IDENTIFICATION AND CHARACTERIZATION OF HIGH YIELDING QUALITY TRADITIONAL AROMATIC NON- BASMATI RICE (*Oryza sativa* L.) VARIETIES UNDER ORGANIC FARMING CONDITION

Akhilesh Kumar Lakra, Shrikant Chitale and Pradeep Kumar Lakra

Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur (CG), India
**E-mail: akhilesh.igkv@gmail.com*

Abstracts: The present investigation was carried out at the Research cum Instructional Farm, IGKV, Raipur (C.G.) during *kharif* season of 2011. A Field experiment was laid out in randomized block design with 30 treatments.
The results revealed that among the varieties, Dubraj, Vasumati, Mahsuri, Indira Maheshwari and Mahamaya gave the higher grain yield and net profit and B:C ratio among all the varieties under organic farming condition. However, improved non-aromatic non- basmati type 'Indira Maheshwari' produced the maximum yield (46.90 q ha^{-1}). The lowest grain yield was produced by Jaldubi (32.84 qha^{-1}) an improved non-aromatic non- basmati type. The less variation was observed in grain yield of improved aromatic varieties.
Substantial variation was observed in the elongation ratio under the group of improved aromatic varieties with the highest in Gopal Bhog. The fine grain varieties have lower values of head rice recovery as compared to bold grain rice varieties irrespective of different groups**.** Rice variety 'Pusa Basmati' gave the highest amylose percent among different rice varieties.

Keywords*:* Organic Farming, Varieties, Rice

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the three major food crops of the world. Being grown worldwide, it is the staple food for more than one and a half of the world's population. India is the second largest producer of rice after China having an area of 37 million hectares with the production of 80.41 million tonnes (Anonymous, 2011). It occupies about 23% of the food grain production and 55 percent of cereal production and plays a very vital role in the national food security. It is a nutritious cereal crop, provides 20 per cent of the calories and 15 per cent of protein consumed by world's population. Besides, being the chief source of carbohydrate and protein, it also provides minerals and fibre. India also grows some of the finest quality aromatic rice.
Rice quality is considered from the viewpoint of milling quality, grain size, shape, appearance and cooking characteristics. Among different quality traits aroma is considered most important. Quality rice are characterized by not only aroma but several other traits like grain length and width, elongation after cooking, amylose content, gelatinization temperature etc. Consumer judges the quality of rice mostly on its appearance, particularly the colour, size and shape and on its elongation during cooking. On the other hand, millers and traders prefer a variety capable of giving high head rice recovery (Sharma, 2002).

MATERIAL AND METHOD

The research was carried out at the Research cum Instructional Farm, IGKV, Raipur (C.G.) during *kharif* season of 2011. Raipur is situated in mid-eastern part of Chhattisgarh state and lies at 21^0 16' North Latitude and 81^0 36' East Longitude with an altitude of 314.15 above the mean sea level. The soil of experimental field was '*Alfisols*' locally known as *Dorsa*. Mostly *Alfisols* are bunded and leveled and occur generally, on mid land situation of landscape in Chhattisgarh plains. It is deep and hence, has good water holding capacity. It was neutral in reaction, low in nitrogen, medium in available phosphorus and medium exchangeable potassium. The experiment was laid out in Randomized Block Design with 3 replications. The experimental material consists of 30 rice varieties of different rice groups namely the group of traditional aromatic-non basmati varieties; improved aromatic varieties; traditional non-aromatic basmati varieties; improved non-aromatic non basmati varieties and the group of improved non-aromatic varieties for *poha* and parboiled rice were tested in randomized block design with three replications. These treatments laid down under the organic farming condition. The experimental material consists of 30 rice varieties of different groups. These 30 varieties were taken as treatments. All 30 varieties were transplanted on July12, 2011 with a planting geometry of 20 X 10 cm and harvested on November 12 and 18, 2011. The crop received 1320 mm rainfall during the study period.

RESULT AND DISCUSSION

Dry matter accumulation (g $hill^{-1}$)

Dry matter accumulation is directly related with the growth pattern of the crop, which linearly influences the biological yield and increased with the advancement of crop age. The results on dry matter accumulation 60 DAT and at harvest revealed that both the rice groups and varieties produced significant variation on this parameter (Table 1). Rice plants accumulated on an average 40-45 percent up to 60 DAT and remaining at harvest. The increase

in dry matter due to increase in tillers, no. of leaves and plant height has also been reported by Agrawal (2000), Krishna *et al*.(2006) and Rao *et al*.(2006).

At 60 DAT under the group of traditional aromatic-non basmati type, the rice variety Vishnu Bhog produced significantly highest dry matter (18.85 g). Under improved aromatic varieties, Vasumati gave higher dry matter accumulation (18.67 g) at 60 DAT, respectively. The lowest dry matter accumulation was observed for Indira Sugandhit Dhan (14.66 g) and Pusa Basmati (26.35 g) respectively. Improved non-aromatic non- basmati type rice varieties IR-36 at 60 DAT gave significantly highest dry matter accumulation (19.57 g and 39.68 g). Mahamaya (18.46 g at 60 DAT) accumulated the highest dry matter under improved non-aromatic especially for *poha* and parboiled rice.

At harvest, among the group of traditional aromatic-non basmati type Dubraj gave significantly highest dry matter accumulation (36.49 g) which was at par with Vishnu Bhog and Bisni. The lowest dry matter was recorded for Gopal Bhog. Among the group of improved aromatic varieties, Vasumati registered significantly highest dry matter accumulator (33.05 g). While, the lowest dry matter was recorded for ISD-1. I. Maheshwari resulted in higher dry matter content (42.56 g) which was at par with Durgeshwari and Indira Sona under improved non-aromatic non-basmati type. In case of improved non-aromatic especially for *poha* and parboiled rice Mahamaya produced significantly highest dry matter accumulation (42.91g) and found at par with Rajeshwari and Kranti.

Yield attributes and yields

High yield is determined by physiological process leading to a high net accumulation of photosynthates and their partitioning (Miah *et al.*, 1996). The genotypes, which produced higher number of effective tillers m^{-2} and higher number of grains $panicle^{-1}$ also showed higher grain yield in rice (Kusutani *et al*., 2000; Dutta *et al*. 2002).The results revealed that among the varieties, Dubraj, Vasumati, Mahsuri, Indira Maheshwari and Mahamaya gave the higher grain yield and net profit and B:C ratio among all the varieties under organic farming condition. However, Indira Maheshwari produced significantly higher yield (46.90 q ha^{-1}) over all the varieties except Indira Sona (45.13 q ha^{-1}), Durgeshwari (46.78 q ha^{-1}) of same group *i.e.* improved non-aromatic non- basmati type. Mahamaya (46.40 q ha^{-1}) followed by Rajeshwari (46.12 q ha^{-1}) of improved non-aromatic especially for *poha* and parboiled rice group have also produced comparable grain yield. In group of traditional aromatic-non basmati type, Dubraj (39.01 q ha^{-1}) gave highest grain yield followed by Vishnu Bhog (38.30 q ha^{-1}) and Bisni (36.48 q ha^{-1}). Improved aromatic varieties showed less variation in grain yield and in order of merit Vasumati stood first (37.64 q ha^{-1}) followed by Kasturi (35.86 q ha^{-1}) and Pusa Basmati (35.57 q ha^{-1}). Grain yield differences due to the varieties were also reported by Wu *et al.*, (1998).

Table 1: Plant dry matter accumulation (g $hill^{-1}$), No. of Effective tillers m^{-2} at harvest, No. of spikelets $panicle^{-1}$ and Sterility percent of different varieties of rice under organic nutrient supply

Group/Varieties	Dry matter accumulation (g $hill^{-1}$)		No. of Effective tillers m^{-2} at harvest	No. of spikelets $panicle^{-1}$	Sterility percent
	60 DAT	At Harvest			
Traditional aromatic-non basmati type					
Dubraj	15.11	36.49	281	174	16.52
Gopal Bhog	18.00	25.68	246	144	15.26
Badshah Bhog	15.17	31.39	253	153	17.67
Jeeraphool	16.25	30.62	268	171	17.69
Bisni	17.10	35.63	285	174	17.27
Shyama Jeera	14.87	31.28	253	168	17.24
Vishnu Bhog	18.85	36.00	264	172	18.17
Improved Aromatic varieties					
ISD-1	14.66	30.01	258	168	13.69
Pusa Basmati	15.38	31.56	290	164	14.00
Kasturi	18.06	32.74	237	146	17.12
Vasumati	18.67	33.05	264	158	14.97
Traditional Non-aromatic basmati type					
Safri	19.81	33.70	242	169	15.76
Mahsuri	16.42	37.64	275	168	17.08
Jalddubi	17.28	30.68	234	158	19.22
Improved Non-aromatic non- basmati type					
MTU-1010	15.02	36.14	307	157	13.94

IR-64	17.00	37.39	300	163	17.72
Durgeshwari	18.61	42.10	290	161	15.23
Karma Mahsuri	13.81	38.74	296	147	13.28
Chandrahasini	15.32	37.16	294	157	14.27
I.B.D.-1	16.70	30.00	254	150	14.71
PKV-HMT	16.94	32.20	256	160	16.09
Swarna	16.91	30.69	263	171	18.06
Samleshwari	15.38	29.01	251	169	17.54
Indira Sona	17.89	41.68	302	184	14.41
IR-36	19.57	39.99	298	157	16.13
Indira Maheshwari	17.03	42.56	294	163	17.70
Improved Non-aromatic especially for Poha and Parboiled rice					
Mahamaya	18.46	42.91	311	180	16.65
Kranti	17.30	41.36	301	161	18.48
Rajeshwari	16.68	42.53	306	171	17.94
Bamleshwari	16.78	38.34	270	163	17.84
SEm ±	0.43	0.67	6	3	0.76
CD (P=0.05)	1.21	1.90	16	8	2.16

Table 2: Yield attributes, grain and straw yield of different rice varieties under organic nutrient supply

Group/Varieties	**Test weight (g)**	**Grain yield (q ha^{1})**	**Straw yield (q ha^{-1})**	**Harvest index (%)**
Traditional aromatic-non basmati type				
Dubraj	21.27	39.01	76.33	33.81
Gopal Bhog	16.66	27.05	53.04	33.73
Badshah Bhog	16.72	34.12	58.01	37.02
Jeeraphool	16.07	32.35	64.20	33.48
Bisni	17.07	36.48	69.26	34.46
Shyama Jeera	17.25	32.58	62.59	34.21
Vishnu Bhog	15.26	38.30	71.42	34.91
Improved aromatic varieties				
ISD- 1	23.07	34.53	65.15	34.48
Pusa Basmati	21.50	35.57	63.16	36.04
Kasturi	22.75	35.86	62.29	36.63
Vasumati	25.40	37.64	63.28	37.27
Traditional non-aromatic basmati type				
Safri	23.15	36.57	68.76	34.70
Mahsuri	21.02	40.79	77.88	34.37
Jaldubi	21.22	32.84	55.13	37.33
Improved non-aromatic non- basmati type				
MTU-1010	25.52	40.76	57.61	41.38
IR-64	26.20	41.51	57.50	41.89
Durgeshwari	29.84	46.78	67.61	40.88
Karma Mahsuri	22.35	42.61	61.06	41.08
Chandrahasini	23.00	41.11	60.47	40.45
I.B.D.-1	24.21	33.67	51.02	39.74
PKV-HMT	19.98	36.96	52.32	41.40
Swarna	21.00	35.83	51.30	41.12
Samleshwari	22.40	33.82	51.23	39.75
Indira Sona	25.60	45.13	65.48	40.82
IR-36	24.01	44.75	62.13	41.85
Indira Maheshwari	29.40	46.90	61.25	43.35
Improved non-aromatic especially for poha and parboiled rice				
Mahamaya	27.84	46.40	63.15	42.34
Kranti	28.37	45.31	61.25	42.51

Rajeshwari	29.40	46.12	60.70	43.14
Bamleshwari	28.06	41.55	60.08	40.83
SEm ±	0.54	1.7	1.90	0.76
CD (P=0.05)	1.52	4.7	5.37	2.16
CV (%)		8.53		

Final number of tillers in terms of effective tillers at harvesting is a vital determinant of grain yield. Irrespective of different rice groups, significantly highest effective tillers m^{-2} was recorded in the variety Mahamaya (311). However IR-36(298), Karma Mahsuri (296), IR 64 (300), MTU 1010 (307), Rajeshwari (306), and Indira Sona (302) was found at par with that of Mahamaya. While, the lowest effective tillers (234) were counted for Jaldubi (Table 1). And the sterility percentage was found to be higher for those rice varieties which were high yielding and improved one under the group of improved non-aromatic non- basmati type and improved non-aromatic especially for *poha* and parboiled rice than the group of traditional aromatic-non basmati type and improved aromatic varieties, except IBD-1which registered lower sterility (14.71%). The test weight were recorded Durgeshwari (29.40g) highest in all group but straw yield were observed highest in Mahsuri (77.88 q ha^{-1}) variety and highest harvest index were recorded in variety IR-64 (41.89 %) among all group of rice varieties.

Quality characters

Rice is only one cereal that is consumed mainly as whole milled and boiled grain. Some of the quality characteristics desire by grower, miller and consumer may be the same but each of them may have different emphasis on various quality parameters. For example, millers wish high percent head recovery on milling. Consumers want quality on the grain appearance, size and shape of the grain and the test, tenderness and flavour after cooking (Cruz and Khush, 2000).

Milled rice L: B ratio, hulling (%), Milling (%) and Head rice recovery (%)

Higher values of L: B ratio of milled rice was ranged from 3.1 to 4.0 for different rice varieties. 12 rice varieties classified as slender type having more than 3.0 L: B ratio, 16 varieties were found as medium sized having 2.12 to 3.0 L: B ratio and only two classified as bold having 1.1 to 2.0 L: B ratio.

Hulling (%) ranged from 72.90 to 80.92% for different rice groups, irrespective of the varieties. The hulling percentage is one of the genetically governed characters of rice varieties (Richharia and Govindswamy, 1962). Higher hulling percent with high variation (ranged from 74.52 to 80.92%) was recorded under improved non aromatic non basmati type rice varieties. However, lower values of hulling percent with less deviation among the varieties (72.90 to 77.15%) were witnessed with traditional aromatic non basmati type group.

Milling percent ranged from minimum (57.72%) in Pusa Basmati to as high as 75.70% in Indira Sona belonged to the group of improved aromatic varieties and improved non-aromatic non- basmati type rice respectively. Improved varieties either non aromatic non basmati type or non-aromatic especially for *poha* and parboiled rice also had higher range from 66.47 to 75.70%. The highest milling percentage was recorded in Gopal Bhog (72.23%), Vasumati (70.59%), Mahsuri (71.20%), Indira Sona (75.70%) and Mahamaya (72.15%) came from different rice groups namely traditional aromatic non basmati type, improved aromatic varieties, traditional non-aromatic basmati type, improved non aromatic non basmati type and improved non-aromatic especially for *poha* and parboiled rice respectively.

Head rice recovery was ranged from 44.20 to 69.08% amongst different rice varieties taken under study. Among traditional aromatic-non basmati type rice, Gopal Bhog gave significantly the highest head rice recovery (69.08%) to rest of the varieties. The rice variety Pusa basmati had the lowest head rice recovery (44.20%) to rest of the varieties. Under improved non-aromatic non-basmati type rice, Samleshwari (65.83%) recorded the highest head rice recovery as compared to other varieties.

Table 3: Milled rice dimension and quality characters of different rice varieties under organic nutrient supply

Group/Varieties	Milled rice L:B ratio (mm)	Hulling (%)	Milling (%)	Head rice recovery (%)	Alkali Spreading value(GT)	Amylose (%)	Elongation ratio
Traditional aromatic-non basmati type							
Dubraj	2.8	72.90	62.80	57.30	6.50	23.19	1.80
Gopal Bhog	3.2	75.41	72.23	69.08	6.00	19.20	2.00
Badshah Bhog	3.3	75.15	65.05	67.21	3.50	20.11	1.90
Jeeraphool	2.5	76.10	70.58	58.59	6.00	18.40	1.73
Bisni	1.6	74.88	67.73	48.64	4.85	21.07	1.82

Shyama Jeera	2.4	77.15	72.19	62.03	4.00	23.23	1.88
Vishnu Bhog	2.4	76.16	71.66	58.10	6.12	18.26	1.85
Improved aromatic varieties							
ISD-1	3.1	75.25	63.50	47.25	6.50	21.63	1.22
Pusa Basmati	4.0	76.30	57.72	44.20	5.81	26.19	1.93
Kasturi	3.9	79.04	70.59	53.46	2.33	23.19	2.17
Vasumati	4.0	76.45	69.00	52.45	4.35	18.13	1.75
Traditional non-aromatic basmati type							
Safari	3.5	76.54	67.42	46.51	4.33	23.36	2.52
Mahsuri	2.8	79.78	71.20	47.13	4.15	25.32	1.85
Jaldubi	2.6	74.31	67.50	58.13	6.86	20.75	1.80
Improved non-aromatic non- basmati type							
MTU-1010	2.9	74.52	67.96	49.44	3.00	21.35	2.13
IR-64	3.0	80.15	74.17	60.16	4.33	22.24	1.99
Durgeshwari	2.8	75.96	69.23	55.05	4.00	24.24	2.14
Karma Mahsuri	3.2	80.00	75.53	50.00	4.00	20.22	1.97
Chandrahasini	3.5	80.58	74.01	61.80	5.50	23.16	2.02
I.B.D.-1	2.7	77.70	71.26	64.31	3.00	24.30	2.11
PKV-HMT	3.4	75.05	70.00	49.76	3.15	23.76	2.67
Swarna	2.5	80.39	73.01	62.95	4.16	24.78	1.54
Samleshwari	2.8	80.92	72.81	65.43	4.83	23.16	1.93
Indira Sona	3.3	80.29	75.70	55.00	6.00	20.42	1.88
IR-36	2.6	75.14	67.56	54.22	3.33	20.60	1.70
Indira Maheshwari	2.7	75.07	66.47	52.23	4.60	24.30	1.76
Improved non-aromatic especially for poha and parboiled rice							
Mahamaya	2.6	80.34	72.15	52.34	5.83	23.16	1.74
Kranti	1.8	79.00	70.84	50.74	4.00	20.32	1.81
Rajeshwari	2.7	77.68	66.34	54.00	3.35	24.44	1.85
Bamleshwari	2.3	76.94	69.95	49.70	6.67	23.16	1.73
SEm ±	0.3	0.48	0.45	0.39	0.46	0.34	0.10
CD (P=0.05)	0.7	1.37	1.28	1.09	1.29	0.95	0.28

Alkali spreading value (GT), Amylose (%) and Elongation ratio

Alkali spreading value ranged from 2.33 to 6.86. Some of the varieties got even double alkali spreading value than the other varieties of their respective group. In group of improved aromatic varieties, Indira Sugandhit Dhan-1 determined the significantly highest alkali spreading value of 6.50 which was more than double to Kasturi (2.33). In traditional non-aromatic basmati type, the highest alkali spreading value (6.86) was recorded for Jaldubi. Indira Sona (6.0) and Bamleshwari (6.67) showed the highest alkali spreading values as compared to all other varieties in their respective groups under improved non-aromatic non- basmati type and improved non-aromatic especially for *poha* and parboiled rice respectively.

Among the different group of rice varieties, overall highest amylose percent was determined for Pusa basmati (26.19%) of improved aromatic varieties. The lowest amylose percentage (18.13%) was also recorded for Vasumati in same groups. Out of 30 rice varieties, 4 varieties fall under low (10 -19%), 24 varieties under intermediate (20-25%) and 2 varieties found under high (>25%) group.

The elongation ratio ranged from 1.20 to 2.60 irrespective of the varieties. Gopal Bhog gave the highest elongation ratio (2.0). Kasturi recorded the higher (2.17) while, the lowest (1.22) was estimated in Indira Sugandhit Dhan-1.

CONCLUSION

Yield was significantly affected by different group of rice varieties. High yielding fertilizer responsive varieties did not performed up to the mark due to sub optimal fertility level *i.e.* 50:50:30 kg $N:P_2O_5:K_2O$ ha^{-1} under organic nutrient supply system as used in the present study. This fertility level failed to fulfill the higher nutrient demand of improved high yielding varieties resulted in lesser number of tillers and grains $panicles^{-1}$ and ultimately lower yield. On the other hand, lesser nutrient requiring traditional aromatic and non aromatic varieties sustained their yield potential and even out performed to those of improved aromatic & non aromatic varieties of same group. The main purpose of this experiment was identifying the suitable varieties under organic farming.

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