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Research Article

Characterization of rice (*Oryza sativa* L.) landraces based on agro-morphological traits

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Abstract
Rice (*Oryza sativa* L.) is an important cereal in the world. Landraces and wild species of rice have immense potential to tolerate or resist different biotic and abiotic stresses due to the presence of trait specific genes. Thirty seven landraces collected from Thanjavur, Ramanathapuram and Salem districts were utilized for the present study. These accessions were raised in RBD replicated twice and evaluated for 30 morphological traits. The local landraces exhibited sufficient genetic variation for most of the traits. Out of 30 descriptors studied, three characters were found monomorphic, while rest of the characters showed variations among the accessions. The genetic potential of the accessions for the desired traits can be utilized in hybridization programme to achieve promising genotypes.

Keywords
Rice, Characterization, Landraces, Descriptor

Introduction

Rice (*Oryza sativa* L.) is an important cereal crop in the world. More than half of the people in the world are consuming rice as staple food(Sasaki and Burr, 2000). However, India having rice grown with improved varieties consist lack in nutrient content Masuda *et al.* (2012) . Now India is facing food crisis mainly due to the erosion of its biodiversity, mono-cropping system in agriculture, almost high usage of chemicals, declining soil fertility and water contamination to the crops Pachauri *et al.* (2009). Several rice germplasm have high micro nutrient content like zinc, copper, magnesium and calcium, but their productivity is very low (Prashanth *et al.*, 2002). These local landraces have specific character to tolerate or resist different biotic and abiotic stresses due to the presence of trait specific genes. In the past decades, several rice germplasm local landraces had been extinct due to ecological factors and predominant cultivation of high yielding varieties / hybrids.

Characterization of germplasm eventually means recording and storing useful data that can be readily retrieved and made available to others and comfort in planning breeding programmes (Dabas *et al.*, 1994). Qualitative traits being more stable over generations (Raut, 2003) are trustworthy for characterization of varieties. Thirty seven landraces collected from different locations were used in the present investigation. The Rice descriptor of Biodiversity International was used for evaluation and characterization. The genetic diversity existing among landraces will provide information on the superior parental selection for future usage, besides knowledge on morphological, nutritive, biochemical and cooking qualities of rice.

Materials and Methods

The present study was conducted in Agricultural Research Station, Tamil Nadu Agricultural University, Vaigai dam, Theni during *Rabi*'2018. Thirty seven landraces were collected from different locations of Thanjavur, Ramanathapuram and Salem districts of Tamil Nadu. These germplasm were sown in well prepared seedbeds on 11.09.2018 and seedlings were transplanted on 10.10.2018. Each entry was sown in two rows of 5 m length at a spacing of 20cm between rows and 15cm between plants replicated twice in randomized block design. The recommended agronomical practices were followed during the study. Observations were recorded on five plants at random per genotype per replication for all the traits at different stages of growth with appropriate procedure as per Bioversity International Rice descriptor Bosetti *et al.* (2011).

The characters *viz.*, basal leaf sheath colour, leaf sheath anthocyanin colouration, leaf blade anthocyanin colouration, distribution of anthocyanin; intensity of colour, attitude, pubescence, length and width of leaf blade; auricle

collar colour, ligule shape, ligule pubescence, ligule colour, ligule margin hairiness, flag leaf length, flag leaf width, flag leaf attitude(Early), flag leaf attitude(Late), culm habit, culm length, anthocyanin colour on node, anthocyanin colour on internode, culm lodging resistance, lemma and palea colour; presence, distribution and colour of awns, panicle texture, shattering and threshability of panicle. All the characters were studied as per procedure of biodiversity at field condition. The qualitative characters were scored visually, and the quantitative characters were measured. Passport details of the individual germplasm taken for study are presented in Table 1.

Results and Discussion

The detailed characterization of 37 landraces of rice evaluated based on the Biodiversity International Rice descriptor on 31 biometrical characters is presented in Table 2. For the morphological characterization or identification of land races of rice, quantitative characters are considered as morphological markers, because they are less influenced by the environmental changes. Out of 37 land races studied, 54.05% possessed green coloured basal leaf sheath, 8.1% had green with purple lines, 32.43% with light purple and 5.4% had purple colour. Anthocyanin colouration in leaf blade was present in 78.37% land races and absent in 21.6% of land races. All the land races showed the distribution of anthocyanin at the tip of the leaf blade.

Anthocyanin coloration on leaf sheath was present in 40.54% landraces, out of which 18.92% were weak and 21.62% were medium. For the intensity of green colour in leaf blade all the accessions exhibited light to dark green in colour, in which 51.35% exhibited medium, while 43.54% and 5.4% exhibited light and dark green colour respectively. 72.97% of landraces had erect leaf blade, while 24.32% and 27% had horizontal and drooping attitude respectively. For pubescence on blade surface 37.83% landraces were found to be distinct for having strong pubescence, while 54.05% with intermediate pubescence and 8.1% were marked for glabrous nature. For the leaf ligule character, 51.35% possessed acute shaped ligules, 32.43% 2 cleft and 16.21% recorded truncate ligules. Among the land races 35.13% of them had yellowish green ligule, 62.16% had whitish and 27.1% had purple colour. Ligule margin is hairy in 83.78% of the landraces. The length of the leaf blade was short in 45.94% and also exhibited intermediate width in 62.16% of landraces.

With respect to flag leaf 45.94% of had medium length, while 32.43% and 21.62% had long and short flag leaf length respectively. Intermediate flag leaf width was observed in 56.75% landraces, 40.54% showed narrow flag leaf width, 56.75% of the types were semi erect 32.43% and 10.81% were erect and horizontal respectively. Regarding culm characters, 51.35% landraces were of semi erect type, 32.43% were open type and 16.21 % were erect type. For culm length (excluding panicle), 5.4% were of very short, 16.21% were of very short to short, 43.24% were of short type, 21.62% were of short to intermediate 10.81% were of intermediate and 2.7% were of intermediate to long type. With respect to anthocyanin colour on node, it was absent in 75.61%; while 10.81% possessed purple colour, 8.1% had light purple and 5.41% had purple lines. 40.54% of the culm are strong and 51.35% were intermediate in culm strength. Lemma and Palea colour was Green in 29.72% and brown furrows on green in 27.02% of landraces. Awns were absent in 35.13%; partly awned in 62.16 and fully awned in 2.7%. Awns were present in the tip only and the colour was whitish in 10.81%; purple in 13.51% and red in 18.91% landraces The awn colour, lemma and palea colour, flower colour, colour of hair, seed colour were the most stable characters across the agro-climatic zones (Gupta *et al.*, 2010; Satyavathi *et al.*, 2004).

Panicle shattering was low in 56.75% and moderate in 32.43% of the landraces. The threshabile was easy in 10.81%, intermediate in 43.24% and difficult in 45.94%. Out of 37 landraces evaluated for 31 characters, three characters viz., distribution of anthocyanin on leaf blade, auricle collar colour, panicle texture on main axis were monomorphic, four characters were dimorphic and 14 characters were trimorphic and rest of the characters had more states of expression. Awn colour, panicle shattering, lemma and palea colour, awn colour, panicle texture and panicle thresability which is more similar type of work reported by Bisne (2000) and Moukoumbi *et al.* (2011). Among the studied germplasm for qualitative and quantitative characters was grouped into 8 cluster produced at 0.52 coefficient (Table 3) by using NTSYS software fig 1. The largest cluster VIII (9 germplasm) followed by cluster VII (8 germplasm) and the smallest cluster is IV which consist (1 germplasm). The cluster analysis based on agro morphological diversity assessment in rice was also reported by Li *et al.* (2000) and Zhang *et al.* (2010).

These information on characterization will be useful for breeders, researchers and farmers to identify and also to conserve beneficial genes for crop improvement. The information generated on these landraces may also support their registration with the PPV and FRA.

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Table 1. List of landraces and place of collection

S. No	Landraces Name	source	Districts
1	Attur Samba	Attur	Salem
2	Bhavani	Rayanathur	Thanjavur
3	Bhomi	Sooriyankovil	Thanjavur
4	Chandikar	Vayalogam	Pudhukottai
5	Chithiraikar	Paramakudi	Ramanathapuram
6	Kaatu Yaanam	Palamuthur	Thanjavur
7	Kallundai	Vilangudi	Thanjavur
8	Kallurandaikar	Parmakudi	Ramanathapuram
9	Kandasaali	Semballur	Thanjavur
10	Karudan Samba	Athiyur	Thanjavur
11	Karung Kuruvai	Vanankudi	Thanjavur
12	Karuthakar	Chitrakudi	Thanjavur
13	Kattanur	Paramakudi	Ramanathapuram
14	Kavuninel	Maruyhanallur	Thanjavur
15	Kothamalli Samba	Karungalammelpathi	Thanjavur
16	Kottarasambha	Palathalu	Thanjavur
17	Kullakar	Senthuryankudikadu	Thanjavur
18	Kuruvai Kalanjiyam	Mathikadu	Thanjavur
19	Kuzhiyadicham	Thennampalagai	Thanjavur
20	Mattaikar	Parmakudi	Ramanathapuram
21	Mysore Malli	Palanjur	Thanjavur
22	Navara	Karuppur	Thanjavur
23	Neelam Samba	Mathagudi	Thanjavur
24	Nootripathu	Paramakudi	Ramanathapuram
25	Norungan	Parmakudi	Ramanathapuram
26	Ottadam	Cholapuram	Thanjavur
27	Paalkudavaalai	Thuranmudi	Thanjavur
28	Poonigar	Paramakudi	Ramanathapuram
29	Salem Samba	Odiyathur	Ramanathapuram
30	Sambhamoosanam	Umaiyalpuram	Thanjavur
31	Sigapu Kavuni	Krishnapuram	Thanjavur
32	Singinikar	Pannivayal	Thanjavur
33	Sornamasoori	Rayanathur	Thanjavur
34	Sornamugi	Rayanathur	Thanjavur
35	Thoyamalli	Keelapalayar	Thanjavur
36	Thulasi Vasanai Seeragasamba	Kondakulan	Thanjavur
37	Vaalan	Valathur	Thanjavur

Table 2. Characterization of landraces

S.no	Characters	Type	Scale	Number of germplasm	Frequency distribution (%)
1	**B**asal leaf sheath : colour	Green	1	20	54.05
		Green with Purple lines	2	3	8.10
		Light Purple	3	12	32.43
		Purple	4	2	5.40
2	Leaf sheath : anthocyanin colouration	Absent	0	22	59.45
		Weak	3	7	18.91
		Medium	5	8	21.62
		Strong	7	0	0.0
3	Leaf blade : anthocyanin colouration	Absent	0	8	21.6
		Present	1	29	78.37
4	leaf blade : distribution of anthocyanin	Tips only	1	29	100
		On margins	2	0	0
		In Blotches	3	0	0
		Even	4	0	0
5	Leaf blade : intensity of colour	No green	0	0	0
		Light	3	16	43.24
		Medium	5	19	51.35
		Dark	7	2	5.40
6	Leaf blade : attitude	Erect	1	27	72.97
		Horizontal	5	9	24.32
		Drooping	7	1	2.7
7	Leaf blade : pubescence	Glabrous	1	3	8.10
		Intermediate	2	20	54.05
		Pubescent	3	14	37.83
8	Auricle collar : colour	Absent	0	37	100
		Green	1	0	0
		Light green	2	0	0
		Purple	3	0	0
		Purple Lines	4	0	0
9	Ligule shape	Absent	0	0	0
		Truncate	1	6	16.21
		Acute	2	19	51.35
		2-cleft	3	12	32.43
10	Ligule Pubescence	Glabrous	1	18	48.64
		Partially <50%	2	7	19.91
		Mostly >50%	3	2	5.40
11	Ligule colour	Absent	0	0	0
		Whitish	1	23	62.16
		Yellowish green	2	13	35.13
		Purple	3	1	2.71
		Light Purple	4	0	0
		Purple lines	5	0	0
12	Ligule margin hairiness	Absent	0	31	83.78
		Present	1	6	16.21
13	Leaf blade : Length(cm)	Very short (<21cm)	1	2	5.40
		Short (22-30cm)	3	17	45.94
		Intermediate (31-50cm)	5	13	35.13
		Long (51-70)	7	5	13.51
		Very long (>80cm)	9	0	0
14	Leaf blade : width(cm)	Narrow (<1cm)	3	12	32.43
		Intermediate	5	23	62.16
		Broad (>2cm)	7	2	5.40
15	Flag leaf : length(cm)	Short (<30cm)	3	8	21.62
		Medium (30-45cm)	5	17	45.94
		Long (>45cm)	7	12	32.43
16	Flag leaf : width(cm)	Narrow (<1cm)	3	15	40.54
		Intermediate	5	21	56.75
		Broad (>2cm)	7	1	2.70
17	Flag leaf : attitude(Early)	Early	1	12	32.43
		Semi- erect	3	21	56.75
		Horizontal	5	4	10.81
		Descending	7	0	
18	Culm : Habit	Erect (<15°)	1	6	16.21
		Semi-erect (~20°)	3	19	51.35
		Open (~40°)	5	12	32.43
		Spreading (>60-80°)	7	0	0
		Procumbent	9	0	0

19	Culm : length	Very short (>50 cm)	1	2	5.40
		Very short to short(51-70 cm)	2	6	16.21
		Short(71-90cm)	3	16	43.24
		Short to intermediate(91-105cm)	4	8	21.62
		Intermediate(106-120cm)	5	4	10.81
		Intermediate to long(121-140cm)	6	1	2.70
		Long (141-155cm)	7	0	0
		Long to very long (156-180cm)	8	0	0
		Very long(>180cm)	9	0	0
20	Culm : anthocyanin colour on node	Absent	0	28	75.61
		Purple	1	4	10.81
		Light purple	2	3	8.10
		Purple Lines	3	2	5.41
21	Culm : internode anthocyanin	Absent	0	24	64.86
		Purple	1	1	2.70
		Purple Lines	2	12	32.43
22	Culm : lodging resistance	Very weak	1	0	0
		Weak	3	3	8.10
		Intermediate -45°	5	19	51.35
		Strong 20°	7	15	40.54
		Very Strong	9	0	0
23	Flag leaf : attitude(Late)	Erect	1	12	32.43
		Semi-erect	3	17	45.94
		Horizontal	5	7	18.91
		Descending	7	1	2.70
24	Lemma and palea : colour	White	1	5	13.51
		Green stripped white	2	1	2.70
		Gold and gold furrows	3	2	5.40
		Brown	4	2	5.40
		Brown spots and green	5	0	0
		Brown furrows on green	6	10	27.02
		Blackish brown	7	0	0
		Green	8	11	29.72
		Yellowish green	9	0	0
		Purple	10	0	0
		Reddish to light purple	11	3	8.10
		Purple shade	12	0	0
		Purple spots on green	13	0	0
		Purple furrows on green	14	0	0
		Black	15	3	8.10
25	Awn presence	Absent	0	13	35.13
		Partly awned	1	23	62.16
		Fully awned	2	1	2.70
26	Awn distribution	Awnless	0	13	35.13
		Tips only	1	24	64.85
		Upper quarter only	2	0	0
		Upper half only	3	0	0
		Upper three-quarters only	4	0	0
		Whole length	5	0	0
27	Awns : colour	Absent	0	13	35.13
		Whitish	1	4	10.81
		Straw	2	0	0
		Gold	3	0	0
		Brown	4	3	8.10
		Light green	5	3	8.10
		Red	6	7	18.91
		Purple	7	5	13.51
		Black	8	2	5.40
28	Texture of panicle	Scabrous	1	37	100
		Smooth	2	0	0
29	Panicle : shattering	Very Low (<1%)	1	4	10.81
		Low (~3%)	3	21	56.75
		Moderate (~15%)	5	12	32.43
		High (~35%)	7	0	0
		Very high (>50%)	9	0	0
30	Panicle : threshability	Difficult (few or no grains)	1	17	45.94
		Intermediate (25-50%)	2	16	43.24
		Easy (>50%)	3	4	10.81

Table 3. Clustering of germplasms

Cluster number	Number of germplasms	List of germplasms
1	3	Singinikar, Navara, Chithiraikar
2	4	Bhavani, Neelam Samba, Salem Samba, Mattaikar
3	6	Kullakar, Sambhamoosanam, Thulasi Vasanai Seeragasamba, Kavuninel, Karuthakar, Nootripathu,
4	1	Karung Kuruvai
5	4	Kattanur, Poonigar, Karudan Samba, Chandikar
6	2	Kandasaali, Kothamalli Sambha
7	8	Ottadam, Kuruvai Kalanjiyam, Vaalan, Mysore Malli, Sornamugi, Paalkudavaalai, Attur Samba, Kallundai
8	9	Kaatu Yaanam, Kuzhiyadicham, Sornamasoori, Sigapu Kavuni, Bhomi, Thoyamalli, Kallurandaikar, Kottarasambha, Norungan

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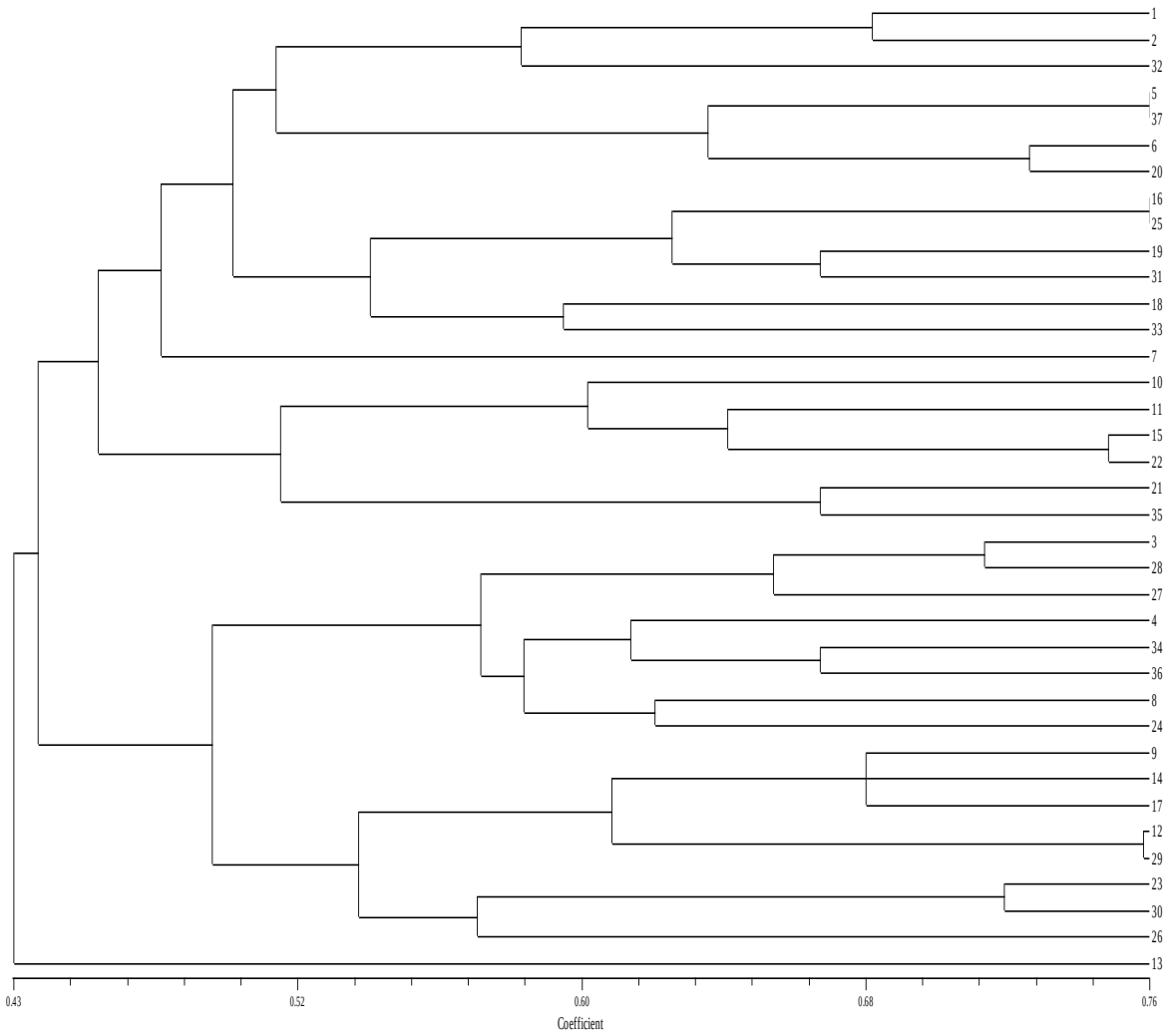

Fig. 1. Morphological cluster analysis using NTSYS software

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Fig. 2. Panicle difference between the germplasm

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