

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON QUALITY OF RICE VARIETIES UNDER NORTH HILL ZONE OF CHHATTISGARH

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Abstract: The experiment was conducted during *kharif* 2018 at Research-cum-instructional farm of Raj Mohini Devi College of Agriculture and Research Station, Ajirma, Ambikapur, Chhattisgarh to study the “Response of quality rice varieties to integrated nutrient management practices under North Hill Zone of Chhattisgarh”. The experiment was conducted in split plot design with three replications. The study comprised 05 rice varieties (V_1 : Trombay CG dubraj mutant-1, V_2 : Tarunbhog mutant-1, V_3 : Safri 17-48-2, V_4 : Trombay Raipur rice and V_5 : Zinco rice) as main plot and 05 management practices { P_1 : 20×10 cm spacing + 100% RDF (80:50:30 kg NPK ha⁻¹) through inorganic (standard check), P_2 : 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}, P_3 : 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}, P_4 : 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} and P_5 : 20×10 cm spacing + 150% RDF through inorganic}. The results revealed that variety Safri 17-48-2 recorded higher value in paddy length (9.39 mm), L:B ratio (3.72), kernel length (7.49 mm before cooking and 12.69 mm after cooking), hulling (72.99) and milling percentage (68.14) but in case of kernel breadth recorded highest in variety Zinco rice before cooking and Tarunbhog mutant-1 after cooking. Among the different management practices 20×10 cm spacing + 150% RDF through inorganic + organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} resulted higher hulling (71.52), milling (66.27) and head rice recovery (50.90) percentage followed by treatment of 20×10 cm spacing + 150% RDF through inorganic and rest of the quality parameters not affected significantly.

Keywords: Aromatic rice, Chhattisgarh, Nutrient, Zinc

INTRODUCTION

Aromatic rice constitutes a small but an important and special sub-group of rice, aromatic varieties of rice are very much popular due to their aroma, grain dimension, cooking qualities and palatability among the users. The area under scented rice varieties is increasing day by day with the opening of the world market as well as increased domestic consumption due to their premium quality (Singh *et al.*, 2008). Scented rice is rated best in quality and fetches much higher price than high quality non-aromatic rice in international market. Nearly 50-70 per cent of the Basmati rice produced in India and Pakistan are exported which contributes 10% of world trade. Other quality aspect like zinc, it is involved in more bodily functions than any other mineral, and is thus essential for survival. Zinc deficiency causes stunting and has serious consequences for health, particularly during childhood when zinc requirement are highest. The India's first zinc rich rice variety “Chhattisgarh zinc rice-1” developed at Indira Gandhi Agriculture University, Raipur (C.G.).

High yielding aromatic/scented rice variety require enormous quantity of nutrients for obtaining optimum yield. Under such circumstances, the use of vermicompost and fertilizers with integrated in proper proportions appears to be the right practice of plant-nutrition (Barik *et al.*, 2004). The integrated

use of nutrient not only improved the yield and quality of aromatic/scented rice but also reduced the cost of chemical fertilizer by 25 per cent and improved soil health (Saha *et al.*, 2007). It is therefore important to obtained high yield from scented rice varieties, with maintaining its quality too.

MATERIALS AND METHODS

The experiment was conducted during *kharif* 2018 at Research-cum-instructional farm of Raj Mohini Devi College of Agriculture and Research Station, Ajirma, Ambikapur, Chhattisgarh. Geographically, Ambikapur is situated in the north of Chhattisgarh. The climate of surguja region is of sub-humid with hot and dry summer and cold winter. The average annual rainfall is about 1356 mm. The soil of experimental field was “*Inceptisols*”, slightly acidic in nature and medium in fertility status having low N, medium P₂O₅ and high K₂O.

The experiment was laid out in Split Plot Design with three replications having five different varieties as main plot and five management practices as sub plot treatments. The varieties were (V_1) Trombay CG dubraj mutant-1 (Scented dwarf), (V_2) Tarunbhog mutant-1 (Scented dwarf), (V_3) Safri 17-48-2 (Non scented dwarf), (V_4) Trombay Raipur rice (Non scented dwarf) and (V_5) Zinco rice (Zinc rice dwarf) and management practices were (P_1) 20 × 10 cm

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spacing + 100% RDF (80:50:30 kg NPK ha⁻¹) through inorganic (standard check), (P₂) 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}, (P₃) 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}, (P₄) 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} and (P₅) 20×10 cm spacing + 150% RDF.

The fertilizers were applied as per the treatments. The N, P and K were applied through Urea, SSP, MOP, DAP and Vermi-compost. The whole amount of K was applied at the time of transplanting as a basal dose by MOP. Whereas, N and P were applied as a basal and top dressing by Urea and Vermicompost @ 2 q/ha + DAP @ 25 kg/ha in treatments viz. P₂, P₃ and P₄ and treatments P₁ and P₅ whole amount of P, K and 50% N were applied at the time of transplanting as a basal and remaining 50% N was applied in two split with 30 interval after transplanting. Quality characters viz. Length and breadth of paddy and kernel were measured with the help of measuring scale and other characters viz. L:B ratio, elongation ratio, hulling %, milling % and head rice recovery % were obtained by following process:

Paddy length: breadth ratio

It was calculated by the formula:- Paddy length : breadth ratio = $\frac{\text{Length of paddy}}{\text{Breadth of paddy}}$

Brown rice length: breadth ratio

It was calculated by the formula:- Brown rice length : breadth ratio = $\frac{\text{Length of brown rice}}{\text{Breadth of brown rice}}$

Kernel length: breadth ratio after cooking

It was calculated by the formula:- Kernel length : breadth ratio = $\frac{\text{Length of kernel}}{\text{Breadth of kernel}}$

Elongation ratio (ER)

This was calculated by the formula:- Elongation ratio = $\frac{\text{Length of cooked kernel (mm)}}{\text{Length of raw kernel rice (mm)}}$

Hulling (%) : Rice samples were cleaned and then 100 g of grain sample was shelled with the Satake Sheller. The samples were hulled and weights of de-hulled grains were recorded. The formula is as follows:

$$\text{Hulling \%} = \frac{\text{Weight of the de-husked kernel}}{\text{Weight of paddy}} \times 100$$

Milling (%) : The hulled samples were milled and weight of milled grains was recorded. The formula is as follows:

$$\text{Milling \%} = \frac{\text{Weight of polished kernel}}{\text{Weight of paddy}} \times 100$$

Head rice recovery (%) : "Head rice" or head rice percentage is the weight of head grain or whole kernels in the rice lot. Head rice normally includes broken kernels that are 75-80% of the whole kernel.

The paddy was hulled and milled with a satake huller and miller. The weight of whole grains was recorded. Compute head rice recovery by following formula:

$$\text{Head rice Recovery \%} = \frac{\text{Weight of whole grains}}{\text{Weight of paddy samples}} \times 100$$

RESULTS AND DISCUSSION

Paddy length (mm), breadth (mm) and L:B ratio :

Paddy length, breadth and L:B ratio were affected significantly by different varieties (Table 1). Significantly longest paddy (9.39 mm) was recorded in variety Safri-17-48-2 and shortest paddy (6.09 mm) was recorded in variety Tarunbhog mutant-1. In case of paddy breadth significantly highest (2.82 mm) was recorded in variety Zinco Rice and lowest (2.23 mm) was recorded in variety Trombay CG dubraj mutant-1. Highest L: B ratio (3.72) was obtained in variety Safri-17-48-2 which was at par with Trombay CG dubraj mutant-1 (3.65) and the lowest L:B ratio (3.08) was recorded in Zinco Rice.

Paddy length, breadth and L: B ratio were affected non significantly by different management practices. Longest paddy (8.16 mm) was recorded in 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} and shortest paddy (8.03 mm) was recorded in 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}. Highest breadth (2.49 mm) was recorded in 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} and lowest (2.41 mm) was recorded in 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}. In case of L: B ratio highest (3.36) was recorded in 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} whereas lowest L:B ratio (3.27) was recorded in 15×10 cm spacing + 150% RDF through inorganic and organic.

Brown rice length (mm), breadth (mm) and L:B ratio :

Brown rice length, breadth and L:B ratio were affected significantly by different varieties (Table 2). Significantly longest brown rice (7.49 mm) and highest L:B ratio (3.42) were obtained in variety Safri-17-48-2 and shortest brown rice (4.66 mm) and lowest L:B ratio (2.14) were obtained in variety Tarunbhog mutant-1 whereas highest brown rice breadth (2.20 mm) was obtained in variety Zinco Rice which was at par with variety Safri-17-48-2 (2.19 mm) and Tarunbhog mutant-1 (2.18 mm).

Brown rice length, breadth and L: B ratio was affected none significantly by different management practices. Longest brown rice length (6.18 mm) and highest breadth (2.12 mm) were recorded in 20×10 cm spacing + 150% RDF through inorganic and organic and highest L:B ratio (2.94) was recorded in 15×10 cm spacing + 150% RDF through inorganic and organic.

The quality components viz., protein content, hulling/milling per cent, kernel length, KLAC of rice was maximum and a minimum value varies due to the varietal characters (Mishra *et al.*, 2015). Similar finding of different rice varieties shows different quality parameters at the same site is also reported by Gautam *et al.* (2005).

Kernel length (mm), breadth (mm) and L:B ratio after cooking : Kernel length, breadth and L: B ratio were affected significantly by different varieties (Table 3). Significantly highest kernel length (12.69 mm) was recorded in variety Safri-17-48-2 and shortest kernel length (7.91 mm) was recorded in Tarunbhog mutant-1. Highest kernel breadth (2.87 mm) was recorded in Tarunbhog mutant-1 which was at par with varieties Zinco Rice (2.85) and Safri-17-48-2 (2.84 mm) and significantly highest L:B ratio (4.81) was recorded in Trombay Raipur Rice-106 than rest of the varieties.

Kernel length, breadth and L: B ratio were affected non significantly by different management practices. Highest kernel length and breadth (10.22 mm and 2.74 mm) were obtained in 20×10 cm spacing + 150% RDF through inorganic and organic whereas lowest kernel length and breadth (10.10 mm and 2.70 mm) was recorded in 20×10 cm spacing + 100% RDF through inorganic. In case of L:B ratio highest (3.78) was recorded in 15×10 cm spacing + 150% RDF through inorganic and organic and lowest (3.73) with 20×10 cm spacing + 150% RDF through inorganic.

Elongation ratio: Elongation ratio was affected significantly by different varieties (Table 4). Significantly highest elongation ratio (1.79) was recorded in variety Trombay Raipur Rice-106 and lowest (1.53) was in Zinco Rice.

In different management practices were not affected significantly on elongation ratio. Highest elongation ratio (1.66) was obtained in 15×10 cm spacing + 150% RDF through inorganic and organic and lowest (1.64) was in 20×10 cm spacing + 100% RDF through inorganic and organic.

Hulling %: Hulling percentage was affected significantly by different varieties (Table 4). Highest hulling percentage (72.99) was recorded in variety Safri-17-48-2 which was at par with varieties Tarunbhog mutant-1 (72.99) and Trombay CG dubraj mutant-1 (72.91).

Hulling percentage was affected significantly by different management practices. Highest hulling percentage (71.52) was recorded under 20×10 cm spacing + 150% RDF through inorganic and organic which was at par with 20×10 cm spacing + 100% RDF through inorganic (71.44) and 20×10 cm spacing + 150% RDF (70.65).

Milling %: Milling percentage was affected significantly by different varieties (Table 4). Highest milling percentage (68.14) was recorded in variety Safri-17-48-2 which was at par with varieties Tarunbhog mutant-1 (67.23) and Trombay CG dubraj mutant-1 (67.14).

Milling percentage was affected significantly by different management practices. Highest milling percentage (66.27) was recorded under 20×10 cm spacing + 150% RDF through inorganic and organic which was at par with 20×10 cm spacing + 100% RDF through inorganic (65.50) and 20×10 cm spacing + 150% RDF (64.82).

Head rice recovery %: Head rice recovery percentage was affected significantly by different varieties (Table 4). Significantly highest head rice recovery percentage (56.83) was recorded in variety Tarunbhog mutant-1 whereas lowest head rice recovery % (42.95) was recorded in variety Trombay Raipur Rice-106.

Head rice recovery percentage was affected significantly by different management practices. Significantly highest (50.90) was recorded under 20×10 cm spacing + 150% RDF through inorganic and organic.

Table 1. Effect of different management practices and quality rice varieties on paddy length, paddy breadth and paddy L:B ratio

Treatments	Paddy length (mm)	Paddy breadth (mm)	L:B ratio
Main plot :- Varieties			
V ₁ - Trombay CG dubraj mutant-1 : Scented dwarf	8.10	2.23	3.65
V ₂ - Tarunbhog mutant-1: Scented dwarf	6.09	2.32	2.63
V ₃ - Safri-17-48-2 : Non-scented dwarf	9.39	2.53	3.72
V ₄ - Trombay Raipur Rice-106 : Non-scented dwarf	8.18	2.33	3.51
V ₅ - Zinco Rice : Zinc rice dwarf	8.69	2.82	3.08
SEm ±	0.08	0.02	0.06
CD (at 5%)	0.26	0.07	0.19
Sub plot :- Management practices			
P ₁ :- 20×10 cm spacing + 100% RDF through inorganic (standard check).	8.07	2.42	3.35
P ₂ :- 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK	8.08	2.41	3.36

through inorganic}.			
P₃ :- 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	8.16	2.49	3.33
P₄ :- 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	8.03	2.45	3.27
P₅ :- 20×10 cm spacing + 150% RDF.	8.12	2.45	3.29
SEm±	0.05	0.02	0.04
CD (at 5%)	N.S.	N.S.	N.S.

Table 2. Effect of different management practices and quality rice varieties on brown rice length, breadth and L:B ratio

Treatments	Brown rice		
	Length (mm)	Breadth (mm)	L:B ratio
Main plot :- Varieties			
V₁ - Trombay CG dubraj mutant-1 : Scented dwarf	5.91	1.91	3.09
V₂ - Tarunbhog mutant-1: Scented dwarf	4.66	2.18	2.14
V₃ - Safri-17-48-2 : Non-scented dwarf	7.49	2.19	3.42
V₄ - Trombay Raipur Rice-106 : Non-scented dwarf	6.45	2.06	3.13
V₅ - Zinco Rice : Zinc rice dwarf	6.25	2.20	2.85
SEm	0.03	0.01	0.02
CD (5%)	0.10	0.03	0.07
Sub plot :- Management practices			
P₁ :- 20×10 cm spacing + 100% RDF through inorganic (standard check).	6.13	2.10	2.92
P₂ :- 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	6.15	2.10	2.93
P₃ :- 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	6.18	2.12	2.93
P₄ :- 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	6.14	2.10	2.94
P₅ :- 20×10 cm spacing + 150% RDF.	6.16	2.11	2.92
SEm	0.02	0.01	0.02
CD (5%)	N.S.	N.S.	N.S.

Table 3. Effect of different management practices and quality rice varieties on kernel length, breadth and L:B ratio

Treatments	Kernel after cooking		
	Length (mm)	Breadth (mm)	L:B ratio
Main plot :- Varieties (5)			
V₁ - Trombay CG dubraj mutant-1 : Scented dwarf	9.05	2.63	3.45
V₂ - Tarunbhog mutant-1: Scented dwarf	7.91	2.87	2.76
V₃ - Safri-17-48-2 : Non-scented dwarf	12.69	2.84	4.47
V₄ - Trombay Raipur Rice-106 : Non-scented dwarf	11.55	2.41	4.81
V₅ - Zinco Rice : Zinc rice dwarf	9.55	2.85	3.36
SEm	0.06	0.03	0.05
CD (5%)	0.20	0.08	0.15
Sub plot :- Management practices (5)			
P₁ :- 20×10 cm spacing + 100% RDF through inorganic (standard check).	10.10	2.70	3.75
P₂ :- 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	10.11	2.71	3.74

P₃ :- 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	10.22	2.74	3.73
P₄ :- 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	10.16	2.72	3.78
P₅ :- 20×10 cm spacing + 150% RDF.	10.17	2.73	3.73
SEm	0.07	0.03	0.06
CD (5%)	N.S.	N.S.	N.S.

Table 4. Effect of different management practices and quality rice varieties on elongation ratio, hulling%, milling% and head rice recovery%

Treatments	Elongation ratio	Hulling (%)	Milling (%)	Head rice recovery (%)
Main plot :-Varieties				
V₁ - Trombay CG dubraj mutant-1 : Scented dwarf	1.53	72.91	67.14	48.20
V₂ - Tarunbhog mutant-1: Scented dwarf	1.70	72.99	67.23	56.83
V₃ - Safri-17-48-2 : Non-scented dwarf	1.69	72.99	68.14	52.20
V₄ - Trombay Raipur Rice-106 : Non-scented dwarf	1.79	60.90	54.92	42.95
V₅ - Zinco Rice : Zinc rice dwarf	1.53	69.18	63.88	44.15
SEm ±	0.01	0.23	0.33	0.27
CD (at 5%)	0.04	0.75	1.07	0.88
Sub plot :- Management practices				
P₁ :- 20×10 cm spacing + 100% RDF through inorganic (standard check).	1.64	67.77	62.38	48.34
P₂ :- 20×10 cm spacing + 100% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	1.65	71.44	65.50	48.97
P₃ :- 20×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	1.66	71.52	66.27	50.90
P₄ :- 15×10 cm spacing + 150% RDF through inorganic and organic {Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic}.	1.65	67.58	62.34	48.40
P₅ :- 20×10 cm spacing + 150% RDF.	0.01	70.65	64.82	47.72
SEm±	N.S.	0.59	0.57	0.49
CD (at 5%)		1.69	1.64	1.41

CONCLUSIONS

In quality characters Safri 17-48-2 recorded higher value in paddy length, L:B ratio, kernel length (before and after cooking), hulling and milling percentage. In case of management practices treatment 20×10 cm spacing + 150% RDF through inorganic + organic{Topdressing of (Vermicompost @ 2q/ha + DAP @ 25 kg/ha) at 25-30 DAT and remaining NPK through inorganic} was recorded highest hulling, milling and head rice recovery percentage and not affected rest of the quality parameters.

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