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Characterization of Rice (*Oryza sativa* L.) Cultivars, Hybrids (KRH-2 & KRH-4) and their Parental Lines Based on Seed and Seedling Traits

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ABSTRACT

Considering the importance of rice, a staple food crop which feeds millions of people around the globe, continuous crop improvement program has been under the way all over the countries and nearby about 2541 varieties have been released so for. Clear identification of exclusive crop varieties and hybrids are essential for the protection and prevention of unauthorized commercial use. In India, this is highly pertinent because the hybrid seed production and marketing of public sector hybrids is principally taken up by private sector (Nandakumar et al, 2004). Besides, supply of genetically pure seed of rice is vital to realize the gains accrued through rice breeding efforts. In order to maintain genuineness (true to type) and quality of seed, careful attention is needed at every stage of seed production of a variety. Hence characterization of 30 rice cultivars, two rice hybrids (KRH-2 & KRH-4) along with their parental lines viz, IR-58025A, KMR-3 and CRMS-32A, MSN-36 based on seed and seedling traits play an important to distinguish between cultivars. The characters such as seed size , seed shape, length, seed colour, seed pubescence, seed awn, seed weight, decorticated grain shape, colour, length exhibuited more variation among the rice cultivars hybrids and their parental lines.

Key words: *Crop varieties, Breeding, Rice, Hybrid*

INTRODUCTION

Rice is the most important staple food in Asia, more than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the world's population lives. Considering the importance of rice, a staple food crop which feeds millions of people around the globe, continuous crop improvement program has been under the way all over the countries and nearby about 2541 varieties have been released so for. India alone contributed significantly for varieties development programme next to China by releasing nearly about 820 varieties so for and are being cultivated in different agro-climatic zones. Out of these 788 varieties and 100 hybrids are in the production chain considering the varietal mass in this production chain of rice.

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Clear identification of exclusive crop varieties and hybrids are essential for the protection and prevention of unauthorized commercial use. The intensive crop improvement programme has resulted in the development of large number of hybrids and varieties in rice and other important crop species. Varietal identification has thus attained critical importance in the National and International Seed Programme in order to maintain the genuineness and quality of seeds. Different cultivars are identified on the basis of the taxonomical differences in seed, seedling and mature plants. Though this has been universally adopted as classical taxonomic approach, several alternative methods based on chemical and biochemical properties of seed and seedlings have also been attempted in many crop species including rice.

MATERIAL AND METHODS

Pure seeds of thirty cultivars and two hybrids along with their parental lines were obtained from Rice Breeding Unit, Zonal Agricultural Research Station, VC Farm, Mandya. The seeds were cleaned and dried to the safe moisture level and preserved for further use. Jaya , Jyothi, Mandya Sona-1, Mandya Sona-2, Mandya Sona-3, Rasi, Gangavathi Sona , Tella Hamsa , BPT-5204, IR-30864 , KMP-128, KMP-153 KMP-175, KMP-200, KMP-201, CTH-1, CTH-3, KRH-2, IR-58025A (A), KMR-3R, MTU 1001, MTU 1010 ,BR 2655, CRMS-32A(A), MSN-36 (R), KRH-4(H), BI-33, TUNGA , JGL-1798,MAS-26 , MAS-946-1, Ratna Choodi, Rajamudi, Thanu, IR-64, Raksha.

Seed morphology: Seed samples of 30 cultivars were studied for various morphometric characters *viz*., seed length, seed width, seed thickness, dehusked grain length and width by using grain micrometer. Besides, seed colour, seed pubescence and 1000 seed weight were also recorded.

Seed length (mm): Seed length was measured using grain micrometer at the distance from the base of the lower most sterile lemma to the tip of the lemma or palea. In case of awned genotypes, length was measured to a point comparable to the tip of the apiculus. Based on seed length, cultivars were classified[7]. The mean length of seed is expressed in milimeter. The groupings of cultivars based on seed length were as follows.

Category	**Length**
Short	: < 7.5 mm
Medium	: 7.5 – 9.0 mm
Long	: 9.0 – 10.0 mm
Very long	: > 10.0 mm

Seed width (mm): Seed width was measured using grain micrometer as the distance across lemma and palea (the widest point) and the mean of seed width was expressed in milimeter. Based on the mean seed width, the cultivars were categorized[7].

Category	**Width**
Narrow	: 1.9 – 2.2 mm
Medium	: 2.3 – 2.8 mm
Broad	: > 2.8 mm

Seed thickness (mm): Seed thickness was calculated as height of seed when placed horizontally and expressed in mm. The thickness is used for computing the profile value of the seed.

Seed size: Based on length (L), width (W) and thickness (T) the seed size was calculated. The formula to calculate seed size is as below:

Seed size (mm^3) = (L x W x T)

Seed shape: Based on length to width ratio the cultivars were grouped into four categories[7].

Category	**Range**
Spherical	: < 2.0
Semispherical	: 2.0 – 2.4
Semi long	: 2.4 – 3.0
Elongated	: > 3.0

Seed colour: The colour of the husk was recorded under natural day light condition using Munsell Colour Chart (Anon, 1954). Based on the colour groups the cultivars were classified into five categories as pale yellow, yellow, yellowish brown, brownish yellow and very pale brown.

Seed pubescence: Seed pubescence (hairiness of lemma and palea) was observed under 10X magnification and cultivars were classified into two group's *viz*., pubescent and glabrous.

1000 seed weight (g): One thousand seeds of eight replications were counted randomly and

weighed upto two decimal places. The mean 1000 weight was expressed in grams and accordingly the cultivars were classified into four groups as follows.

Category		**Range**
Very light	:	14 – 16 g
Light	:	16 – 18 g
Medium	:	18 – 20 g
Heavy	:	> 20 g

Dehusked grain length (mm): The lemma and palea of the seeds were carefully removed (dehulled) and the length was taken from the base to the tip of the kernel and expressed in milimeter. Based on the mean length, cultivars were classified into four categories[7].

Category	**Length**
Short	: < 7.5 mm
Medium	: 7.5 – 9.0 mm
Long	: 9.0 – 10.0 mm
Very long	: > 10.0 mm

Dehusked grain width (mm): The lemma and palea of the grain were removed carefully and the width was measured across the seed at the widest point and expressed in milimeter. The mean width is used to determine the decorticated seed shape.

Dehusked grain shape: The shape of the dehusked grain was determined based on the mean Dehusked grain length to width ratio the cultivars were classified into four groups[7].

Category	**Range**
Spherical	: < 2.0
Semispherical	: 2.0 – 2.4
Semi long	: 2.4 – 3.0
Elongated	: > 3.0

Seedling morphology: Four replications of fifty seeds in each of selected cultivar were tested for germination by between paper methods as per ISTA (2013). The rolled towels were incubated in a germinator at 25 $\pm$ 1°C. At the end of the 14th day, 25 normal seedlings from each replication were taken randomly and seedling morphological characters like root length and shoot length were measured in centimeters. The mesocotyl length, ratio of root to shoot, coleoptile coloration and Anthocyanin colouration were also recorded.

RESULTS AND DISCUSSION

Significant difference was observed among the rice cultivars, hybrids and their parental lines for shape of seed, which was governed by length to width ratio. Larger the ratio, the more slender is the seed. There is a definite association between the length and length to width ratio. The longer the grain the finer it tends to be. So, it is suggested that the genes governing length also partly govern the seed shape[7]. In the present study, the length to width ratio was ranged from 2.83 (CTH-3) to 4.70 (KRH-2 (H)). However, the length to thickness ratio varied from 3.13 (MSN-36 (R)) to 5.33 (KMP-153). Therefore, the results clearly revealed that the shorter the length, the lower will be the length to width and length to thickness ratio and longer the length, higher the length to width and length to thickness ratio. Seed size varied significantly among the rice cultivars, hybrids and their parental lines tested (Table 4.1). It was ranged from 2.20 (Mandya Sona-1) to 6.73 mm^3 (KMP-201) with a mean of 4.20 mm^3. Similar results have also been reported by several workers in rice[3, 4, 5, 6,7].

In the present investigation, 1000 seed weight showed significant differences among the cultivars and hybrids studied and the values ranged from 13.27 (Gangavathi Sona) to 28.16g (KMP-201). Similar differences were observed by in rice [3, 4, 5, 6,7]. For seed awn charcters only CTH-1, KRH-2 (H) and IR-58025A showed seed awn character. Seed colour which was heritable character based on seed colour the cultivars grouped into pale yellow, yellow, yellowish brown, brownish yellow and very pale brown. the dehusked grain weight showed significant differences among the rice cultivars, hybrids and their parental lines studied[1] and the dehusked seed weight was ranged from 12.38g (KRH-4 and CRMS 32A) to 26.03g (Jaya). Significant variations were observed between the rice cultivars, hybrids and their parental lines for dehusked grain length and shape (table 2). The cultivars were grouped as short and medium based on the decorticated seed length while, the cultivars were grouped as semi long and elongated based on grain shape. The

decorticated seed length was varied from 5.07 (Mandya Sona-3) to 9.34 mm (IR-64) and the length to width ratio was ranged from 2.32 (Jaya) to 3.46 mm (KMP-153) (table 2) and these characters could be used for broad classification of cultivars although it may not be useful for identification. Similar results have also been reported by several workers in rice[3, 4, 5, 6].

In this study significant variation was observed for the seedling chaacters such as shoot length, root length and mesocotyl length (table 3) based on these characters rice cultivars hybrids and their parental lines grouped as short, medium and long. Shoot length was varied from 8.62 (KMP-200) to 18.72 cm (MAS-946-1) with a mean of 13.71 cm. Root length was varied from 15.72 (BR-2655) to 22.91cm (BI-33) with a mean of 19.73 cm (table 3). Mesocotyl length was observed only in some of the genotypes which was also recorded by[3]. Seedling shoot length, root length, mesocotyl length, shoot to root ratio at a particular growth stage are heritable and stable varietal characters that could be used for characterization of rice cultivars. Thus, seedling morphological traits were found useful in broad classification of cultivars into different groups but not for identification of individual cultivars except seedling anthocyanin pigmentation. Though, these characters are in use for a long time for varietal classification, their utility appears to be doubtful as these characters are quantitative in nature and are subject to fluctuations due to environment. Similar observation were made by [3, 4, 5, 6] classified the rice cultivars based on the seedling characters.

Table 1: Seed morphological characters recorded in different rice cultivars and hybrids with its parental lines

Sl. no.	Cultivar name	Seed length (mm)	Seed Width (mm)	Seed thickness (mm)	Seed size	L/W ratio	L/T ratio	Test weight	Seed colour
1	BI-33	8.81	2.66	2.01	4.78	3.31	4.38	20.43	Yellow
2	BPT-5204	7.55	2.48	2.05	3.83	3.04	3.68	15.57	Yellow
3	BR-2655	9.31	2.42	2.02	4.55	3.84	4.60	23.34	Yellow
4	CRMS 32A	8.00	2.01	2.02	3.25	4.05	3.98	15.41	Pale brown
5	CTH-1	8.35	2.74	1.83	4.12	3.04	4.56	24.99	Yellow
6	CTH-3	7.77	2.74	1.97	4.19	2.83	3.94	20.19	Brownish yellow
7	Gangavathi Sona	7.38	2.20	1.62	2.63	3.35	4.55	13.27	Pale brown
8	IR-30864	9.74	2.42	1.94	4.57	4.02	5.00	25.32	Yellow
9	IR-58025A	8.38	2.24	2.10	3.94	3.74	4.00	20.24	Yellow
10	IR-64	10.17	2.71	2.01	5.50	3.65	5.05	22.03	Yellow
11	Jaya	8.63	3.01	2.02	5.24	2.86	4.27	27.20	Yellow
12	JGL1798	7.12	2.28	1.78	2.88	3.12	4.00	14.59	Yellow
13	Jyothi	8.84	2.80	1.97	4.87	3.15	4.48	24.94	Pale brown
14	KMP 128	8.83	2.23	1.92	3.78	3.95	4.59	27.22	Yellow
15	KMP 153	10.34	2.38	1.95	4.98	4.34	5.33	26.32	Yellow
16	KMP 175	8.51	2.38	2.15	4.35	3.57	3.95	20.06	Yellow
17	KMP 200	8.89	2.65	2.13	5.01	3.35	4.17	26.82	Yellow
18	KMP 201	9.48	3.17	2.24	6.73	2.99	4.23	28.16	Yellow
19	KMR 3R	8.15	2.78	1.97	4.46	2.93	4.14	22.41	Brownish yellow
20	KRH 2 (H)	9.84	2.09	1.99	4.09	4.70	4.95	18.74	Light yellow
21	KRH 4 (H)	8.00	2.01	2.00	3.21	3.78	3.78	21.51	Pale brown
22	Mandya Sona-1	7.18	2.20	1.46	2.30	3.26	4.07	15.77	Yellow
23	Mandya Sona-2	7.28	2.18	1.39	2.20	3.33	3.97	14.40	Yellow
24	Mandya Sona-3	7.04	2.20	1.50	2.32	3.20	4.14	14.53	Very Pale brown
25	MAS 26	8.21	2.55	1.92	4.01	3.21	4.27	19.50	Pale brown
26	MAS 946-1	9.71	2.21	2.15	4.61	4.39	4.51	24.64	Pale brown
27	MSN 36 (R)	7.85	2.10	2.80	4.61	3.71	3.13	17.56	Yellow
28	MTU 1001	8.75	2.89	2.09	5.28	3.02	4.18	24.38	Yellow
29	MTU1010	8.41	2.75	2.11	4.88	3.05	3.99	26.35	Yellow
30	Rajamudi	8.88	2.33	2.03	4.20	3.81	4.37	18.67	Yellow
31	Raksha	7.89	2.49	1.90	3.73	3.16	4.15	19.23	Yellow
32	Rasi	7.97	2.69	1.91	4.09	2.96	4.27	19.81	Yellow
33	Ratna Choodi	8.08	2.79	1.91	4.30	2.89	4.23	21.49	Yellowish brown
34	Tella Hamsa	9.80	2.58	2.11	5.33	3.80	4.64	24.88	Yellow
35	Thanu	7.53	2.25	1.88	3.10	3.34	4.00	18.12	Brownish yellow
36	Tunga	9.50	2.67	2.16	5.50	3.55	4.40	23.75	Yellow
	Mean	**8.50**	**2.48**	**2.00**	**4.20**	**3.45**	**4.266**	**21.18**	-
	S.Em±	**0.24**	**0.021**	**0.11**	**0.051**	**0.070**	**0.073**	**0.770**	-
	CD (0.05P)	**0.86**	**0.069**	**0.30**	**0.205**	**0.198**	**0.273**	**0.278**	-
	CV (%)	**1.42**	**2.141**	**4.21**	**2.786**	**3.537**	**2.786**	**3.915**	-

Table 2: Dehusked grain characters recorded in different rice cultivars and hybrids with its parental lines

Sl. No.	Cultivar name	Seed length (mm)	Seed Width (mm)	Seed thickness (mm)	L/W Ratio	Test weight	Seed colour	Pearl spot
1	BI-33	8.18	2.25	1.74	2.75	19.82	Pale brown	Medium
2	BPT-5204	6.78	2.01	1.82	2.87	15.25	White	Small
3	BR-2655	8.64	2.18	1.82	3.04	21.53	White	Small
4	CRMS 32A	7.81	1.88	1.93	3.14	12.38	Pale yellow	Small
5	CTH-1	7.48	2.51	1.76	2.42	23.26	Red	Absent
6	CTH-3	5.29	1.97	1.92	2.69	19.21	Pale brown	Large
7	Gangavathi Sona	6.31	1.92	1.23	2.77	12.90	White	Large
8	IR-30864	8.51	2.16	1.76	3.35	23.94	White	Medium
9	IR58025A	7.11	1.84	1.94	3.86	18.36	White	Absent
10	IR-64	9.14	2.34	1.84	3.13	20.15	White	Small
11	Jaya	7.98	2.58	1.80	2.32	26.03	White	Absent
12	JGL1798	5.29	1.90	1.51	2.78	13.47	Pale brown	Absent
13	Jyothi	6.51	2.43	1.86	2.70	23.12	Reddish brown	Medium
14	KMP-128	8.41	2.08	1.71	3.56	25.92	White	Small
15	KMP 153	9.34	2.15	1.76	3.46	24.17	White	Absent
16	KMP-175	7.98	2.10	1.88	2.85	17.54	Pale brown	Medium
17	KMP-200	8.12	2.61	1.99	2.34	25.11	White	Large
18	KMP 201	8.23	2.63	2.02	2.59	25.79	White	Large
19	KMR 3R	7.08	2.41	1.52	2.93	20.14	White	Small
20	KRH 2(H)	7.09	1.85	1.81	3.83	18.21	White	Absent
21	KRH 4(H)	6.91	1.93	2.01	3.06	12.38	Pale yellow	Small
22	Mandya Sona-1	6.13	1.89	1.53	2.71	13.80	White	Absent
23	Mandya Sona-2	6.21	1.93	1.51	2.73	13.33	White	Medium
24	Mandya Sona-3	5.07	1.95	1.57	2.60	13.15	White	Absent
25	MAS 26	7.84	2.13	1.68	2.74	18.28	White	Medium
26	MAS 946-1	7.99	2.15	1.88	3.25	20.15	White	Absent
27	MSN 36(R)	6.32	2.01	2.05	2.64	13.71	White	Medium
28	MTU 1001	7.17	2.46	1.93	2.50	21.28	White	Medium
29	MTU 1010	7.84	2.23	1.91	2.89	24.43	Pale brown	Medium
30	Rajamudi	5.96	2.08	1.80	2.86	16.62	White	Absent
31	Raksha	5.75	2.16	1.66	2.66	17.50	White	Absent
32	Rasi	5.83	2.40	1.69	2.43	18.08	White	Absent
33	Ratna Choodi	7.77	2.36	1.68	2.44	19.19	Pale brown	Large
34	Tella Hamsa	8.68	2.25	1.91	3.10	21.04	Pale brown	Absent
35	Thanu	7.15	2.01	1.44	2.56	17.69	White	Small
36	Tunga	8.81	2.26	1.95	3.08	21.18	Pale brown	Absent
	Mean	**6.17**	**2.17**	**1.77**	**2.88**	**19.80**	-	-
	S.Em±	**0.021**	**0.036**	**0.14**	**0.117**	**0.87**	-	-
	CD (0.05P)	**0.084**	**0.135**	**0.39**	**0.331**	**2.44**	-	-
	CV (%)	**5.34**	**4.69**	**5.15**	**5.65**	**3.62**	-	-

Table 3:Seedling morphological characters recorded in different rice cultivars and hybrids with parental lines

Sl. No.	Cultivar name	Shoot length (mm)	Root length (mm)	Mesocotyl (cm)	Root to shoot ratio	Seedling pigment-ation	Coleoptile colour
1	BI-33	16.51	22.91	Present (1.29)	1.38	Absent	Absent
2	BPT-5204	12.11	21.92	Absent	1.81	Absent	Absent
3	BR-2655	12.23	15.72	Absent	1.41	Absent	Absent
4	CRMS 32A	15.78	19.82	Absent	1.26	Absent	Absent
5	CTH-1	14.73	19.74	Absent	1.34	Absent	Absent
6	CTH-3	12.05	21.23	Absent	1.76	Absent	Absent
7	Gangavathi Sona	9.56	16.06	Absent	1.68	Absent	Absent
8	IR-30864	14.27	18.15	Absent	1.32	Absent	Absent
9	IR58025A	12.09	17.29	Absent	1.43	Absent	Absent
10	IR-64	13.25	21.89	Present(1.75)	1.65	Absent	Absent
11	Jaya	15.59	21.15	Absent	1.36	Absent	Absent
12	JGL1798	13.85	21.89	Present(0.82)	1.58	Absent	Absent
13	Jyothi	14.65	19.84	Present(1.19)	1.35	Absent	Absent
14	KMP-128	12.74	21.15	Absent	1.68	Absent	Absent
15	KMP 153	15.82	19.61	Absent	2.50	Absent	Absent
16	KMP-175	13.86	22.08	Absent	1.59	Absent	Absent
17	KMP-200	8.62	18.73	Absent	2.17	Absent	Absent
18	KMP 201	13.79	19.45	Absent	1.41	Absent	Absent
19	KMR 3(R)	17.06	19.72	Absent	1.16	Absent	Absent
20	KRH 2(H)	11.65	18.34	Absent	1.57	Absent	Absent
21	KRH 4(H)	14.76	21.44	Absent	1.59	Absent	Absent
22	Mandya Sona-1	9.53	17.14	Present (1.32)	1.82	Absent	Absent
23	Mandya Sona-2	9.44	16.34	Present(1.32)	1.82	Absent	Absent
24	Mandya Sona-3	10.38	18.48	Present(1.29)	1.77	Absent	Absent
25	MAS 26	11.12	19.76	Present(1.43)	1.80	Absent	Absent
26	MAS 946-1	18.72	22.71	Present(1.24)	1.21	Absent	Absent
27	MSN 36	14.06	22.50	Absent	1.60	Absent	Absent
28	MTU 1001	12.80	20.96	Absent	1.65	Absent	Absent
29	MTU1010	13.89	20.38	Absent	1.47	Absent	Absent
30	Rajamudi	13.92	21.10	Present(1.03)	1.56	Absent	Absent
31	Raksha	10.50	17.21	Absent	1.63	Absent	Absent
32	Rasi	12.06	19.12	Present(0.85)	1.59	Absent	Absent
33	Ratna Choodi	13.04	19.64	Present (1.21)	1.50	Absent	Absent
34	Tella Hamsa	12.35	19.86	Absent	1.60	Absent	Absent
35	Thanu	14.07	18.15	Absent	1.29	Absent	Absent
36	Tunga	13.52	20.10	Absent	1.49	Absent	Absent
	Mean	**13.17**	**19.73**	-	**1.57**	-	-
	S.Em±	**0.021**	**0.647**	-	**0.378**	-	-
	CD (0.05P)	**0.084**	**3.834**	-	**1.59**	-	-
	CV (%)	**5.34**	**5.19**	-	**4.65**	-	-

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