

Studies on Performance of Coloured and White Rice Genotypes

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ABSTRACT

The present investigation was undertaken with 33 coloured and white rice genotypes to identify promising slender grain genotypes with high yield and good nutrition quality. The study involved seven red pericarp, eight black pericarp and 17 white rice genotypes, in addition to the check, BPT 5204. The results revealed black pericarp genotypes to be high yielding with high grain number per panicle and greater panicle length, compared to the red pericarp and white rice genotypes studied in the present investigation. The red pericarp genotypes were in general noticed to be relatively tall and early with greater test weight and high antioxidant activity, compared to the black pericarp and white rice genotypes. Further, the red pericarp genotypes, BPT 3178 and BPT 3111; black pericarp genotypes, BPT 2848, BPT 3165, BPT 2841 and BPT 3145; and the white rice genotypes, BPT 2615, BPT 2782 and MTU 1281 were identified to be promising, high yielding and nutritionally rich rice genotypes, compared to BPT 5204.

Keywords: Coloured Rice, Grain Yield, Mean performance and Nutritional Quality.

Rice (*Oryza sativa* L.) is one of the leading cereal crops of the world and is a staple food source for more than half of the world's population. Hence, the slogan, "Rice is Life" was raised. To further, acknowledge the importance of rice in alleviating poverty and malnutrition, the year 2004 was declared as "International Year of Rice" by the United Nations. The crop is a major source of food for about three million people worldwide and accounts for about 20 per cent of calorie consumption. In Asia, nearly two billion people depend on rice for their 60-70 per cent calories. Increased health consciousness among the rice consumers in the recent years has resulted in greater attention to rice genotypes containing higher levels of bioactive compounds, such as antioxidants. In this context, rice genotypes with red and black pericarp color containing high levels of antioxidants (Tian *et al.*, 2004) are in increasing demand. The present investigation is therefore, an attempt to identify slender grain colored rice genotypes, superior to BPT

5204, the popular rice variety, in terms of grain yield and nutritional quality, namely, total antioxidant activity.

MATERIAL AND METHODS

The experimental material consisted of 33 white and coloured rice genotypes obtained from Agricultural Research Station, Bapatla, Andhra Pradesh state in addition to collections from Telangana and Tamil Nadu states. Among the 33 genotypes, 15 genotypes were coloured, of which, seven were with red pericarp (Apputhokal, Asandi, BPT 3111, BPT 3139, BPT 3178, Chittiga and Hallabhatta) and eight genotypes were with black pericarp (BPT 2841, BPT 2842, BPT 3136, BPT 3140, BPT 3141, BPT 3145, BPT 3165 and Kakirekalu), while remaining 17 genotypes had brown pericarp and were white rice genotypes (ADT 49, BPT 2411, BPT 2507, BPT 2595, BPT 2615, BPT 2660, BPT 2766, BPT 2776, BPT 2782, BPT 2846, BPT 3173, JKRH 3333, PHI 17108, MTU 1281, US 301, WGL 14 and 27P63)

in addition to BPT 5204, a popular high yielding white rice genotype with excellent cooking quality traits, which was used as check variety in the present study.

All the 33 genotypes were sown at Agricultural College Farm, Bapatla during *“Kharif”* 2019 on separate raised nursery beds. All recommended package of practices were adopted to raise a healthy nursery and thirty days old seedlings were transplanted in the main field laid out in Randomized Complete Block Design (RCBD) with three replications. Each genotype was transplanted separately in 5 rows of 4.5 m length by adopting a spacing of 20 cm between rows and 15 cm between plants. All the recommended package of practices were adopted throughout the crop growth period and need based plant protection measures were taken up to raise a healthy crop. Observations were recorded on five randomly selected plants for grain yield per plant and the yield component traits, namely, plant height, panicle length and grains per panicle. However, days to 50 per cent flowering and maturity were recorded on plot basis. Observations for test weight and total antioxidant activity were obtained from a random grain sample drawn from each plot in each genotype and replication using standard procedures (Pathirana and Shahidi, 2005). The data collected was subjected to statistical procedures of RCBD analysis given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) for yield, yield components and quality characters studied in the present investigation is presented in Table 1. A perusal of the results revealed significant differences among the genotypes for all the characters studied, indicating the existence of sufficient variation among the genotypes studied.

Mean performance of the genotypes studied for yield, yield components and quality characters are presented in Table 2. Days to 50 per cent flowering in the present study was observed to range from 95 (Asandi) to 120 days (BPT 2660) with an overall mean of 110 days. Further, early flowering and maturity of the red (104 and 139 days, respectively) and black pericarp genotypes (109 and 143 days, respectively) was observed in the present study, compared to the white rice genotypes (112 and 144 days, respectively). The findings are in agreement with the reports of Sridevi (2018). In contrast, the red (122.24cm) and black pericarp (117.33cm) genotypes had recorded greater mean plant height, compared to the white rice genotypes (99.15cm). The red (24.18cm and 22.15g, respectively) and black (26.40cm and 18.63g, respectively) pericarp genotypes had also recorded greater panicle length and test weight, respectively, compared to the white rice (23.54cm and 16.53g, respectively) genotypes studied. Sridevi (2018) in her studies on coloured rice genotypes had also reported similar findings earlier. Further, the black pericarp genotypes had in general recorded greater number of grains per panicle (251), compared to the red pericarp (180) and white rice (213) genotypes.

Grain yield per plant in the present study was observed to range from 11.00g (BPT 2507) to 33.41g (Hallabhata) with an overall mean value of 21.91g, indicating high variability among the genotypes with respect to grain yield. The findings are in agreement with the reports of Rao (2019). Among the black pericarp genotypes, BPT 3141 (18.66g) recorded minimum grain yield per plant, while BPT 3165 recorded maximum grain yield per plant (29.33g). Grain yield per plant among the red pericarp genotypes was noticed to range from 16.00g (Chittiga) to 33.41g (Hallabhata); and from 11.00g (BPT 2507)

Table 1. Analysis of variance for yield, yield components and quality characters in rice

Source of variation	d.f.	Days to 50 per cent flowering	Days to maturity	Plant height	Panicle length	Grains per panicle	Test Weight	Grain yield per plant	Total Antioxidant activity
Mean sum of squares									
Replications	2	52.16	44.64	42.38	22.21	1898.27	0.63	9.11	47.27
Genotypes	32	133.54**	124.04**	768.50**	28.50**	12002.75**	37.48**	99.61**	2709.38**
Error	64	13.32	20.15	12.41	2.74	665.65	0.52	5.22	0.96

** Significant at 1 per cent level of probability

to 32.04g (BPT 2615) among the white rice genotypes. A perusal of the results also revealed significantly higher grain yield per plant, compared to the check, BPT 5204 (17.00g) for five red pericarp genotypes, namely, Apputhokal, Asandi, BPT 3111, BPT 3178 and Hallabhatta; six black pericarp genotypes, namely, BPT 2841, BPT 2848, BPT 3136, BPT 3145, BPT 3165 and Kakirekalu; and six white rice genotypes, namely, BPT 2615, BPT 2776, BPT 2782, BPT 3174, MTU 1281 and US 301. The red (23.64g) and black (24.16g) pericarp genotypes studied in the present investigation had in general recorded higher grain yield per plant, compared to the white rice genotypes (20.21g) studied in the present investigation. The findings are in conformity with the reports of Sridevi (2018).

In the present study, the white coloured genotype, BPT 2595, recorded minimum value for total antioxidant activity (25.68mg), while maximum value was manifested by the red coloured genotype, Apputhokal (109.73mg). Overall average value of the genotypes studied in the present investigation was 62.32mg. In general, the red (96.62mg) and black pericarp (90.63mg) genotypes had recorded higher total antioxidant activity, compared to white rice (36.38mg) genotypes. The findings are in conformity with the reports of Tian *et al.* (2004). Coloured rice was reported to have a health promoting potential due to its instantial antioxidant activity which inhibits

the formation or reduces the concentration of reactive cell damaging free radicals thus protecting the body tissues from oxidative damage. Among the red pericarp genotypes, Chittiga (76.25mg) recorded minimum total antioxidant activity, while Apputhokal recorded maximum total antioxidant activity (109.73mg). Among the black pericarp genotypes, total antioxidant activity was noticed to range from 74.39mg (BPT 3165) to 103.87mg (BPT 3141); and from 25.68mg (BPT 2595) to 47.07 per cent (BPT 3174) among the white rice genotypes. A perusal of the results revealed significantly greater total antioxidant activity, compared to the check, BPT 5204 (29.92mg) for all red and black pericarp genotypes studied; and eight white rice genotypes, namely, BPT 2660, BPT 2782, BPT 2846, BPT 3174, JKRH 3333, PHI 17108, MTU 1281 and 27 P 63. Raghuvanshi *et al.* (2017) also reported that red pericarp coloured rice genotypes showed excellent antioxidant properties which are in agreement with the present results. Veni *et al.* (2016), Pathak *et al.* (2017) and Chakuton *et al.* (2012) also reported that the pigmented rice was found to have highest total antioxidant activity than non pigmented rice.

The results revealed 23 genotypes to possess medium slender grain type, of which two were red pericarp genotypes (BPT 3111 and BPT 3139) and three black pericarp genotypes (BPT 2841, BPT 2848 and BPT 3145), while all the 18 white rice

Table 2. Mean performance of the genotypes studied for yield, yield components and quality characters in rice

S. No.	Genotypes	Days to 50 per cent flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Grains per panicle	Test weight (g)	Grain yield per plant (g)	Total Antioxidant Activity (mg AAE/100g)
Red pericarp genotypes									
1	Apputhokal	98	134	109.13	20.33	126	20	24.03	109.73
2	Asandi	95	131	144.33	21.66	108	26.75	23.38	95.49
3	BPT 3111	107	138	100.86	26.66	221	19.5	23.25	91.57
4	BPT 3139	118	152	113.33	28.16	290	18.36	18	101.41
5	BPT 3178	115	149	121.33	25.97	284	18.5	27.43	106.49
6	Chittiga	98	133	123.53	22.45	109	26.2	16	76.25
7	Hallabhatta	100	135	143.2	24.05	125	25.8	33.41	95.46
Minimum		95	131	100.86	20.33	108	18.36	16	76.25
Maximum		118	152	144.33	28.16	290	26.75	33.41	109.73
Mean		104	139	122.24	24.18	180	22.15	23.64	96.62
Black pericarp genotypes									
1	BPT 2841	105	135	105	23.24	234	13.9	24.97	96.58
2	BPT 2848	112	146	111.33	29.88	295	14.7	25	91.22
3	BPT 3136	111	146	104.46	28.11	205	19.9	28.93	77.9
4	BPT 3140	111	142	122.33	24.33	271	18.85	20.33	102.88
5	BPT 3141	117	152	114.66	27.16	244	18.5	18.66	103.87
6	BPT 3145	110	145	116.66	30.5	355	22.56	22.33	93
7	BPT 3165	109	144	148.53	26.2	268	16.8	29.33	74.39
8	Kakirekalu	96	131	115.73	21.81	133	23.9	23.8	85.22
Minimum		96	131	104.46	21.81	133	13.9	18.66	74.39
Maximum		117	152	148.53	30.5	355	23.9	29.33	103.87
Mean		109	143	117.33	26.4	250.62	18.63	24.16	90.63
White Rice genotypes									
1	ADT 49	103	137	102.93	23.4	176	13	19.66	32
2	BPT 2411	118	151	98.12	22.32	203	19.73	18.74	30.32
3	BPT 2507	109	144	82.46	28	149	12.75	11	35.75
4	BPT 2595	117	150	104.86	25.37	197	21.23	18	25.68
5	BPT 2615	107	139	95.8	22.32	210	16.56	32.04	33.21
6	BPT 2660	120	153	113.33	25.4	246	15.45	20.93	40.81
7	BPT 2766	116	149	105.06	25.57	305	14.7	20.83	32.32
8	BPT 2776	119	151	106.33	25.92	262	16	23	36.04
9	BPT 2782	113	144	113.33	24.72	271	15.5	28.5	39.3
10	BPT 2846	116	148	102.23	25.15	258	15.98	14.16	37.87
11	BPT 3173	110	142	100.66	25.22	258	17.43	28.69	47.07
12	BPT 5204	110	140	89.86	19.38	167	14.68	17	29.92
13	JKRH 3333	107	139	88	19.76	178	16.83	12	43.32
14	PHI 17108	109	139	93.73	20.38	195	15.35	20.33	45
15	MTU 1281	111	138	117.66	28	260	20.2	27.8	42
16	US 301	106	145	87.66	20.97	162	17.56	23.66	32.63
17	WGL 14	108	142	92.56	21.08	154	16.8	14.5	31
18	27 P 63	110	143	90.16	20.78	174	18.16	13	40.61
Minimum		103	137	82.46	19.38	149	12.75	11	25.68
Maximum		120	153	117.66	28	305	21.23	32.04	47.07
Mean		112	144	99.15	23.54	213	16.53	20.21	36.38
Overall Minimum		95	131	82.46	18.7	108	12.75	11	25.68
Overall Maximum		120	153	148.53	30.5	355	26.75	33.41	109.13
Overall Mean		110	144	108.46	24.14	228	18.35	21.91	62.32
SEM		2.1	2.59	2.59	0.95	14.89	0.42	1.32	2.29
C.D. (0.05)		5.95	7.32	5.47	2.7	42.08	1.18	3.72	6.47

Table 3. Details of the promising slender grain genotypes identified in the present study

S. No.	Genotypes	Grain yield per plant (g)	Per cent increase in yield over BPT 5204	Grain type	Duration	Total antioxidant activity (mg AAE/100g)
Red pericarp						
1	BPT 3178	27.43	61.35	LS	Mid-late	106.49
2	BPT 3111	23.25	36.76	MS	Medium	91.57
Black pericarp						
3	BPT 2841	24.97	46.88	MS	Medium	96.58
3	BPT 2848	25.00	47.05	MS	Mid-late	91.22
4	BPT 3145	22.33	31.35	MS	Mid-late	93.00
4	BPT 3165	29.33	72.52	LS	Mid-late	74.39
White pericarp						
7	BPT 2615	32.04	88.47	MS	Medium	33.21
8	BPT 2782	28.5	67.64	MS	Mid-late	39.30
9	BPT 2776	23.00	35.29	MS	Late	36.04
10	BPT 3173	28.69	68.76	MS	Mid-late	47.07
5	MTU 1281	27.8	63.52	MS	Medium	42.00
Check variety						
1	BPT 5204	17	–	MS	Mid-late	29.92
C.D (0.05)		3.72	–	–	7.32	6.47

genotypes studied belonged to the medium slender group. Further, four red pericarp (Apputhokal, Asandi, Chitiga and Hallabhata) and two black pericarp genotypes (BPT 3136 and BPT 3141) recorded medium bold grain type, while one red pericarp (BPT 3178) and two black pericarp genotypes (BPT 3140 and BPT 3165) had recorded long slender grain type. Only one black pericarp genotype (Kakirekhalu) had recorded long bold grain type in the present study.

In general, the black pericarp genotypes studied were observed to be high yielding with high grain number per panicle and greater panicle length, compared to the red pericarp and white rice genotypes studied in the present investigation. The red pericarp genotypes were in general noticed to be relatively tall and early with greater test weight and high antioxidant activity, compared to the black pericarp and white rice genotypes studied in the present investigation. The findings are in broad agreement with the reports of Sridevi (2018).

Details of the promising slender grain genotypes with more than 30 per cent higher grain yield, coupled with significantly higher levels of total antioxidant activity, compared to the check, BPT 5204 are presented in Table 3. The performance of these genotypes, as alternate to the popular rice variety, BPT 5204, needs to be evaluated across seasons and locations prior to their potential commercial exploitation as high yielding and nutritionally rich rice genotypes.

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