Erect	Medium	Strong	Purple	Short	Present	Medium	Well exserted
Kuruka	Green	Erect	Medium	Very strong	Purple	Very short	Absent	Medium	Well exserted
Chetuveliyan	Green	Semi-erect	Medium	Very strong	Purple	Medium	Absent	Long	Well exserted
Kuttiveliyan	Green	Horizontal	Early	Very strong	Purple	Medium	Absent	Long	Well exserted
Taothabi	Green	Horizontal	Early	Absent	White	Short	Absent	Medium	Well exserted
Gandha Malati	Green	Horizontal	Medium	Absent	White	Short	Absent	Long	Well exserted
Chenthadi	Light purple	Horizontal	Medium	Strong	Purple	Medium	Present	Long	Well exserted
Kayama	Green	Horizontal	Medium	Very strong	Purple	Medium	Absent	Very	Well

Name of the landrace	Basal: leaf sheath colour	Flag leaf: attitude of blade	Time of heading	Lemma: anthocyanin colouration of apex	Spikelet: colour of stigma	Stem length	Stem: anthocyanin colouration of node	Panicle length	Panicle: exsertion
								long	exserted
Karad	Green	Semi-erect	Very early	Very strong	Light purple	Very short	Present	Short	Well exserted
Surjeet Basmati 01	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Long	Well exserted
Jhuli	Purple lines	Semi-erect	Early	Very strong	Purple	Very short	Absent	Medium	Well exserted
Urunikayama	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Medium	Well exserted
Phourelamubi	Green	Semi-erect	Early	Absent	Light purple	Medium	Absent	Medium	Well exserted
Baid Dulah	Light purple	Semi-erect	Early	Very strong	Purple	Very short	Present	Medium	Well exserted
Mullankayama	Green	Horizontal	Late	Absent	White	Medium	Absent	Very long	Well exserted
Bagh Jhapta	Green	Semi-erect	Medium	Absent	White	Short	Absent	Long	Well exserted
Adukkan	Light purple	Horizontal	Early	Very strong	Purple	Short	Absent	Medium	Well exserted
Valichoori	Green	Semi-erect	Late	Absent	White	Short	Absent	Long	Mostly exserted
Onavattan	Green	Erect	Early	Absent	White	Very short	Absent	Medium	Well exserted
Marathondi	Light purple	Semi-erect	Medium	Very strong	Purple	Medium	Absent	Medium	Mostly exserted
Mannuveliyan	Light purple	Semi-erect	Medium	Very strong	Purple	Short	Absent	Medium	Well exserted
Kailash Rana	Green	Horizontal	Early	Very strong	White	Short	Absent	Long	Well exserted
Titabora	Purple lines	Erect	Early	Very strong	White	Short	Present	Long	Well exserted
Nata	Purple lines	Erect	Early	Very strong	Purple	Very short	Absent	Medium	Well exserted
Phoudum	Green	Semi-erect	Early	Absent	White	Short	Absent	Medium	Well exserted
Lal Dhepa	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Medium	Well exserted
Kunjootti Matta	Green	Erect	Late	Absent	White	Very short	Absent	Medium	Partially exserted
Gandeshwari	Green	Horizontal	Medium	Absent	White	Short	Absent	Medium	Well exserted
Thonnuran Thondi	Green	Horizontal	Early	Strong	Purple	Medium	Absent	Long	Well exserted
Kurumottan	Green	Erect	Medium	Absent	White	Short	Absent	Long	Partially exserted
Nuapada-padampur-Assam chudi	Green	Semi-erect	Medium	Absent	White	Very short	Present	Medium	Well exserted

Name of the landrace	Basal: leaf sheath colour	Flag leaf: attitude of blade	Time of heading	Lemma: anthocyanin colouration of apex	Spikelet: colour of stigma	Stem length	Stem: anthocyanin colouration of node	Panicle length	Panicle: exsertion
Dubraj	Green	Horizontal	Medium	Absent	White	Very short	Present	Short	Well exserted
Sapari	Green	Horizontal	Medium	Absent	White	Very short	Present	Long	Well exserted
Kalamara	Purple lines	Horizontal	Early	Strong	White	Short	Present	Medium	Well exserted
Koraput-Kundra- Assam chudi	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Medium	Mostly exserted
Koraput-Kundra- Haldi chudi	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Medium	Well exserted
Kathi Dhan	Green	Horizontal	Medium	Medium	White	Short	Absent	Medium	Well exserted
Bhulo	Green	Erect	Late	Absent	White	Very short	Absent	Medium	Mostly exserted
Yubaraj	Green	Semi-erect	Early	Absent	White	Very short	Absent	Medium	Well exserted
Akul-B	Green	Semi-erect	Early	Absent	White	Very short	Absent	Medium	Well exserted
Lalkain	Uniform purple	Semi-erect	Medium	Strong	Purple	Short	Present	Medium	Well exserted
Ganthia Sikila	Green	Erect	Medium	Absent	White	Very short	Absent	Medium	Well exserted
Majhali Jhuli	Green	Erect	Early	Absent	White	Very short	Absent	Medium	Well exserted
Jubaraj	Green	Semi-erect	Early	Strong	Purple	Short	Absent	Medium	Well exserted
Ankul	Green	Semi-erect	Early	Absent	White	Very short	Absent	Medium	Well exserted
Akula	Green	Semi-erect	Medium	Absent	White	Very short	Absent	Medium	Mostly exserted
Makadhana	Purple lines	Semi-erect	Medium	Weak	Purple	Short	Present	Medium	Well exserted
Dhinkiasiali	Green	Erect	Early	Absent	White	Very short	Absent	Short	Well exserted
Ganjamgedi	Green	Erect	Medium	Absent	White	Very short	Absent	Medium	Partially exserted
Rajahansa	Green	Semi-erect	Late	Absent	White	Very short	Absent	Medium	Well exserted
Champe Siali-C	Uniform purple	Semi-erect	Late	Medium	Purple	Short	Present	Medium	Mostly exserted
Sagiri	Light purple	Horizontal	Medium	Medium	Purple	Short	Present	Medium	Well exserted
Mayurkantha-K	Light purple	Semi-erect	Medium	Strong	Purple	Short	Present	Medium	Well exserted
Kalakaincha	Light purple	Erect	Medium	Strong	Purple	Short	Present	Medium	Well exserted
Dhusura	Purple lines	Erect	Late	Strong	Purple	Short	Present	Medium	Well exserted

Name of the landrace	Basal: leaf sheath colour	Flag leaf: attitude of blade	Time of heading	Lemma: anthocyanin colouration of apex	Spikelet: colour of stigma	Stem length	Stem: anthocyanin colouration of node	Panicle length	Panicle: exsertion
Luchei	Green	Erect	Late	Absent	White	Very short	Absent	Medium	Mostly exserted
B.Hunar	Green	Semi-erect	Early	Absent	White	Very short	Absent	Short	Well exserted
Chinamali-K	Green	Erect	Medium	Absent	White	Very short	Absent	Medium	Well exserted
Dal	Green	Erect	Early	Absent	White	Very short	Absent	Medium	Partially exserted

Table 2: Characterization of landraces of rice based on grain quality parameters

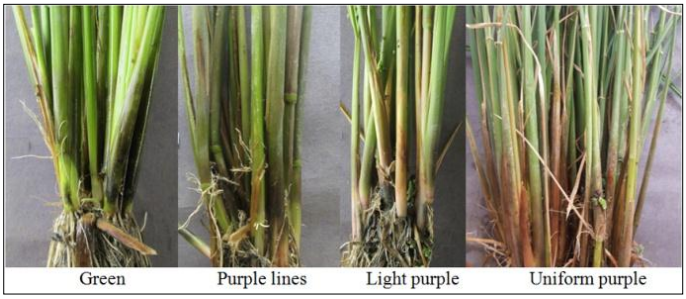
Name of the landrace	Decorticated grain: length	Decorticated grain: width	Decorticated grain: shape	Decorticated grain: colour	Amylose content (%)
Nimisaal	Short	Narrow	Short slender	Red	Very high
Thuroodi	Medium	Narrow	Short slender	Red	Very high
Danaguri	Short	Narrow	Short slender	Light brown	Medium
Kottathondi	Medium	Narrow	Short slender	Red	Medium
Kankri	Medium	Narrow	Long slender	Light brown	High
Chandrakanta	Medium	Narrow	Long slender	Light red	Medium
Krishna Kamod	Medium	Narrow	Short slender	Light brown	Medium
Banshpati	Medium	Narrow	Short slender	Red	High
Chakhao	Medium	Narrow	Short slender	Black	Very low
Batiasora	Short	Narrow	Short slender	White	Medium
Moirangphou	Medium	Narrow	Long slender	White	Low
Srabanti Sal	Medium	Narrow	Long slender	Light red	Low
Kuruka	Short	Narrow	Short bold	Red	High
Chetuveliyan	Medium	Narrow	Short slender	Red	Very high
Kuttiveliyan	Short	Narrow	Medium slender	Red	High
Taothabi	Medium	Narrow	Short slender	Red	High
Gandha Malati	Short	Narrow	Medium slender	White	Medium
Chenthadi	Medium	Narrow	Short slender	Light red	Low
Kayama	Short	Narrow	Short slender	White	Medium
Karad	Medium	Narrow	Short slender	Red	Medium
Surjeet Basmati	Extra long	Narrow	Long slender	Light brown	Medium
Jhuli	Short	Narrow	Short slender	Brown	High
Urunikayama	Medium	Narrow	Short slender	Light red	Medium
Phourelamubi	Long	Narrow	Long slender	White	Low
Baid Dulah	Short	Narrow	Short slender	Red	High
Mullankayama	Short	Narrow	Short slender	Light brown	Low
Bagh Jhapta	Medium	Narrow	Long slender	Light brown	High
Adukkan	Short	Narrow	Medium slender	Red	High
Valichoori	Medium	Narrow	Long slender	Light red	Medium
Onavattan	Short	Narrow	Short slender	Red	High
Marathondi	Short	Narrow	Short slender	Light red	Low
Mannuveliyan	Medium	Narrow	Short slender	Red	High
Kailash Rana	Short	Narrow	Short slender	Light brown	Medium
Titabora	Medium	Narrow	Short slender	White	Very low
Nata	Medium	Narrow	Short slender	Red	High

Name of the landrace	Decorticated grain: length	Decorticated grain: width	Decorticated grain: shape	Decorticated grain: colour	Amylose content (%)
Phoudum	Short	Narrow	Short slender	White	Low
Lal Dhepa	Medium	Narrow	Short slender	Red	High
Kunjootti Matta	Short	Narrow	Short slender	Red	High
Gandeshwari	Short	Narrow	Short slender	White	Medium
Thonnuran	Medium	Narrow	Short slender	Red	Medium
Kurumottan	Medium	Narrow	Medium slender	Red	High
Nuapada-	Short	Narrow	Short slender	Red	High
Dubraj	Short	Narrow	Short slender	Dark brown	Medium
Sapari	Medium	Narrow	Short slender	White	High
Kalamara	Medium	Narrow	Short slender	Light red	High
Koraput-Kundra-	Medium	Narrow	Long slender	Red	High
Koraput-Kundra-	Medium	Narrow	Short slender	Light brown	High
Kathi Dhan	Short	Narrow	Short slender	Red	Medium
Bhulo	Medium	Narrow	Long slender	Red	High
Yubaraj	Medium	Narrow	Short slender	Dark brown	Medium
Akul-B	Short	Narrow	Short slender	Light brown	High
Lalkain	Short	Narrow	Short slender	Light brown	High
Ganthia Sikila	Short	Narrow	Short slender	Light brown	High
Majhali Jhuli	Short	Narrow	Short slender	Light brown	High
Jubaraj	Medium	Narrow	Short slender	Light brown	High
Ankul	Short	Narrow	Short slender	Light brown	Medium
Akula	Medium	Narrow	Short slender	Light red	High
Makadhana	Medium	Narrow	Long slender	Red	Medium
Dhinkiasiali	Short	Narrow	Short slender	Red	Medium
Ganjamgedi	Short	Narrow	Short slender	White	Medium
Rajahansa	Medium	Narrow	Short slender	Light brown	Very high
Champe Siali-C	Medium	Narrow	Short slender	Red	High
Sagiri	Medium	Narrow	Short slender	Light red	Low
Mayurkantha-K	Medium	Narrow	Short slender	Light brown	Low
Kalakaincha	Short	Narrow	Short slender	Brown	High
Dhusura	Medium	Narrow	Short slender	Light brown	High
Luchei	Medium	Narrow	Short slender	Red	Medium
B.Hunar	Short	Narrow	Short slender	Light brown	High
Chinamali-K	Medium	Narrow	Short slender	Light red	High
Dal	Medium	Narrow	Short slender	Red	High

Table 3: Frequency distribution of landraces of rice for various DUS characters

S. No	Character	State of expression	Number of genotypes	Frequency distribution (%)
1	Basal: leaf sheath colour	Green	50	71.43
		Light purple	8	11.43
		Purple lines	8	11.43
		Purple	4	5.71
2	Flag leaf: attitude of blade (late observation)	Erect	19	27.14
		Semi erect	32	45.71
		Horizontal	18	25.71
		Deflexed	1	1.43
3.	Time of heading (50 % plants with panicles)	Very early	1	1.43
		Early	26	37.14

S. No	Character	State of expression	Number of genotypes	Frequency distribution (%)
		Medium	35	50.00
		Late	8	11.43
4.	Lemma: anthocyanin colouration of apex	Absent	38	54.29
		Weak	1	1.43
		Medium	3	4.29
		Strong	12	17.14
		Very strong	16	22.86
5.	Spikelet: colour of stigma	White	42	60.00
		Light purple	3	4.29
		Purple	25	35.71
6.	Stem length (excluding panicle)	Very short	32	45.71
		Short	28	40.00
		Medium	10	14.28
7	Stem: anthocyanin colouration of node	Absent	53	75.71
		Present	17	24.29
8.	Panicle: exsertion	Partially exerted	4	5.71
		Mostly exerted	8	11.43
		Well exerted	58	82.86
9.	Panicle length	Short	5	7.14
		Medium	52	74.28
		Long	11	15.71
		Very long	2	2.86
10.	Decorticated grain: length	Short	29	41.43
		Medium	39	55.71
		Long	1	1.43
		Extra long	1	1.45
11.	Decorticated grain: width	Narrow	70	100.00
12.	Decorticated grain: shape	Short slender	54	77.14
		Short bold	1	1.43
		Medium slender	4	5.71
		Long slender	11	15.71
13.	Decorticated grain: colour	White	10	14.28
		Light brown	17	24.28
		Dark brown	5	7.14
		Light red	10	14.28
		Red	27	38.57
		Black	1	1.43
14.	Amylose content	Very low	2	2.86
		Low	9	12.86
		Medium	22	31.43
		High	33	47.14
		Very high	4	5.71

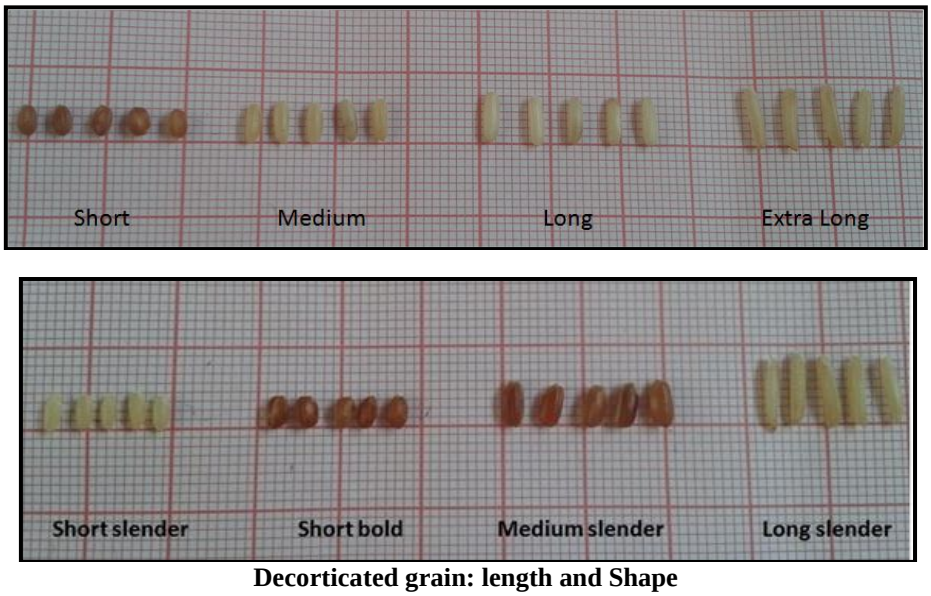


Basal leaf: sheath colour

lemma: anthocyanin colouration of apex

Colour of stigma

Decorticated grain: colour



Decorticated grain: length and Shape

Fig 1: Variability observed for various DUS characters

CONCLUSIONS

To meet the continuously expanding needs of varietal improvement, the assemblage, evaluation, preservation and characterization of the entire existing germplasm are essential to more rewarding breeding efforts. Out of the fourteen DUS characters recorded, stem anthocyanin colouration of node was dimorphic, spikelet colour of stigma, stem length and panicle exsertion were trimorphic, basal leaf sheath colour, time of heading (50 % plants with panicles), flag leaf attitude (late observation), panicle length, decorticated grain length and shape were tetramorphic and lemma anthocyanin colouration of apex and amylose content showed five states of

expression and based on decorticated grain colour highest number of groups i.e., six were made.

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