Plant Archives Vol. 25, Supplement 2, 2025 pp. 115-122 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.015

MORPHOLOGICAL CHARACTERIZATION OF INDIGENOUS COLLECTION OF LANDRACES OF RICE (*ORYZA SATIVA* L.)

Tejraj A. Naik Nimbalkar, Sudheer K. Pathak*, Shama Parveen and Pramod Sharma
Department of Genetics and Plant Breeding, ITM University, Gwalior (M.P.) India
*Corresponding Author E-mail: sudheerpathak.soag@itmuniversity.ac.in
(Date of Receiving : 22-02-2025; Date of Acceptance : 30-04-2025)

ABSTRACT

This study characterizes and evaluates 46 rice genotypes (*Oryza sativa* L.), comparing 40 indigenous landraces and six check varieties, using the Distinctness, Uniformity, and Stability (DUS) descriptors developed by the PPV & FRA Authority (2001). Conducted during the Kharif season of 2024 at ITM University, Gwalior, Madhya Pradesh, the research was performed under a semi-humid subtropical climate favourable for rice cultivation. A randomized block design was employed to assess 62 DUS descriptors, focusing on 48 morphological traits across five randomly selected plants per genotype. Significant variability was observed in traits such as leaf colour, anthocyanin presence, culm attitude, and panicle characteristics. Most genotypes displayed green leaf coloration (91.3%) and erect to semi-erect culm orientations (89.12%). Key findings highlighted landraces with potential for breeding: Matla and Mohan Bogh for short-duration cropping, Matidhan and Bhutmuri for waterlogging tolerance, and IR-64 and Pusa-44 for high yield potential. Aromatic varieties such as 1121 and Lal Basmati were noted for their superior grain quality. This study underscores the critical role of morphological diversity in breeding programs, contributing to improved stress tolerance, enhanced yield, and strengthened food security in India.
***Keywords* :** Rice, Morphological Study, DUS, Frequency Distribution.

Introduction

Rice (*Oryza sativa L.*) is an important cereal crop and a pivotal member of the Poaceae family. It plays a vital role in global food security, with more than three billion people depending on rice worldwide (Shrivastava *et al*., 2014). The theme for the 2004 International Year of Rice was "Rice is life," highlighting its immense significance as a food and trade commodity (Gampala *et al*., 2014).

The cultivation area of 163 million hectares, global rice production in 2023/24 reached 523.9 million tons (milled basis), reflecting a 0.8% increase from the previous season (FAO, 2023). India remains one of the largest rice producers, with over 45.5 million hectares cultivated and an estimated production of 134 million tons in 2023/24. India is traditionally rich in the diversity of rice with including wild progenitors of cultivated varieties of rice also (Bisne, 2000). India's rice, grown with improved varieties, lacks sufficient nutrient content (Keerthivarman *et al*., 2019). However, states like Madhya Pradesh, despite cultivating 5 million hectares and producing 14.5 million tons, struggle with lower productivity compared to the national average, emphasizing the need for better genetic resources and breeding strategies.

Traditional rice landraces, cultivated for years in Madhya Pradesh, are under threat due to modern high-yielding varieties. This study aims to morphologically characterize 40 rice landraces and six check varieties to evaluate their uniqueness and adaptability. Morphological and physiological characteristics can be used to determine a variety's uniqueness in nearly all of the important crop species (Moukoumbi *et al.,* 2011). Characterization entails examining a range of agro-morphological characteristics, including both qualitative and quantitative descriptors (Saxena and Rawte, 2018). Morphological characterization, including traits like plant height, panicle length, awn length, and seed dimensions, plays a crucial role in assessing genetic diversity for breeding programs.

The Protection of Plant Varieties and Farmers' Rights Act (PPV&FRA) of 2001 safeguards plant varieties that pass the Distinctness, Uniformity, and Stability (DUS) test, ensuring the recognition of unique traits. Such characterization supports conservation efforts and sustainable agricultural practices.

Rice is a primary energy source with varying nutritional values. White rice provides quick energy but lacks fiber and essential nutrients due to processing, while brown rice retains more fiber, vitamins, and minerals, making it nutritionally superior.

Rice cultivation in India, particularly in regions like Madhya Pradesh, presents both opportunities and challenges. To meet the growing global demand, genetic improvement through breeding is crucial for enhancing yield, stress resilience, and nutritional quality. Modern breeding technologies, biofortification, and sustainable practices can lead to superior rice varieties that address both productivity concerns and nutritional deficiencies. By integrating molecular biology innovations**,** rice production can contribute significantly to global food security, ensuring higher yields while improving dietary health.

The aim of this study is to assess and document the morphological diversity among 40 indigenous rice landraces and 6 check varieties using DUS descriptors. This characterization will help identify unique traits for varietal distinction, conservation efforts, and future breeding programs tailored to local agro-climatic conditions.

Material and Methods

Location and Experimental Site

The present study was conducted on 40 rice germplasms along with six check varietiesat Crop Research Centre-1, ITM University, Sithouli Campus, Gwalior, situated within the Gird agroclimatic zone of Madhya Pradesh. The region experiences an annual rainfall of 800-1000 mm and is characterized by red, light, and shallow soil. The experimental site is located at 26°08'22.6" N latitude, 78°11'42.9" E longitude, and 211.5 m above sea level. The climate is semi-humid, subtropical with summer temperatures ranging from 23°C to 40°C and winter temperatures from 4°C to 29°C. Adequate rainfall and favourable soil conditions facilitated optimal seed germination. Although the soil had a tendency to form a hard crust, it did not hinder seedling emergence due to timely germination.

Twenty-one days following sowing, the seedlings were moved into a field that was well-puddled. Each accession was planted in three rows with two replications using a randomized block design (RBD), maintaining a row-to-row spacing of 30 cm. The Distinctness, Uniformity, and Stability of Rice (*Oryza sativa* L.) test recommendations were followed in recording measurements of several morphological traits of these gathered landraces at various growth stages (Anonymous, 2007).

Our research study trial was conducted with 46 different genotypes, comparing 40 indigenous landraces and six check varieties, with nearly 48 morphological characters were characterised. This data was collected from five randomly collected plants from every accession. The details of the characters and their observation about the genotypic descriptors "The guidelines for conducting the Distinctness Uniformity Stability (DUS) test on rice" are provided by (PPV & FRA, 2007) (Anonymous, 2007). Table 2.1 is a list of the landraces employed in this experiment.

Experimental Material: The germplasm of Ricewas received from The Fuliya, Indigenous Aromatic Rice Research Station Nadiya (W.B.), ICAR-IARI, New Delhi, through the material transfer agreement (MTA).

Table 1: List of genotypes (Indigenous collection) under study

S.No	Genotype	Germplasm	Collected From
1	Pusa-2090	Indigenous	ICAR-IARI, New Delhi
2	PRH-10	Indigenous	ICAR-IARI, New Delhi
3	Jaya	Indigenous	ICAR-IARI, New Delhi
4	Pusa-44	Indigenous	ICAR-IARI, New Delhi
5	1886	Indigenous	ICAR-IARI, New Delhi
6	P-2070	Indigenous	ICAR-IARI, New Delhi
7	PS-5	Indigenous	Rice Research Station Nadiya (W.B.)
8	Matla	Indigenous	Rice Research Station Nadiya (W.B.)

9	Matidhan	Indigenous	Rice Research Station Nadiya (W.B.)
10	Mohan bogh	Indigenous	Rice Research Station Nadiya (W.B.)
11	Bhutmuri	Indigenous	Rice Research Station Nadiya (W.B.)
12	Molliphulo	Indigenous	Rice Research Station Nadiya (W.B.)
13	IR-64	Indigenous	Rice Research Station Nadiya (W.B.)
14	Lal Chal Mota	Indigenous	Rice Research Station Nadiya (W.B.)
15	Bishnu Bogh	Indigenous	Rice Research Station Nadiya (W.B.)
16	Radhe emo	Indigenous	Rice Research Station Nadiya (W.B.)
17	Radha Tilak	Indigenous	Rice Research Station Nadiya (W.B.)
18	Ramjira	Indigenous	Rice Research Station Nadiya (W.B.)
19	Black	Indigenous	Rice Research Station Nadiya (W.B.)
20	Putikhali	Indigenous	Rice Research Station Nadiya (W.B.)
21	1885	Indigenous	Rice Research Station Nadiya (W.B.)
22	Raj jhinge	Indigenous	Rice Research Station Nadiya (W.B.)
23	Akhanibora	Indigenous	Rice Research Station Nadiya (W.B.)
24	Joldhyapa	Indigenous	Rice Research Station Nadiya (W.B.)
25	Gumbaho	Indigenous	Rice Research Station Nadiya (W.B.)
26	Burma black	Indigenous	Rice Research Station Nadiya (W.B.)
27	Paru	Indigenous	Rice Research Station Nadiya (W.B.)
28	siuli	Indigenous	Rice Research Station Nadiya (W.B.)
29	Jugol	Indigenous	Rice Research Station Nadiya (W.B.)
30	Ambha mohar	Indigenous	Rice Research Station Nadiya (W.B.)
31	1121	Indigenous	Rice Research Station Nadiya (W.B.)
32	Sitabogh	Indigenous	Rice Research Station Nadiya (W.B.)
33	Pateni	Indigenous	Rice Research Station Nadiya (W.B.)
34	Ashanliya	Indigenous	Rice Research Station Nadiya (W.B.)
35	Langal Muthi	Indigenous	Rice Research Station Nadiya (W.B.)
36	Baigan Manjira	Indigenous	Rice Research Station Nadiya (W.B.)
37	Shikote	Indigenous	Rice Research Station Nadiya (W.B.)
38	1847	Indigenous	Rice Research Station Nadiya (W.B.)
39	Pokhrabora	Indigenous	Rice Research Station Nadiya (W.B.)
40	Lal boro	Indigenous	Rice Research Station Nadiya (W.B.)
41	Lal Basmati	Indigenous	Rice Research Station Nadiya (W.B.)
42	Adanchilpa	Indigenous	Rice Research Station Nadiya (W.B.)
43	Kalojira	Indigenous	Rice Research Station Nadiya (W.B.)
44	Sial Bhomra	Indigenous	Rice Research Station Nadiya (W.B.)
45	Borshlaxmi	Indigenous	Rice Research Station Nadiya (W.B.)
46	Dubraj	Indigenous	Rice Research Station Nadiya (W.B.)

Result and Discussion

The present study characterized 46 rice genotypes, comparing 40 indigenous landraces and six check varieties, based on DUS descriptors, analysing 48 morphological traits to assess their diversity and potential applications in breeding programs. The study revealed significant variability in leaf colour, pubescence, culm attitude, spikelet features, lemma and palea coloration, awn presence, and maturity duration. Qualitative traits serve as consistent morphological markers for distinguishing rice landraces, as they are less affected by environmental changes (Chakravorty and Ghosh, 2012).

Qualitative traits serve as morphological markers for rice germplasm identification, being less influenced by the environment (Rao *et al.*, 2013; Kalyan *et al.,* 2017). The majority of varieties (91.30%) had green leaves, with medium green being the most common. Leaf pubescence varied significantly, with 45.65% of the genotypes exhibiting weak pubescence and 15.21% showing strong pubescence, which is beneficial for pest resistance. Leaf pubescence diversity aids in developing sucking pest-resistant cultivars (Subba Rao *et al.*, 2015).

Anthocyanin coloration was absent in most cases. The lemma and palea colours ranged from straw to purple-black, while awns were present in 43.47% of landraces, making them an important trait for breeding programs aimed at resistance and adaptability.

The study found that culm attitude varied among genotypes, with 43.47% having erect stems and 45.65% being semi-erect. Similarly, flag leaf orientation was either erect (50%) or semi-erect (43.47%), playing a role in photosynthetic efficiency and lodging resistance. Maturity duration varied, with some accessions maturing in under 100 days (very early) and others requiring 141–160 days (late), providing valuable insights for the selection of early-maturing varieties.

Regarding reproductive traits, none of the genotypes exhibited male sterility, confirming that all 100 accessions were male fertile. Lemma anthocyanin on the keel and below the apex was absent in 32% and 28.69% of genotypes, respectively, while weak anthocyanin presence was noted in 39% and 13%. The coloration of the lemma apex was absent in 56.52% of accessions. Stigma colour was predominantly white (73.91%), with only 10.86% exhibiting purple-coloured stigma, an important trait for hybrid breeding.

Stem characteristics such as length and thickness exhibited notable variation, with more than 80% of genotypes lacking anthocyanin coloration in nodes and internodes. Panicle length, a yield-related trait, showed variation, with 39.13% of genotypes classified as having short panicles, 45.65% medium, and 13.04% long. Longer panicles are often associated with increased grain production. Due to the weight of the grains, 47% of panicles had a semi-straight curvature of the main axis, which could impact grain-filling efficiency. The number of panicles per plant also varied, with 50% of genotypes having 11–20 panicles per plant, while 47.82% had fewer than 11 panicles. Additionally, 73.91% of landraces had straw-coloured sterile lemmas, an important marker for varietal differentiation.

Several landraces were identified for their potential use in breeding programs. The varieties Matla and Mohan Bugh were found suitable for developing short-duration rice cultivars, while Matidhan and Bhutmuri exhibited strong tolerance to waterlogging, making them ideal for breeding programs targeting flood-prone regions. Black and Burma Black genotypes, with their uniform black grain colour, were identified as potential morphological markers in rice improvement programs.

High-yielding varieties such as IR-64 and Pusa-44 showed strong adaptability to irrigated conditions, making them valuable for breeding programs focused on yield enhancement. Genotypes such as Lal Chal Mota and Lal Boro exhibited distinct red grain characteristics, which could be useful for improving grain quality. Landraces such as Siuli and Paru demonstrated tolerance to submergence and could serve as potential donors for developing flood-resistant rice varieties.

Aromatic rice varieties, including 1121, Dubraj, and Lal Basmati, were identified as excellent candidates for breeding programs aimed at improving aroma and grain quality. Additionally, Putikhali and Raj Jhinge showed promise for their adaptability to saline environments, making them potential donors for salt-tolerant breeding programs. The traditional landrace Kalojira, known for its slender grains and fragrance, could be used to enhance grain aesthetics and quality in premium rice breeding initiatives.

Varieties like Jaya and Pusa-2090 exhibited superior performance under stress-prone environments, while Radha Tilak and Ramjira showed potential for drought tolerance. Rarely cultivated genotypes such as Ambhamohar, Shikote, and Langal Muthi may be further explored for their unique traits, including disease resistance and adaptability to specific agro-climatic conditions.

Conclusion and Future Prospects

The study highlights the significant diversity present in rice genotypes, which can be leveraged for breeding programs aimed at yield improvement, stress tolerance, and grain quality enhancement. The identified landraces and modern varieties provide valuable genetic resources for addressing challenges related to climate change, biotic and abiotic stresses, and nutritional enhancement. Future research should integrate molecular breeding techniques, genomic selection, and gene-editing tools to accelerate varietal improvement. Additionally, efforts should be made to conserve traditional landraces, as they hold key traits for resilience and adaptation. By combining conventional breeding with advanced biotechnological interventions, rice improvement programs can ensure global food security while meeting the increasing demand for high-quality rice.

Table 2: Frequency distribution of all rice germplasms for 48 DUS characters.

Sr. no	Characteristics	Stage of expression	No. of geno-types	Frequency Distribution %
1	**Coleoptile: Colour**	Colourless (1)	19	41.30
		Green (2)	13	28.26
		Purple (3)	14	30.43
2	**Basal Leaf Sheath Colour**	Green (1)	42	91.30
		Light Purple (2)	0	0
		Purple Lines (3)	0	0
		Uniform Purple (4)	4	8.69
3	**Leaf: Intensity of**	Light (3)	14	30.43
	green colour	Medium (5)	22	47.82
		Dark (7)	10	21.73
4	**Leaf: Anthocyanin colouration**	Absent (1)	42	91.30
		Present (9)	4	8.69
5	**Leaf: Distribution of**	On tips only (1)	1	2.17
	Anthocyanin Coloration	On margins only (2)	1	2.17
		In blotches only (3)	0	0
		Uniform (4)	2	2.17
6	**Leaf Sheath:**	Absent (1)	42	91.30
	Anthocyanin colouration	Present (9)	4	8.69
7	**Leaf sheath: Intensity**	Very weak (1)	0	0
	of anthocyanin colouration	Weak (3)	0	0
		Medium (5)	1	2.17
		Strong (7)	1	2.17
8	**Leaf: Pubescence of blade**	Absent (1)	6	13.04
	surface	Weak (3)	21	45.65
		Medium (5)	12	26.08
		Strong (7)	7	15.21
		Very strong (9)	1	2.17
9	**Leaf Auricles**	Present (9)	43	93.47
		Absent (1)	3	6.5
10	**Leaf: Anthocyanin**	Colourless (1)	41	89.13
	colouration of	Light Purple (2)	3	6.52
	auricles	Purple (3)	2	4.3
11	**Leaf: Collar**	Absent (1)	0	0
		Present (9)	46	100
12	**Leaf: Anthocyanin coloration**	Absent (1)	43	93.47
	of collar	Present (9)	3	6.5
13	**Leaf Ligule**	Present (9)	46	100
		Absent (1)	0	0
14	**Leaf: Shape of**	Truncate (1)	0	0
	Ligule	Acute (2)	0	0
		Split (3)	46	100
15	**Leaf: Colour of**	White (1)	39	84.78
	Ligule	Light Purple (2)	7	15.21
		Purple (3)	0	0
		Strong (7)	1	2.17
		Very strong (9)	0	0
16	**Leaf: Length of blade**	Short (<30 cm) (3)	15	32.60
		Medium (1-2 m) (5)	17	36.95
		Broad (>2 m) (7)	14	30.43
17	**Leaf: Width of blade**	Narrow (<1 cm) (3)	22	47.82
		Medium (1-2 cm) (5)	20	43.47
		Broad (>2 cm) (7)	4	8.69
18	**Culm: Attitude**	Erect (1)	20	43.47
		Semi-erect (3)	21	45.65
		Open (5)	3	6.52
		Spreading (7)	2	4.34
19	**Time of heading (50% of plants**	Very early (<71 days) (1)	2	4.34
	with panicles)	Early (71-90 days) (3)	9	19.56
		Medium (91-110 days) (5)	12	26.08
		Late (111-130 days) (7)	14	30.43
		Very late (> 131 days) (9)	9	19.56
20	**Flag leaf: Attitude of blade**	Erect (1)	23	50
	(early observation)	Semi-erect (3)	20	43.47
		Horizontal (5)	0	0
		Drooping (7)	3	6.52
21	**Spikelet: Density of pubescence**	Absent (1)	0	0
	of lemma	Weak (3)	22	47.82
		Medium (5)	23	50
		Strong (7)	1	2.17
		Very strong (9)	0	0
22	**Male Sterility**	Absent (1)	46	100
		Present (9)	0	0
23	**Lemma: Anthocyanin coloration**	Absent or very weak (1)	15	32.60
	of keel	Weak (3)	18	39.13
		Medium (5)	13	28.26
		Strong (7)	0	0
		Very strong (9)	0	0
24	**Lemma: Anthocyanin coloration**	Absent (1)	27	28.69
	of area below apex	Weak (3)	6	13.04
		Medium (5)	11	23.91
		Strong (7)	1	2.17
		Very strong (9)	0	0
25	**Lemma: Anthocyanin coloration**	Absent (1)	26	56.52
	of apex	Weak (3)	6	13.04
		Medium (5)	13	28.26
		Strong (7)	1	2.17
		Very strong (9)	0	0
26	**Spikelet: Colour**	White (1)	34	73.91
	of stigma	Light Green (2)	4	8.69
		Yellow (3)	2	4.34
		Light Purple (4)	1	2.17

		Purple (5)	5	10.86
27	**Stem: Thickness**	Thin (<0.40 cm) (3)	5	10.86
		Medium (0.40-0.55 cm) (5)	26	56.52
		Thick (>0.55 cm) (7)	16	34.78
28	**Stem: Length (excluding panicle;**	Very short (<91 cm) (1)	5	10.86
	excluding floating rice)	Short (91-110 cm) (3)	13	28.26
		Medium (111-130 cm) (5)	11	23.91
		Long (131-150 cm) (7)	12	26.08
		Very long (>150 cm) (9)	5	10.86
29	**Stem: Anthocyanin coloration**	Absent (1)	37	80.43
	of nodes	Present (9)	9	19.56
30	**Stem: Intensity of anthocyanin**	Weak (3)	3	6.52
	coloration of nodes	Medium (5)	2	4.34
		Strong (7)	4	8.69
31	**Stem: Anthocyanin coloration of**	Absent (1)	41	89.13
	internodes	Present (9)	5	10.86
32	**Panicle: Length of main axis**	Very short (<16 cm) (1)	0	0
		Short (16-20 cm) (3)	1	2.17
		Medium (21-25 cm) (5)	18	39.13
		Long (26-30 cm) (7)	21	45.65
		Very long (>30 cm) (9)	6	13.04
33	**Flag leaf: Attitude of blade (late**	Erect (1)	16	34.78
	observation)	Semi-erect (3)	27	58.69
		Horizontal (5)	3	6.52
		Deflexed (7)	0	0
34	**Panicle: Curvature of main axis**	Straight (1)	5	10.86
		Semi Straight (3)	22	47.82
		Deflexed (5)	13	28.26
35	**Panicle:**	Few (<11) (3)	22	47.82
	Number per plant	Medium (11-20) (5)	23	50
		Many (>20) (7)	1	2.17
36	**Spikelet: Colour of tip**	White (1)	11	23.91
	of lemma	Yellowish (2)	20	43.47
		Brown (3)	9	19.56
		Red (4)	1	2.17
		Purple (5)	3	6.52
		Black (6)	2	4.34
37	**Lemma and Palea:**	Straw (1)	18	39.3
	Colour	Gold and Gold furrow on straw background (2)	16	34.78
		Brown spots on straw (3)	4	8.69
		Brown furrows	0	0

		(4)		
		on straw (5)	1	2.17
		Brown (tawny) (6)	2	4.34
		Reddish to light purple (7)	1	2.17
		Purple spots / furrows on straw (8)	1	2.17
		Purple Black (9)	3	6.51
38	**Panicle: Awns**	Absent (1)	26	56.52
		Present (9)	20	43.47
39	**Panicle: Colour of**	Yellowish White (1)	7	15.21
	awns (late	Yellowish Brown (2)	7	15.21
	observation)	Brown (3)	4	8.69
		Reddish brown (4)	0	0
		Light Red (5)	0	0
		Red (6)	0	0
		Light Purple (7)	0	0
		Purple (8)	2	4.34
		Black (9)	0	0
40	**Panicle: Length of longest awn**	Very short (1)	3	6.52
		Short (3)	3	6.52
		Medium (5)	6	13.04
		Long (7)	5	10.86
		Very long (9)	3	6.52
41	**Panicle: Distribution of awns**	Tip only (1)	8	17.39
		Upper half only (3)	0	0
		Whole length (5)	12	26.08
42	**Panicle: Presence of secondary**	Absent (1)	0	0
	branching	Present (9)	46	100
43	**Panicle: Secondary branching**	Weak (1)	1	2.17
		Strong (2)	24	52.17
		Clustered (3)	21	45.65
44	**Panicle: Attitude of branches**	Erect (1)	4	8.69
		Erect to semi-Erect (3)	7	15.21
		Semi-Erect (5)	18	39.13
		Semi-erect to spreading (7)	12	26.08
		Spreading (9)	5	10.86
45	**Panicle: Exertion**	Partly exerted (3)	5	10.86
		Mostly exerted (5)	9	19.56
		Well exerted (7)	32	69.56
46	**Time maturity (days)**	Very early (<100) (1)	1	2.17
		Early (101-120) (3)	5	10.86
		Medium (121-	14	30.43

		140) (5)		
		Late (141-160) (7)	23	50
		Very late (>160) (9)	3	6.52
47	**Leaf: Senescence**	Early (3)	5	10.86
		Medium (5)	24	52.17
		Late (7)	17	36.95
48	**Sterile lemma: Colour**	Straw (1)	34	73.91
		Gold (2)	9	19.56
		Red (3)	0	0
		Purple (4)	3	6.52

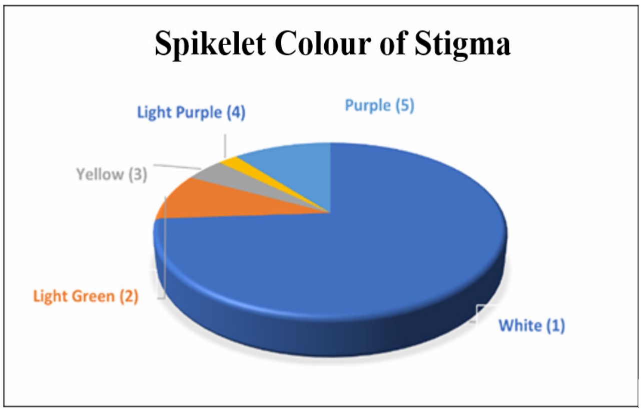

Fig. 1 : Distribution of Spikelet Stigma Colours Observed Among the Studied Genotypes.

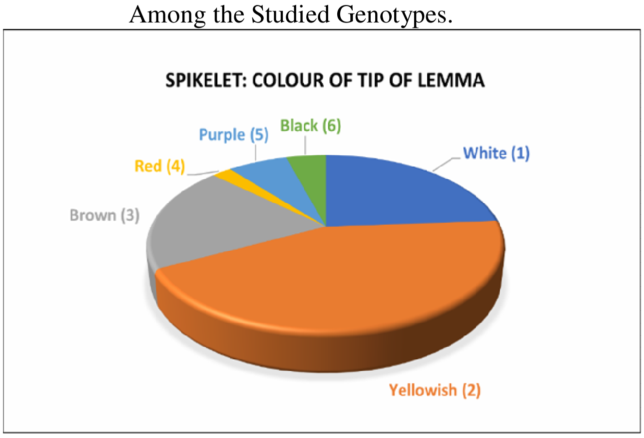

Fig. 2 : Distribution of Spikelet colour of tip of lemma Observed Among the Studied Genotypes.

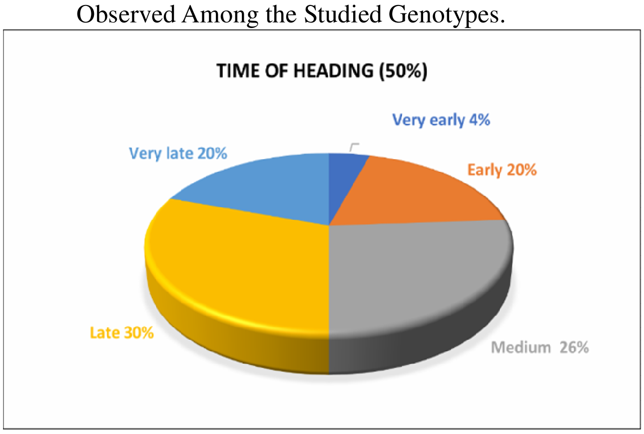

Fig. 3 : Distribution of Time of Heading Observed Among the Studied Genotypes.

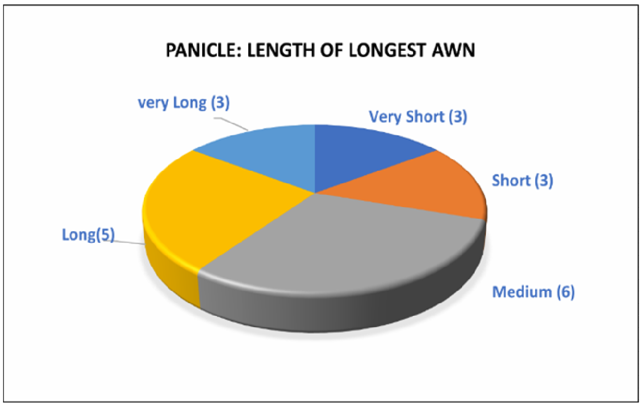

Fig. 4 : Distribution of Panicle length of longest awn Observed Among the Studied Genotypes.

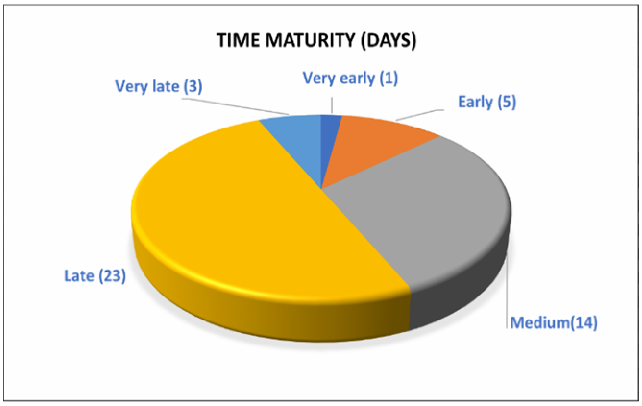

Fig. 5 : Distribution of Time maturity Observed Among the Studied Genotypes.

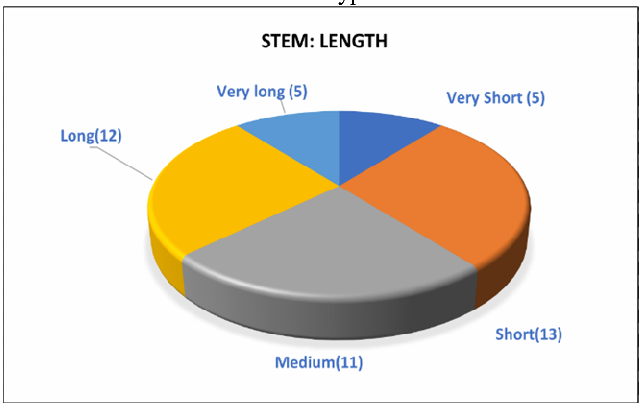

Fig. 6 : Distribution of Stem Length Observed Among the Studied Genotypes

References

Anonymous. (2007). *Guidelines for conducting the Distinctness, Uniformity, and Stability (DUS) test on rice*. Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA), Government of India.

Bisne, R. and Sarawgi, A.K. (2000). Agro-morphological and quality characterization of Badshah Bhog group from aromatic rice germplasm of Chhattisgarh. *Bangladesh Journal of Agricultural Research*, **33**, 479–492.

Chakravorty, A. and Ghosh, P.D. (2012). Characterization of landraces of rice following DUS guidelines. *Research in Plant Biology*, **2**(6), 30–40.

FAO. (2023). *Global rice market trends and production forecasts for 2023/24*. Food and Agriculture Organization of the United Nations. Retrieved from www.fao.org

Gampala, S., Reddy, K. N. and Reddy, P. V. (2014). The significance of rice in global food security. *International Journal of Agriculture and Food Science*, **6**(3), 112–118.

Kalyan, K., & Bodempudi, K. (2017). Characterization, evaluation and genetic divergence studies in rice (*Oryza sativa* L.) germplasm. Professor Jayashankar Telangana State Agricultural University.

Keerthivarman, K., Hepziba, S. J., Gnanamalar, R. P., & Ramalingam, J. (2019). Characterization of rice (*Oryza sativa* L.) landraces based on agro-morphological traits. *Electronic Journal of Plant Breeding*, **10**(2), 627–635.

Subba Rao, L. V., Shiva Prasad, G., Chiranjivi, M., Chaitanya, U., & Surendhar, R. (2013). DUS characterization for farmer varieties of rice.

Subba Rao, L. V., Sharma, H. C., & Srinivasan, R. (2015). Expression of different mechanisms of resistance to insects in groundnut under field conditions. *Phytoparasitica*, **43**, 669–677.

PPV&FRA. (2001). *The Protection of Plant Varieties and Farmers' Rights Act, 2001*. Government of India.

PPV&FRA. (2007). *Guidelines for the conduct of DUS testing in rice*. Protection of Plant Varieties and Farmers' Rights Authority, New Delhi, India.

Shrivastava, P., Kumar, R., & Singh, V. (2014). Rice as a staple food: Global importance and breeding strategies. *Journal of Crop Science*, **7**(2), 45–53.

Moukoumbi, Y. D., Sie, M., Vodouhè, B., Ndri, B., Toulou, S. A., Ogunbayo, S., &Ahanchede, A. (2011). Assessing phenotypic diversity of interspecific rice varieties using agro-morphological characterization. *Journal of Plant Breeding and Crop Science*, **3**(5), 74–86.

Rao, Y., Yadav, S., Singh, A., Singh, M. R., Goel, N., Vinod, K. K., Mohapatra, T., & Singh, A. K. (2013). Assessment of genetic diversity in Indian rice germplasm (*Oryza sativa* L.): Use of random versus trait-linked microsatellite markers. *Journal of Genetics*, **92**(3), 545–557.

Rawte, S., & Saxena, R. R. (2018). Morphological characterization of selected rice (*Oryza sativa* L.) from core group genotypes collected from different parts of Chhattisgarh. *International Journal of Current Microbiology and Applied Sciences*, **7**(3), 456–465.