Int.J.Curr.Microbiol.App.Sci (2020) *9*(8): 2397-2408

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 8 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.908.274

Assessment of Diversity based on Agro-morphological and Quality Characterization of Germplasm Accessions of Rice (*Oryza sativa* L.)

Kanushree Nandedkar*, A.K. Sarawgi, Mangla Parikh, Ritu R. Saxena and Suman Rawte

Department of Genetics and Plant Breeding, College Of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G), India

**Corresponding author*

Keywords

Rice, Germplasm, Characterization, Agro-morphological, Quality, Shannon diversity index

Article Info

Accepted:
20 July 2020
Available Online:
10 August 2020

A B S T R A C T

To estimate the diversity present in rice germplasm accessions collected from NBPGR, New Delhi, the present investigation was performed involving agro-morphological characterization of 48 rice genotypes based on 36 morphological and 15 agronomical and quality traits which revealed existence of sufficient variability in the germplasm accessions of rice. Among the 48 genotypes, the value of Shannons diversity index ranged between 0 to 1.242 with a mean of 0.524 showing wide range of variations for qualitative traits. The coefficient of variation for all quantitative traits ranged from 1.24 to 19 representing sufficient amount of variations in them. The germplasm accessions viz. IC0135883, IC0116088, IC0115346, EC0290871, IC0115512, IC0098713 were identified as best donors and could be used either as donors in rice breeding program or directly used for development of high yielding varieties with superior grain quality.

Introduction

Rice has the largest germplasm collections in the world consisting of tremendous genetic variability and serving as store house of elite genes which can further be exploited for enriching the rice cultivars with potential genes of desirable traits. Germplasm can serve as a good source of resistance against biotic and abiotic stresses like drought and insect pest and diseases but they are often inferior to commercial cultivars because of several agronomically undesirable features such as poor plant type, spreading habit, high grain shattering, long awns, purple pericarp and/or red kernel and low yield (Gupta *et al.*, 2014). For better utilization of germplasm accessions and estimation of genetic variability present in germplasm, characterization and evaluation are two important activities to be performed. Agro-morphological characterization provides the

mark of identification being an important tool for differentiating one line or variety from other and it also determine their yield potential, local suitability and ability to deal with biotic and abiotic stresses. So, systematic study and characterization of such germplasm is an important step for utilizing the appropriate donors and protecting the unique rice in present era (Parikh *et al*., 2012). Characterization can also be utilized for varietal identification in seed production programs, maintaining the genetic purity of a genotype and also DUS testing becomes easy in a well characterized genotype (Avtar *et al.*, 2016). Thus, characterization of these varieties will further contribute towards creating a genetic database for breeding programs strategies in the region (Rawte and Saxena, 2018).

Materials and Method

The research work was conducted at Research cum Instructional farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The material for the study consisted of 48 genotypes of rice of which 45 germplasm accessions were received from National Bureau of Plant Genetic Resources (NBPGR), New Delhi along with 3 checks namely Swarna, IGKV-R1244 (Maheshwari) and Indira Sugandhit Dhan (Table-1). The experimental material was grown in *Kharif* 2018 in Randomized Block Design (RBD) with 2 replications. 21 days old seedlings of each genotype was transplanted manually in 2 rows of 2m length maintaining a spacing of 20cm between rows and 15 cm between plants in each row.

Observations for all quantitative traits were recorded on 5 random plants from each genotype and their average values were used for statistical analysis. Range, mean and coefficient of variation for 15 agronomical and quality traits were estimated in order to access the genetic diversity and potential donors for further improvement of rice. The germplasm accessions were also characterized based on 36 morphological traits and the phenotypic frequencies of these traits were used to estimate diversity using Shannon-Weaver Diversity Index. The index (H) was calculated as presented by Negassa (1985).

$$H = -\sum_{i=1}^{n} pi \log pi$$

Where; *n* is the number of phenotypic classes for a character and pi is the portion of the total number of entries belonging to the i^{th} class.

Results and Discussion

Morphological characterization

After germination, the observations recorded on agro-morphological traits are presented in Table 2. For coleoptiles colour, among 48 genotypes, 71% showed green colour, 25% showed purple and 4% genotypes showed colourless coleoptiles. At booting stage observations were recorded for all the leaf characters. For basal leaf sheath colour, 79% genotypes showed green colour, 15% showed purple colour, 4% showed purple lines and 2% showed light purple colour (Fig. 1A and Fig. 2). Similar findings were reported by Umarani *et al.*2017. Similarly, for Leaf: intensity of green colour, 79% genotypes showed medium green colour whereas 21% showed dark green colour leaves.

Leaf: anthocyanin colouration was present in 21% genotypes and absent in rest of the genotypes. Among the genotypes carrying anthocyanin colouration in leaves, in 90% genotypes the colouration was distributed on margin only and in rest of the 21% genotypes anthocyanin colouration was present on tips only. Leaf sheath: anthocyanin colouration

was reported to be present in 21% genotypes, whereas it was absent in rest 79% genotypes. Leaf sheath: intensity of anthocyanin colouration was medium in 50% genotypes, strong in 30% genotypes and weak in 20% genotypes (Fig. 1G).

Leaf: pubescence of blade surface was found to be medium in 81% genotypes, strong in 45% genotypes and weak in 15% genotypes. Leaf: auricles were found to be present in all the 48 genotypes (Similar findings were reported by Sarawgi *et al.,* 2013) but anthocyanin colouration of auricles was colourless in 83% genotypes, purple in 15% and light purple in 2% genotypes (Fig. 3D to E). Similarly, leaf: collar was present in all the 48 genotypes (Similar findings were reported by Sarawgi *et al.,* 2013) among which only 21% genotypes showing presence of anthocyanin colouration whereas rest 79% genotypes showed absence of anthocyanin colouration of collar.

Leaf: ligule was found to be present in all the 48 genotypes also all of them having split shape of ligule (Similar findings were reported by Sarawgi *et al.,* 2013**)** and among them 83% showed white colour, 13% showed light purple and 4% genotypes showed purple ligule colour (Fig. 3A to C). Among 48 genotypes, 88% showed long length of leaf blade and rest 12% showed medium length of leaf blade. Similarly 75% genotypes showed medium width of leaf blade and 25% showed narrow type of leaf blade. Culm attitude which indicates growth habit of any particular species also showed variation as 63% genotypes were found to have semi-erect, 31% with erect and 6% with open culm attitude. Wide variation was reported for time of heading viz. 67% genotypes were with medium, 19% genotypes were early in nature, 10% were late and 4% were very late for time of heading (Fig. 1B) similar findings were reported by Umarani *et al.,* (2017). For spikelet: colour of stigma, 69% genotypes showed white colour, 27% showed purple colour and 4% showed light purple stigma colour (Fig. 1F). Among 48 genotypes, anthocyanin coluration of nodes was absent in 94% genotypes and present only in 6% of the genotypes (Fig. 7C and D) among which 67% showed strong anthocyanin colouration of nodes and rest 33% showed medium anthocyanin colouration of nodes. Anthocyanin colouration of internode was absent in all the 48 genotypes. After time of heading, due to absence of seed setting in 2 genotypes the observations were recorded only on 46 genotypes. For spikelet: densities of pubescence of lemma, 63% genotypes were categorized into medium, 33% into strong and 4% into weak category. Flag leaf: attitude of blade (late observation) was semi-erect in 44% genotypes, erect in 39% genotypes and horizontal in 17% genotypes (Fig 6A to C), (Umarani *et al.,* 2017). Similarly, panicle: curvature of main axis was deflexed in 94% genotypes, semi-straight in 4% and drooping in 2% genotypes. Panicle: awns were found to be absent in 87% genotypes and present only in 13% genotypes. Among 13% genotypes with awns, 50% were having awns of yellowish white colour, 33% with reddish brown colour awns and 17% with yellowish brown colour awns (Fig. 1 E). 50% were found with medium length of awns, 17% with long awns and 16% with short awns (Fig. 1 C and Fig. 5A to D). The distribution of awns in 83% genotypes was on “whole length” and 17% genotypes were having distribution of awns on tip only. All the 48 genotypes showed presence of secondary branches among which 85% were having strong branching, 9% were having clustered type of secondary branching and 6% showed weak secondary branching (Fig. 4A to C). Panicle: attitude of branches was erect to semi-erect in 78% genotypes and semi-erect in 22% genotypes. Panicle exertion was well exerted in 74% genotypes, partly exerted in 15%

genotypes and mostly exerted in 11% genotypes (Fig. 7A and B). The time maturity was late in 39% genotypes, early in 38% genotypes and medium in 28% genotypes (Fig. 1 D). Leaf: senescence was medium in all the 48 genotypes.

Thus, some characters were monomorphic, some were bimorphic, some were trimorphic and tetramorphic showing wide range of variations. Similar pattern of distribution was reported by Sajid *et al.*, 2015, Pauchauri *et al.*, 2017, Pragnya *et al.*, 2018 and Rawte and Saxena, 2018.

Shannon-weaver diversity indices

The Shannon-Weaver diversity indices among the germplasm accessions for 36 morphological traits (Table 2) ranged from 0 to 1.242 with a mean value of 0.524. The highest value of diversity index 1.242 was obtained for Panicle: Length of longest awn, whereas, lowest value of diversity index of 0 was obtained for Leaf: Auricles, Leaf: collar, Leaf: ligule, Leaf: Shape of ligule, Stem: Anthocyanin colouration of internode, Panicle: Presence of secondary branches and Leaf: Senescence as germplasm accessions exhibited no difference for these traits. Thus, these values of diversity index revealed presence of high diversity in the morphological characters studied and therefore, the germplasm accessions can be effectively utilized for improvements for these traits.

Agronomical and quality characterization

Only 46 genotypes were subjected to agronomical and quality characterization for 15 traits presented in Table 3. The values for time of heading varied from 83 days to 119 days with a mean value of 100.30 and 1.24 coefficient of variation. Plant height ranged from 81.30 cm – 163.40 cm with a mean of 131.13 cm. About 50% of the genotypes exhibited plant height in the range of 131-150 and thus, grouped as tall. Reduction in plant height may improve their resistance to lodging and reduce substantial yield losses associated with this trait Pachauri *et al* (2017). Dwarf plant height was exhibited by EC0268881 (81.3) followed by Swarna (86.2) and Indira Sugandhit Dhan (93.8) and IC0139938 (94.9). The coefficient of variation was found to be 3.81%.

The values of panicle length ranged from 21.50 cm to 29.95 cm with a mean value of 25.16 cm. Maximum panicle length contributes positively towards grain yield thus, is an important yield contributing trait. The maximum panicle length was recorded for IC0135772 (29.95) followed by IC0135883 (29.49) and IC0142541 (28.89) with the coefficient of variation being 5.89%. Number of filled grains per panicle was recorded with a range of 55 grains per panicle to maximum 228 grains per panicle. The average value recorded was 124.03 grains per panicle and with 13.01% of coefficient of variation.

The 100 seed weight ranged from 1.18 g to 3.31 g with 3.13 g with a mean value of 2.16 g and 3.76% coefficient of variation. Biological yield ranged from 34.40 g to 116.13g. The mean value recorded was 67.67g and 13.81% of coefficient of variation. Harvest index varied from 22.66% to 44.13% having a mean value of 32.42% and coefficient of variation being 13.65%.

Grain yield per plant ranged from 10.30 g to 39.50 g and average grain yield of 21.95 g. High grain yield was exhibited in genotypes EC0290871 (39.5g) and IC0135883 (38.3g). The coefficient of variation recorded was 19.00%. Milling (%) ranged widely from 43.37% to 78.54% having a mean milling of 67.57% and 1.43% coefficient of variation. A

range of 35.97% to 66.29% was recorded for head rice recovery (%) having a mean value of 51.61%. High values of head rice recovery are preferred for selection of genotypes. The highest value of head rice recovery was exhibited by EC0268881 (66.11%) followed by IC0115707 (65.14%) and EC0290871 (64.75%). The coefficient of variation recorded was 1.85%.

Kernel length ranged from 3.80 cm to 6.75 cm with an average of 5.50 cm and 1.29 coefficient of variation. Kernel breadth ranged from 1.65 cm to 2.65 cm with a mean of 2.26 cm and 1.97% coefficient of variation. Values for Kernel L/B ratio ranged from 1.62 cm to 3.55 cm with an average of 2.47cm and coefficient of variation being 2.70.

The Alkali spreading value had a range of 2.00 to 7.00 and a mean of 4.15. Genotypes with intermediate value of alkali spreading value i.e. 4-5 are always considered best for selection. In the experimental material genotypes *viz.* IC0538217, IC0115512, IC0115758, IC0134999, IC0134976, IC013 5772, IC0089251, IC0098713, Swarna, IC0115346, IC0142543, IC0538350, IC011 5385, IC0115469, IC0115824, IC0116083, EC0290871, IC0134873, IC0135015, IC013 5883, IC0142533, IC0142540, EC0544860, IC0443805, Maheshwari exhibited intermediate values of alkali spreading value. The coefficient of variation was 6.17%.

Values of gel consistency ranged from 25.00 to 84.50 with a mean of 40.87. The intermediate value of gel consistency i.e. 41-60 is considered best and selection is generally done for genotypes with intermediate value of gel consistency. The genotypes fulfilling this criteria are EC0268881 (41.00), Indira Sugandhit Dhan (44.50), IC0135772 (46.00), IC0139938 (49.50), IC0142543 (52.50), IC0134134 (52.50), IC0135883 (54.00), IC0142533 (56.00). The coefficient of variation recorded was 2.65%.

Table.1 Germplasm accessions used as experiment material during Kharif, 2018

S. No	Accessions	S. No	Accessions	S. No	Accessions	S. No	Accessions
1	IC0538217	13	IC0115824	25	IC0134999	37	IC0089251
2	IC0538227	14	IC0116090	26	IC0134976	38	IC0098713
3	IC0538350	15	IC0116077	27	IC0135015	39	IC0146047
4	IC0115346	16	IC0116088	28	IC0135170	40	IC0134134
5	IC0115414	17	IC0116083	29	IC0135552	41	EC0268881
6	IC0115385	18	EC0545411	30	IC0135772	42	EC0544860
7	IC0115427	19	IC0461104	31	IC0135883	43	IC0264137
8	IC0115469	20	EC0290802	32	IC0139938	44	IC0443805
9	IC0115512	21	EC0290950	33	IC0142533	45	EC0205191
10	IC0115691	22	EC0290871	34	IC0142543	C1*	Swarna
11	IC0115707	23	EC0291283	35	IC0142540	C2*	Maheshwari
12	IC0115758	24	IC0134873	36	IC0142541	C3*	Indira Sugandhit Dhan

* C1, C2 and C3 taken as checks

Table.2 Frequency distribution and percentage value of 36 agro-morphological characters studied for the experimental material

S. No.	Characteristics	Category	No. of accessions	Frequency (%)	Shannon's diversity index
1	Coleoptile: colour	Colourless	2	4	0.723
		Green	34	25	
		Purple	12	71	
2	Basal leaf: sheath colour	Green	38	79	0.679
		Light purple	1	2	
		Purple lines	2	4	
		Purple	7	15	
3	Leaf: intensity of green colour	Medium	38	79	0.512
		Dark	10	21	
4	Leaf: anthocyanin colouration	Absent	38	79	0.512
		Present	10	21	
5	Leaf: distribution of anthocyanin colouration	On tips only	1	10	0.325
		On margins only	9	90	
6	Leaf sheath: anthocyanin colouration	absent	38	79	0.512
		Present	10	21	
7	Leaf sheath: intensity of anthocyanin colouration	Weak	2	20	1.030
		Medium	5	50	
		Strong	3	30	
8	Leaf: pubescence of blade surface	Weak	7	15	0.582
		Medium	39	81	
		Strong	2	4	
9	Leaf: Auricles	Absent	0	0	0.000
		Present	48	100	
10	Leaf: anthocyanin colouration of auricles	Colourless	40	83	0.513
		Light purple	1	2	
		Purple	7	15	
11	Leaf: collar	Present	48	100	0.000
		Absent	0	0	
12	Leaf: Anthocyanin colouration of collar	Absent	38	79	0.512
		Present	10	21	
13	Leaf: ligule	Present	48	100	0.000
		Absent	0	0	
14	Leaf: Shape of ligule	Split	48	100	0.000
		Truncate	0	0	
		Acute	0	0	
15	Leaf: colour of ligule	White	40	83	0.544
		Light purple	6	13	
		Purple	2	4	
16	Leaf: length of blade	Medium	6	12	0.377
		Long	42	88	
17	Leaf: width of blade	Narrow	12	25	0.562
		Medium	36	75	
18	Culm: attitude	Erect	15	31	0.831
		Semi-erect	30	63	
		Open	3	6	

19	Time of Heading	Early	9	19	0.952
		Medium	32	67	
		Late	5	10	
		Very late	2	4	
20*	Spikelet: Density of pubescence of lemma	Weak	2	4	0.793
		Medium	29	63	
		Strong	15	33	
21	Spikelet: Colour of Stigma	Purple	13	27	0.744
		White	33	69	
		Light purple	2	4	
22	Stem: anthocyanin colouration of node	Absent	45	94	0.234
		Present	3	6	
23	Stem: Intensity of anthocyanin colouration of node	Medium	1	33	0.637
		Strong	2	67	
24	Stem: Anthocyanin colouration of internode	Absent	48	100	0.000
		Present	0	0	
25*	Flag leaf: Attitude of blade(late observation)	Erect	18	39	1.033
		Semi-erect	20	44	
		Horizontal	8	17	
26*	Panicle: Curvature of main axis	semi-straight	2	4	0.283
		deflexed	43	94	
		dropping	1	2	
27*	Panicle: Awns	absent	40	87	0.387
		present	6	13	
28*	Panicle: Colour of awns	yellowish white	3	50	1.011
		yellowish brown	1	17	
		reddish brown	2	33	
29*	Panicle: Length of longest awn	short	1	16	1.242
		medium	3	50	
		long	1	17	
		very long	1	17	
30*	Panicle: Distribution of awns	tip only	1	17	0.451
		whole length	5	83	
31*	Panicle: Presence of secondary branches	absent	0	0	0.000
		present	46	100	
32*	Panicle: Secondary branching	weak	3	6	0.530
		strong	39	85	
		clustered	4	9	
33*	Panicle: Attitude of branches	erect to semi-erect	36	78	0.524
		semi-erect	10	22	
34*	Panicle: Exertion	partly exerted	7	15	0.751
		mostly exerted	5	11	
		well exerted	34	74	
35*	Time maturity	Early	15	33	1.090
		Medium	13	28	
		Late	18	39	
36*	Leaf: Senescence	early	0	0	0.000
		medium	46	100	
		late	0	0	

*observations are recorded only on 46 genotypes.

Table.3 Descriptive statistics of 48 germplasm accessions for 15 agronomical and quality traits

S. No.	Characters	Mean	Min.	Max.	CV (%)
1	Time of heading (days)	100.30	83.00	119.00	1.24
2	Plant height (cm)	131.13	81.30	163.40	3.81
3	Panicle length (cm)	25.16	21.50	29.95	5.89
4	Number of filled grains per panicle	124.03	55.00	228.00	13.01
5	100 seed weight (g)	2.16	1.18	3.31	3.76
6	Biological yield (g)	67.67	34.40	116.13	13.81
7	Harvest index (g)	32.42	22.66	44.13	13.65
8	Grain yield per plant (g)	21.95	10.30	39.50	19.00
9	Milling (%)	67.57	43.37	78.54	1.43
10	Head rice recovery (%)	51.61	35.97	66.29	1.85
11	Kernel length(mm)	5.50	3.80	6.75	1.29
12	Kernel breadth(mm)	2.26	1.65	2.65	1.97
13	Kernel L/B ratio	2.47	1.62	3.55	2.70
14	Alkali spreading value	4.15	2.00	7.00	6.17
15	Gel consistency	40.87	25.00	84.50	2.65

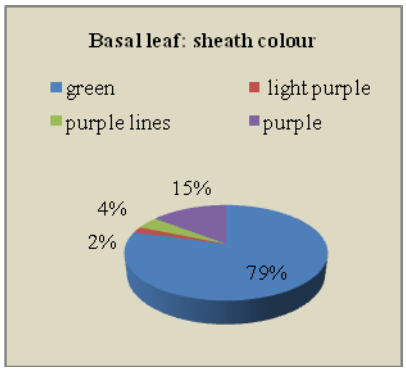
Table.4 List of unique genotypes based on morphological characters

Character	Pattern	Accessions
Anthocyanin colouration of auricle	Light purple	IC0538227
Anthocyanin colouration of node	Present	IC0538227,IC0134976, IC0115414
Basal leaf sheath colour	Purple lines	IC0116083, IC0134976
	Light purple	EC0544860
Leaf: anthocyanin distribution	on tips only	IC0116083
Colour of stigma	Light purple	EC0545411, IC0142533
Colour of ligule	Purple	IC0098713, IC0134134

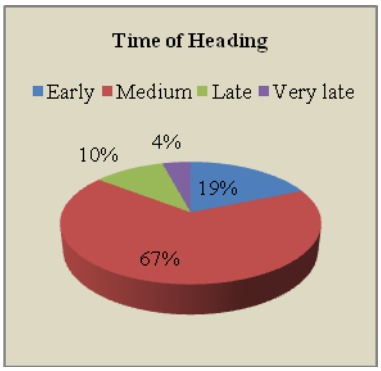
Table.5 Promising germplasm accessions with grain yield along with other yield related traits

Characters	Promising accessions	Characters	Promising accessions
High panicle length	IC0135883, IC0116088	High HRR	EC0290871, IC0115346
High 100 seed weight	IC0115346	Gel consistency (41-60)	IC0135883
High milling %	EC0290871, IC0116088	Desirable alkali spreading value(4-5)	IC0115512, IC0098713, IC0115346, EC0290871, IC0135883

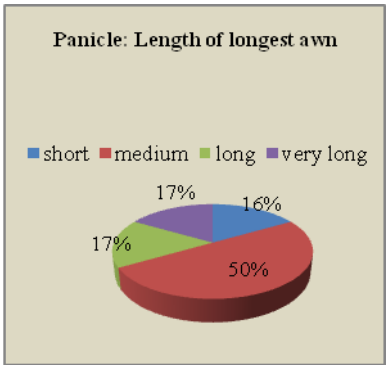
Fig.1 Frequency distribution and percentage value of different characters in germplasm accessions of rice (A to G)



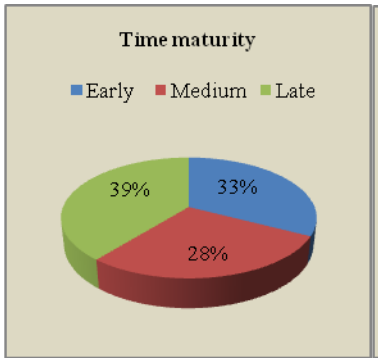
A: Basal Leaf Sheath colour



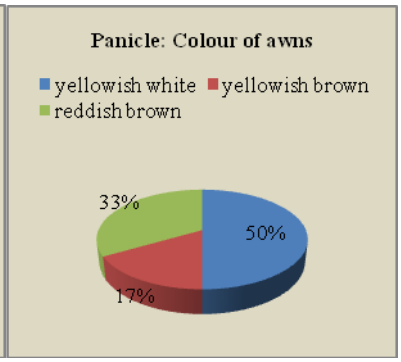
B: Time of Heading



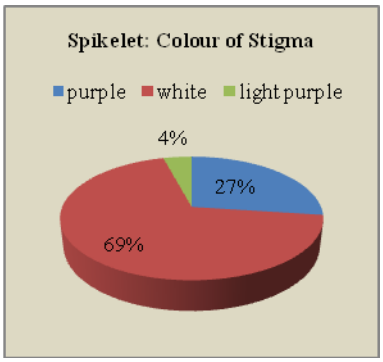
C: Panicle: length of longest awn



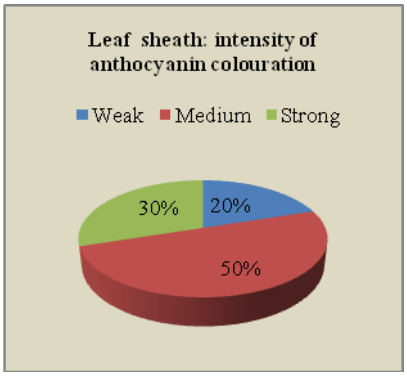
D: Time maturity



E: Panicle: colour of awn



F: Spikelet: Colour of stigma

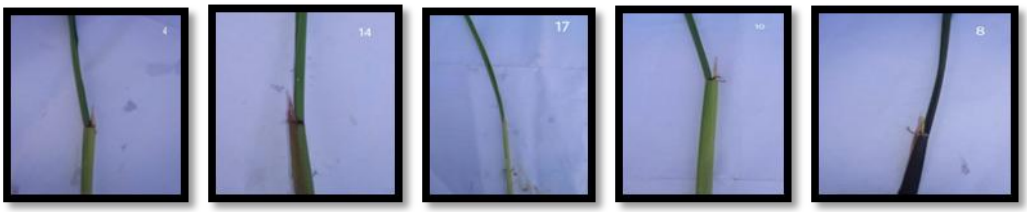


G: Leaf sheath: intensity of anthocyanin colouration

Fig.2 Basal leaf sheath colour

Purple Purple lines Light Purple Green

Fig.3 Leaf: colour of ligule (A to C) and Leaf: anthocyanin colouration of auricles (D and E)

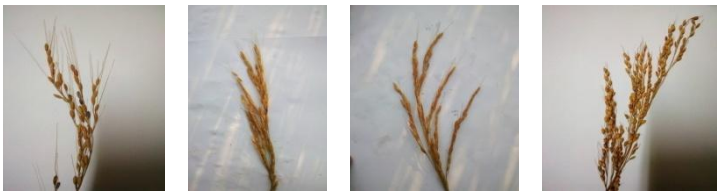


A. Light purple B. Purple C. White D. Purple E. Light purple

Fig.4 Panicle: secondary branching

A. Weak **B. Strong** **C. Clustered**

Fig.5 Panicle: length of longest awn



A. Very long B. Long C. Medium D. Small

Fig.6 Flag leaf: attitude of blade (late observation)

A. Erect **B. Semi-erect** **C. Horizontal**

Fig.7 Panicle: exertion (A and B) and Stem: anthocyanin colouration of node (C and D)

A. Mostly exerted **B. Well exerted** **C. Absent** **D. Present**

After evaluation of 48 rice genotypes for morphological, agronomical and quality characters it was concluded that the accessions viz. IC0538227, IC0116083, IC0134976, EC0544860, EC0545411, IC0142533, IC0098713, IC0134134, IC0115414 were found to be unique (Table 4) which can be utilized as reference variety for DUS testing or can act as morphological marker for distinguishing and future characterization of any germplasm material. The germplasm accessions viz. IC0135883, IC0116088, IC0115346, EC0290871, IC0115512, IC0098713 were identified as promising/ best donors (Table 5) and could be used in rice breeding program or directly used for development of high yielding varieties with superior grain quality.

References

Avtar, R., Kumari, N., Rani, B., Narula, A., Thakral, N. K. and Singh, D. (2016). Evaluation, classification and characterization of Toria germplasm for different agro-morphological traits. 52 *J. Oilseed Brassica*, 7(1):52-62.

Gupta, R., Tetwar, S. and Nair, S.K. (2014). Agro-morphological characterization of rice germplasm of Chhattisgarh. *Internat. J. Plant Sci.*, 9 (1): 257-262.

Kumar, V.K., Rastogi, N.K., Sarawgi, A.K., Chandrakar, P., Singh, P.K. and Jena, B.K. 2016. Agro-morphological and quality characterization of indigenous and exotic aromatic rice (*Oryza sativa* L.) germplasm. Journal of Applied and Natural Science 8 (1) : 314 – 320.

Negassa, M. 1985. Patterns of phenotypic diversity in an Ethiopian barley collection, and the Arussi-Bale Highland as a center of origin of barley. *Hereditas* 102: 139–150.

Pachauri, A.K., Sarawgi, A.K., Bhandarkar, S. and Ojha, G.C. 2017. Agro-morphological characterization and morphological based genetic diversity analysis of Rice (*Oryza sativa* L.) germplasm. Journal of Pharmacognosy and Phytochemistry, 6(6): 75-80.

Parikh, M., Motiramani, N.K., Rastogi, N.K. and Sharma, B. 2012. Agro-morphological characterization and assessment of variability in aromatic rice germplasm. Bangladesh J. Agril. Res. 37(1): 1-8.

Pragnya, K., Radha Krishna, K.V., Subba Rao, L.V. and Suneetha, K. 2018. Studies on morphological characterization in Soft Rice (*Oryza sativa* L.) genotypes. *Int.J.Curr.Microbiol.App.Sci*. *7*(5): 1348-1374.

Rawte, S. and Saxena, R.R. 2018. Morphological characterization of selected rice (*Oryza sativa* L.) from Core germplasm group of Chhattisgarh using DUS descriptors. *Int.J.Curr.Microbiol.App.Sci*. *7*(10): 350-357.

Rawte, S. and Saxena, R.R. 2018. Phenotypic Diversity and Correlation analysis for Agro-Morphological Traits in 100 Landraces of Rice (*Oryza sativa* L.)

from Chhattisgarh, *Int. J. Pure App. Biosci.* 6(6): 345-353.

Sajid, M., Khan, S. A., Khurshid, H., Iqbal, J., Muhammad, A., Saleem, N., and Shah, S. M. A. 2015. Characterization of rice (*Oryza sativa* L.) germplasm through various agro-morphological traits. Scientia, 9(2), 83-88.

Sarawgi, A. K., Subba Rao, L. V., Parikh, M., Sharma, B., and Ojha, G. C. 2013. Assessment of variability of Rice (*Oryza sativa* L.) germplasm using agro-morphological characterization. Journal of Rice Research, 6(1), 14.

Umarani, E., Radhika, K., Padma, V. and Subbarao, L.V. 2017. Agro-morphological characterization of Rice(*Oryza sativa* L.) landraces based on DUS descriptors. Int. J. Pure App. Biosci. 5 (4): 466-475.

How to cite this article:

Kanushree Nandedkar, A.K. Sarawgi, Mangla Parikh, Ritu R. Saxena and Suman Rawte. 2020. Assessment of Diversity based on Agro-morphological and Quality Characterization of Germplasm Accessions of Rice (*Oryza sativa* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(08): 2397-2408. doi: https://doi.org/10.20546/ijcmas.2020.908.274