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Assessment of Variability in Rice (*Oryza sativa* L.) Germplasm using Agro-Morphological and Quality Traits

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The present study was carried out to characterize 47 rice germplasm accessions based on 58 agro-morphological and quality traits. Most of the studied traits showed a wide variation among the germplasm accessions except leaf auricle, leaf collar, leaf ligule, leaf shape of ligule and male sterility. All 47 accessions were found to be distinct on the basis of 53 agro-morphological and quality traits. Unique accessions for different morphological traits were found in Cross. 116, Gadakhuta, CGR: 7144, Kali muchh, Khira sar, Safri, Surmatia, IC-116076, Jhilli paragi, Jhingo, Maiphal jira III, Banki, Bangle, CGR: 7142, Ramti and Gedrei. Desirable accessions identified for the yield ancillary and quality traits were Bangle, Bangoli-1 (II), Ramti, Bankal (II), CGR: 7144, CGR: 7142, Kakadiha, Jhuna, Kanthdudgi and IC-132754. The accessions like Bangle, Banki and Kala jira had both high yield as-well-as better quality traits like kernel length and head rice recovery percentage. These germplasm accessions of rice can be used as phenotypically divergent sources for traits of interest in breeding programmes.

Key Words: Agro-morphological Traits, Characterization, Germplasm, Rice, Variability

Introduction

In any crop, germplasm is an important source of genetic variability. Characterization of germplasm is of great importance for current and future genetic improvement of the crop. Rice breeding strategy involves the collection of variable germplasm and selection of superior genotypes from the germplasm for utilizing them as a promising variety or in hybridization programme to develop a superior variety. Agro-morphological characterization of germplasm accessions is fundamental to provide information for plant breeding programme and is a tool for selecting varieties or lines based on agronomical, morphological, genetic or physiological characters (Ndour, 1998). The demand of germplasm is dynamic. One does not know what tomorrow's need may be and how far germplasm would fulfill them. The available diversity in the germplasm serves as an insurance against unknown future needs. The more the diversity is conserved and made available for future use, the better chance of fulfilling the future demand. Therefore, in the present study an attempt was made to study genetic variability in the indigenous rice germplasm accessions.

Materials and Methods

Forty seven rice (*Oryza sativa* L.) germplasm accessions including five checks were grown in randomized block design at Research-cum-Instructional Farm, IGKV, Raipur during *Kharif* 2015 (Table 1). Each entry was sown in single row at spacing of 20 cm between rows and 15 cm between plants. Crop was raised following recommended package of practices. Observations were recorded on five randomly chosen plants of each genotype per replication for quantitative traits. The qualitative traits were visually assessed according to the National Test Guidelines for DUS test in rice, which was developed by Indian Institute of Rice Research, Hyderabad (Shobha Rani *et al*., 2006). The observation of various characteristics was recorded at different stages of growth with appropriate procedures as per the DUS test guidelines of PPV & FR Act, 2001.

The traits studied were Coleoptile colour, Basal leaf: sheath colour, Leaf: intensity of green colour, Leaf: anthocyanin colouration, Leaf sheath: anthocyanin colouration, Leaf sheath: intensity of anthocyanin colouration, Leaf: pubescence of blade surface, Leaf: auricles, Leaf: anthocyanin colouration of auricles, Leaf: Collar, Leaf: anthocyanin colouration of collar, Leaf: ligule, Leaf: shape of ligule, Leaf: colour of ligule, Culm: attitude, Days to 50% flowering (days), Flag leaf: attitude of blade (early observation), Spikelet: density of pubescence of lemma, Male sterility, Lemma: anthocyanin colouration of keel, Lemma: anthocyanin

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Table 1. List of the 47 rice germplasm accessions

S.No.	Collector's No.	IC No.	Accessions name	Source
1	CGR:1814	IC-132751	Anjan	Mahasamund
2	CGR:1816	IC-132753	Anjan	Raigarh
3	CGR:1817	IC-132754	Anjan	Raipur
4	CGR:1818	IC-132755	Anjan	Raipur
5	CGR:1819	IC-132756	Bhata anjan	Mahasamund
6	CGR:1829	IC-132767	Anjaniya	Bemetara
7	CGR:1834	IC-132773	Anjaniya	Raipur
8	CGR:1835	IC-132881	Bangle	Raipur
9	CGR:1836	IC-132842	Bangoli-1	Raipur
10	CGR:1837	IC-132883	Bangoli-1 (II)	Raipur
11	CGR:1845	IC-132891	Bankal (II)	Dewas
12	CGR:1846	IC-132892	Banki	Bastar
13	CGR:6323	IC-125558	Kanak chudi	Bastar
14	CGR:6366	IC-125601	Cross. 116	Raigarh
15	CGR:6416	IC-125648	Deshi safri	Rajnandgaon
16	CGR:6644	IC-125878	Gada khuta	Bastar
17	CGR:6711	IC-125945	Gedrei	Raigarh
18	CGR:7133	IC-114277	Jhaler genda	Raigarh
19	CGR:7139	IC-114281	Jhili	Sarguja
20	CGR:7142	NA	Jhilli	Durg
21	CGR:7144	NA	Jhilli	Raipur
22	CGR:7159	IC-114289	Son jhilli	Raigarh
23	CGR:7168	IC-114295	Jhilli paragi	Raigarh
24	CGR:7176	IC-114303	Jhingo	Sarguja
25	CGR:7187	IC-114309	Jhumaki	Bastar
26	CGR:7189	IC-114311	Jhuna	Sarguja
27	CGR:7209	IC-114325	Kala jira	Raigarh
28	CGR:7210	NA	Kanak jira	Durg
29	CGR:7211	IC-114326	Maiphal jira III	Bastar
30	CGR:7306	IC-114362	Kakadiha	Raipur
31	CGR:7367	IC-114403	Kali muchh	Muraina
32	CGR:7472	IC-114470	Kanthdudgi	Raigarh
33	CGR:7565	IC-114505	Kera ghul	Raigarh
34	CGR:7593	IC-114518	Ketaki 11	Sarguja
35	CGR:7629	IC-114539	Khira sar	Sarguja
36	CGR:7634	IC-114543	Khira sar	Sarguja
37	CGR:9186	NA	Ramti	Bastar
38	CGR:9281	IC-115592	Safri	Raipur
39	CGR:9622	IC-11511	Sulthu	Mandla
40	CGR:9671	NA	Surmatia	Raipur
41	CGR:9896	IC-116003	Baronda off type V	Bastar
42	CGR:10007	IC-116076	–	–
43	Check 1		Maheshwari	Raipur (IGKV)
44	Check 2		Jaldubi	Raipur (IGKV)
45	Check 3		Rajeshwari	Raipur (IGKV)
46	Check 4		Indira aerobic 1	Raipur (IGKV)
47	Check 5		Samleshwari	Raipur (IGKV)

colouration of area below apex, Lemma: anthocyanin colouration of apex, Spikelet: colour of stigma, Stem thickness, Stem: length (excluding panicle), Stem: anthocyanin colouration of nodes, Stem: intensity of anthocyanin colouration of nodes, Stem: anthocyanin colouration of internodes, Panicle: length of main axis, Flag leaf: attitude of blade (late observation), Panicle: curvature of main axis, Panicle: number per plant, Spikelet: colour of tip of lemma, Lemma and palea: colour, Panicle: awns, Panicle: presence of secondary

branching, Panicle: secondary branching, Panicle: attitude of branches, Panicle: exertion, Leaf: senescence, Sterile lemma: colour, Grain: phenol reaction of lemma, Grain: weight of 1000 fully developed grains, Grain: length, Grain: width, Decorticated grain: length, Decorticated grain: width, Decorticated grain: shape, Decorticated grain: colour, Endosperm: content of amylose, Decorticated grain: aroma, grain yield per plant, kernel length, kernel length breadth ratio, kernel length after cooking, cooked kernel length breadth ratio, head rice recovery percentage and elongation ratio. Frequency distribution was computed to categorize the accession into different classes. Simple statistics (means, ranges) was calculated to have an idea of the level of variation.

Results and Discussion

To establish distinctness among rice germplasm accessions, 58 qualitative and quantitative characters were studied. Qualitative characters are considered as morphological markers in the identification of landraces of rice, because they are less influenced by environmental changes (Raut, 2003). Frequency distribution for agro-morphological characters in 47 rice germplasm accessions is presented in Table 2.

Morphological Characterization

Qualitative characters are important for plant description (Kurlovich, 1998) and mainly influenced by the consumers preference, socio-economic scenario and natural selection (Hien *et al.,* 2007). Most of the morphological characters showed variation in different accessions except Leaf: auricle, Leaf: collar, Leaf: ligule, Leaf : shape of ligule and male sterility. A majority of accessions were found to possess Coleoptile: colour (43% colourless), Basal leaf: sheath colour (60% green), Leaf: intensity of green colour (62% medium green), Leaf: anthocyanin colouration (60% absent), Leaf sheath: anthocyanin colouration (53% absent), Leaf sheath: intensity of anthocyanin colouration (50% strong), Leaf: pubescence of blade surface (51% strong), Leaf: anthocyanin colouration of auricles (85% colourless), Leaf: anthocyanin colouration of collar (85% absent), Leaf: colour of ligule (89% white), Culm: attitude (55% semi-erect), Flag leaf: attitude of blade early observation (55% erect), Spikelet: density of pubescence of lemma (47% medium), Lemma: anthocyanin colouration of keel (51% absent/very weak), Lemma: anthocyanin colouration of area below apex (73% absent), Lemma: anthocyanin colouration of apex (74% absent), Spikelet: colour of stigma (72% white), Stem: thickness (68% medium), Stem: length (36% long), Stem: anthocyanin colouration of nodes (83% absent), Stem: intensity of anthocyanin colouration of nodes (100% medium), Stem: anthocyanin colouration of internodes (68% absent), Flag leaf: attitude of blade late observation (55% semi-erect), Panicle: curvature of main axis (60% semi-straight), Panicle: number per plant (32% few), Spikelet: colour of tip of lemma (58% white), Lemma and palea: colour (36% straw and brown furrows on straw), Panicle: awns (87% absent), Panicle: presence of secondary branching (91% present), Panicle: secondary branching (58% weak), Panicle: attitude of branches (55% erect), Panicle: exertion (70% well exerted), Leaf: senescence (87% medium), Sterile lemma: colour (90% straw), Grain: phenol reaction of lemma (62% absent), Grain: weight of 1000 fully developed grains (41% low), Grain: length (57% short), Grain: width (53% medium), Decorticated grain: length (45% medium), Decorticated grain: width (57% medium), Decorticated grain: shape (51% long bold), Decorticated grain: colour (55% white), Endosperm: content of amylose (70% high) and Decorticated grain: aroma (94% absent). Similar type of work was also reported by Bisne and Sarawgi (2008), Das and Ghosh (2011), Moukoumbi *et al.* (2011). Parikh *et al.* (2012), Subba Rao *et al.* (2013), Sarawgi *et al*., (2014), Sinha *et al*. (2015), Kumar *et al*. (2016) and Singh *et al*. (2016). Based on the morphological descriptors 47 accessions were classified based on 51 characters.

In the present study some of the unique accessions with distinct features were recorded (Table 3).Unique accessions like Cross. 116, Gadakhuta and CGR: 7144 for purple line basal leaf sheath colour; Cross. 116 and Jaldubi for medium intensity of anthocyanin colouration of leaf sheath; Kali muchh, Khira sar, Jaldubi and Samleshwari for very strong pubescence of leaf blade surface; Safri, Surmatia and IC- 116076 for open culm attitude; Jhilli paragi, Jhingo and Maiphal jira III for very strong spikelet density of pubescence of lemma; Banki for lemma anthocyanin colouration of keel, lemma anthocyanin colouration of area below apex and lemma anthocyanin colouration of apex; Bangle for weak lemma anthocyanin colouration of apex; CGR: 7142 for red spikelet: colour of tip of lemma; IC-116076 for gold and gold furrows on straw background of lemma and palea colour; Banki for reddish to light purple lemma and palea colour; Ramti for purple furrows on straw

Table 2. Frequency distribution of agro-morphological and quality characters of forty seven germplasm accessions of rice

S.No.	Characteristics	States	No. of accessions	Frequency (%)
1.	Coleoptile: Colour	Colourless	20	43
		Green	15	25
		Purple	12	32
2	Basal leaf: Sheath colour	Green	28	60
		Light purple	7	15
		Purple lines	3	6
		Uniform purple	9	19
3.	Leaf: Intensity of green colour	Light	5	10
		Medium	29	62
		Dark	13	28
4.	Leaf: Anthocyanin colouration	Absent	28	60
		Present	19	40
5.	Leaf Sheath: anthocyanin colouration	Absent	25	53
		Present	22	47
6.	Leaf sheath: Intensity of anthocyanin colouration	Very weak	0	0
		Weak	6	27
		Medium	2	9
		Strong	11	50
		Very strong	0	14
7.	Leaf; pubescence of blade surface	Absent	0	0
		Weak	8	17
		Medium	11	23
		Strong	24	51
		Very strong	4	9
8.	Leaf: Auricles	Absent	0	0
		Present	47	100
9.	Leaf: Anthocyanin colouration of auricles	Colourless	40	85
		Light purple	0	0
		Purple	7	15
10.	Leaf: collar	Absent	0	0
		Present	47	100
11.	Leaf: Anthocyanin colouration of collar	Absent	40	85
		Present	7	15
12.	Leaf: Ligule	Absent	0	0
		Present	47	100
13.	Leaf: Shape of Ligule	Truncate	0	0
		Acute	0	0
		Split	47	100
14.	Leaf: Colour of Ligule	White	42	89
		Light purple	0	0
		Purple	5	11
15.	Culm: Attitude	Erect	17	36
		Semi-erect	26	55
		Open	3	7
		Spreading	1	2
16.	Time of heading (50% plants with panicles)	Very early	0	0
		Early	0	0
		Medium	35	74
		Late	12	26
		Very late	0	0
17.	Flag leaf: attitude of blade (early observation)	Erect	26	55
		Semi-erect	21	45
		Horizontal	0	0
		Drooping	0	0
18.	Spikelet: Density of pubescence of lemma	Absent	0	0
		Weak	11	24
		Medium	22	47
		Strong	11	23
		Very strong	3	6

S.No.	Characteristics	States	No. of accessions	Frequency (%)
19.	Lemma: Anthocyanin colouration of keel	Absent or very weak	24	51
		Weak	8	17
		Medium	8	17
		Strong	6	13
		Very strong	1	2
20.	Lemma: Anthocyanin colouration of area below apex	Absent	34	73
		Weak	8	17
		Medium	2	4
		Strong	2	4
		Very strong	1	2
21.	Lemma: Anthocyanin colouration of apex	Absent	34	73
		Weak	8	17
		Medium	2	4
		Strong	2	4
		Very strong	1	2
22.	Spikelet: colour of stigma	White	34	72
		Light green	0	0
		Yellow	0	0
		Light purple	0	0
		Purple	13	28
23.	Stem: length	Very short	4	8
		Short	0	0
		Medium	12	26
		Long	17	36
		Very long	14	30
24.	Stem: Anthocyanin colouration of nodes	Absent	39	83
		Present	8	17
25.	Stem: Intensity of anthocyanin colouration of nodes	Weak	0	0
		Medium	8	100
		Strong	0	0
26.	Stem: Intensity of anthocyanin colouration of internodes	Absent	32	68
		Present	15	32
27.	Panicle: length of main axis	Very short	0	0
		Short	3	6
		Medium	24	51
		Long	14	30
		Very long	6	13
28.	Flag leaf: Attitude of blades (late observation)	Erect	12	26
		Semi-erect	26	55
		Horizontal	9	19
		Deflexed	0	0
29.	Panicle: Curvature of main axis	Straight	17	36
		Semi-Straight	28	60
		Deflexed	1	2
		Dropping	1	2
30.	Panicle: number per plant	Few	68	32
		Medium	32	15
		Many	0	0
31.	Spikelet: colour of tip of lemma	White	27	58
		Yellowish	2	4
		Brown	3	6
		Red	1	2
		Purple	14	30
		Black	0	0

Table 2 Contd.

S.No.	Characteristics	States	No. of accessions	Frequency (%)
32.	Lemma and palea: colour	Straw	17	36
		Gold and gold furrows on straw background	1	2
		Brown spots on straw	7	15
		Brown furrows on straw	17	36
		Brown (tawny)	3	7
		Reddish to light purple	1	2
		Purple spots/ furrows on straw	1	2
		Purple	0	0
		Black	0	0
33.	Panicle: Awns	Absent	41	87
		Present	6	13
34.	Panicle: Presence of secondary branching	Absent	4	9
		Present	43	91
35.	Panicle: secondary branching	Weak	25	58
		Strong	12	28
		Clustered	6	14
36.	Panicle: attitude of branches	Erect	26	55
		Erect to semi erect	7	15
		Semi-erect	12	26
		Semi erect to spreading	2	4
		Spreading	0	0
37.	Panicle: Exertion	Partly exerted	0	0
		Mostly exerted	14	30
		Well exerted	33	70
38.	Sterile lemma: colour	Straw	42	89
		Gold	4	9
		Red	0	0
		Purple	1	2
39.	Grain: Weight of 1000 fully developed grains	Very low	3	6
		Low	19	41
		Medium	16	34
		High	8	17
		Very high	1	2
40.	Grain: Length	Very short	0	0
		Short	27	57
		Medium	20	43
		Long	0	0
		Very long	0	0
41.	Grain: Width	Very narrow	0	0
		Narrow	17	36
		Medium	25	53
		Broad	5	11
		Very broad	0	0
42.	Decorticated grain: length	Short	12	25
		Medium	21	45
		Long	13	28
		Extra long	1	2
43.	Decorticated grain: width	Narrow	4	9
		Medium	27	57
		Broad	16	34
44.	Decorticated grain: shape (in lateral view)	Short slender	1	2
		Short bold	14	30
		Medium slender	1	2
		Long bold	24	51
		Long slender	7	15
		Extra Long slender	0	0

Table 2 Contd.

S.No.	Characteristics	States	No. of accessions	Frequency (%)
45.	Decorticated grain: colour	White	26	55
		Light brown	15	32
		Variegated brown	0	0
		Dark brown	4	9
		Light red	0	0
		Red	2	4
		Variegated purple	0	0
		Purple	0	0
		Dark purple	0	0
46.	Endosperm: content of amylose	Very low	0	0
		Low	3	6
		Medium	11	24
		High	33	70
		Very high	0	0
47.	Decorticated grain: Aroma	Absent	44	94
		Present	3	6

Table 3. Unique accessions for different morphological traits

S.No.	Morphological characters	Colour pattern/ type	Unique accessions
1	Basal leaf sheath colour	Purple lines	Cross. 116, Gada khuta, CGR:7144
2	Leaf sheath intensity of anthocyanin colouration	Medium	Cross. 116, Jaldubi
3	Leaf pubescence of blade surface	Very strong	Kali muchh, Khira sar, Jaldubi, Samleshwari
4	Culm attitute	Open	Safri, Surmatia, IC-116076
5	Spikelet density of pubescence of lemma	Very strong	Jhilli paragi, Jhingo, Maiphal jira
6	Lemma anthocyanin colouration of keel	Very strong	Banki
7	Lemma anthocyanin colouration of area below apex	Very strong	Banki
8	Lemma anthocyanin colouration of apex	Very strong	Banki
		Weak	Bangle
9	Panicle: Curvature of main axis	Deflexed	Rajeshwari
		Drooping	Samleshwari
10	Spikelet: colour of tip of lemma	Red	CGR: 7142
11	Lemma and palea colour	Gold and gold furrows on straw background	IC-116076
		Reddish to light purple	Banki
		Purple furrows on straw	Ramti
12	Decorticated grain length	Extra long	Maheshwari
13	Decorticated grain shape	Medium slender	Ramti
		Short slender	Surmatia
14	Decorticated grain colour	Red	Gada khuta, Gedrei

of lemma and palea colour; Maheshwari for extra long decorticated grain length; Ramti for medium slender decorticated grain shape; Surmatia for short slender decorticated grain shape; and Gada khuta, Gedrei for red colour decorticated grain may be utilized in hybridization programme to provide morphological markers in transgressive segregants towards development of new rice varieties which is essentially required for novelty.

Agronomical Characterization

Rice accessions were evaluated for agronomical traits *viz.,* days to 50% flowering, Panicle: length of main axis, Panicle: number per plant, Time of maturity, Grain: weight of 1000 fully developed grains, Grain: length, Grain: width and grain yield per plant from five randomly selected plants of each entry.

Days to 50% Flowering: It had mean value of 106.84 days and range of 92-122 days. All the accessions fall

in the range of medium to late group. Samleshwari (92 days) had minimum days to 50% flowering followed by Bangle (95 days).

Panicle Length: It exhibited reasonable amount of variation with range values of 19.70-32.52 cm. The average panicle length was 26.15 cm. Most of the accessions fall under the range of 21-25 cm panicle length. The maximum panicle length was observed in Indira aerobic 1 (32.52 cm) followed by Bangoli-1 (II) (32.21 cm). Although it contributes positively yet maximum panicle length is not the only factor responsible for higher grain yield (Abbasi *et al.,* 1995). So, panicle length alone does not determine the high grain yield as traits such as grain size, grain shape, higher number of tillers/plant, longer panicles and greater number of grains/panicle ultimately contribute to higher grain yield (Akram *et al.,* 1994).

Number of Panicles Per Plant: It is another yield attributing trait (Abbasi *et al.,* 1995). A great variability with high range (6.32-14.78) and mean value of 9.84 was exhibited for number of panicles/plant. Ramti had maximum number of panicles (14.78).

Days to Maturity: It exhibited high range (120-150 days) with a mean of 135.21 days Samleshwari had shortest maturity period (120 days). Most of the accessions fall under medium followed by late duration.

Thousand Grain Weight: It is also a yield attributing trait (Abbasi *et al.,* 1995). Most of the accessions were in the range of 21-25 g. Accessions with very high (>30 g) and very low (<15) grain weight were also observed. Rajeshwari (30.91 g) had maximum 1000 grain weight followed by Maheshwari (29.96 g) and Bangle (29.23 g).

Grain Length: Grain length is an important quality parameter. Rice grain can be classified as very long, long, medium, short and very short. It exhibited high range (6.03-10.00 mm) with a mean of 8.12 mm. Accession CGR:7144 (10.00 mm) was found with maximum grain length followed by Maheshwari (9.98 mm) and Kakadiha (9.92 mm).

Grain Width: It exhibited range (2.27-3.37 mm) with mean of 2.71 mm. Most of the accessions fall under medium followed by narrow grain width. Cross. 116 was observed with maximum grain width (3.37 mm) while Bankal (II) had narrow grain width (2.27 mm).

Grain Yield Per Plant: It varied from 20.51 to 34.55 g with a mean value of 28.14 g. Rajeshwari (34.55 g) was observed with maximum grain yield per plant followed by Bangle (34.40 g) and Banki (33.93 g).

After evaluation of 47 accessions for important quantitative characters, on the basis of mean values, desirable accessions were identified for the yield and its component traits (Table 4). Accessions found desirable for different traits were Bangle for days to 50% flowering (earliness) and grain yield per plant; Bangoli-1 (II) for panicle length; Ramti for panicle number per plant; Bangle for 1000 grain weight; CGR: 7144 for grain length and Bankal (II) for grain width. These germplasm accessions for different agronomical characters in phenotypically divergent sources would help in prebreeding and breeding programs.

Quality Characterization

Rice accessions were evaluated for quality traits *viz.,* kernel length, kernel length breadth ratio, kernel length after cooking, cooked kernel length breadth ratio, head rice recovery percentage, elongation ratio and amylose content.

Kernel Length: It showed variation from 3.70 to 6.77 mm with a mean value of 5.19 mm. Bankal II was

Table 4. Desirable rice accessions for yield ancillary traits

S. No.	Days to 50% flowering (earliness)	Panicle length (cm)	Panicle no. per plant	1000 grain weight (g)	Grain length (mm)	Grain width (mm)	Grain yield per plant (g)
1	Samleshwari (92.00)	Indira aerobic 1 (32.52)	Ramti (14.78)	Rajeshwari (30.91)	CGR:7144 (10.00)	Bankal (II) (2.27)	Rajeshwari (34.55)
2	Bangle (95.00)	Bangoli-1 (II) (31.23)	Indira aerobic 1 (13.44)	Maheshwari (29.96)	Maheshwari (9.98)	Safri (2.30)	Bangle (34.40)
3	Bangoli-1 (98.00)	Safri (31.20)	Safri (13.34)	Bangle (29.23)	Kakadiha (9.92)	Jhilli paragi (2.32)	Banki (33.93)
4	IC-132751 (99.00)	IC-132773 (30.40)	Sulthu (12.78)	Kala jira (29.03)	Bangoli-1 (II) (9.53)	Surmatia (2.32)	Kala jira (33.87)
5	IC-132753 (99.00)	Bhata anjan (30.37)	Jhumaki (12.66)	Cross. 116 (28.98)	Kera ghul (9.52)	Bangoli-1 (II) (2.37)	Maheshwari (33.53)

Table 5. Desirable rice accessions for quality traits

S. No.	Kernel length (mm)	Kernel length breadth ratio	Kernel length after cooking (mm)	Cooked kernel length breadth ratio	Elongation ratio	Head rice recovery %	Amylose content (%)
1	Bankal (II) (6.77)	Bankal (II) (3.03)	Rajeshwari (10.10)	Kakadiha (3.22)	IC-132754 (2.91)	Jhuna (58.35)	Kanthdudgi (20.35)
2	Bangle (6.67)	Kali muchh (2.99)	CGR:7142 (10.00)	Baronda off type V (3.01)	IC-132767 (2.84)	Jhingo (57.66)	Rajeshwari (21.19)
3	Bangoli-1 (II) (6.57)	Bangoli-1 (II) (2.94)	CGR:7144 (9.63)	Ketaki 11 (2.92)	Bhata anjan (2.79)	CGR:7142 (56.18)	Khira sar (21.42)
4	Maheshwari (6.44)	Jhilli paragi (2.91)	Baronda off type V (9.63)	Kanak chudi (2.92)	IC-132751 (2.79)	Kali muchh (54.28)	Jhingo (21.75)
5	Banki (6.43)	Kanak chudi (2.86)	Kanak chudi (9.43)	IC-116076 (2.90)	IC-132755 (2.76)	Kala jira (54.20)	Baronda off type V (22.51)

observed for maximum kernel length(6.77 mm) followed by Bangle (6.67 mm) and Bangoli-1 (II) (6.57 mm).

Kernel Length Breadth Ratio: It ranged from 1.65 to 3.03 with a mean value of 2.39. Bankal II (3.03) was observed for maximum kernel length breadth ratio followed by Kali muchh (2.99), Bangoli-1 (II) (2.94) and Jhilli paragi (2.91).

Kernel Length after Cooking: It showed variation from 6.03 to 10.10 mm with a mean value of 8.15 mm. Rajeshwari (10.10 mm) was observed for maximum kernel length after cooking followed by CGR: 7142 (10.00 mm).

Cooked Kernel Length Breadth Ratio: It ranged from 2.03 to 3.22 with a mean value of 2.53. The maximum cooked kernel length breadth ratio was found in Kakadiha (3.22) followed by Baronda off type V (3.01).

Elongation Ratio: It varied from 1.31 to 2.91 with a mean value of 1.93. IC-132754 (2.91) had maximum elongation ratio followed by IC-132767 (2.84).

Head Rice Recovery Percentage: It varied from 32.66 to 58.35 % with a mean value of 43.70 per cent. The maximum head rice recovery percentage was found in Jhuna (58.35%) followed by Jhingo (57.66%).

Amylose Content: It ranged from 14.88 to 30.58% with a mean value of 26.19 per cent. The intermediate amylose content being desirable was recorded in Kanthdudgi (20.35%) followed by Rajeshwari (21.19%), Khira sar (21.42%), Jhingo (21.75%) and Baronda off type V (22.51%).

After evaluation of 47 accessions for important quality traits, on the basis of mean values, desirable accessions were identified for the quality (Table 5). Accessions found desirable for important quality traits were Bankal (II) for kernel length and kernel length breadth ratio; CGR: 7142 for kernel length after cooking; Kakadiha for cooked kernel length breadth ratio; IC-132754 for elongation ratio; Jhuna for head rice recovery percentage; and Kanthdudgi for amyolse content.

The accessions like Bangle, Banki and Kala jira having high yield were also better in quality traits like kernel length and head rice recovery percentage.

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