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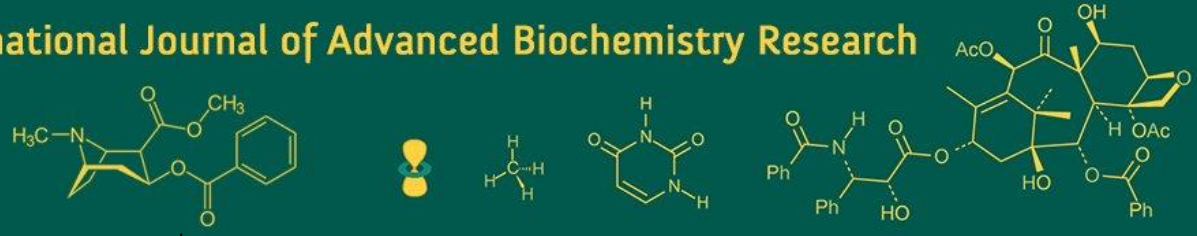

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Performance of aromatic paddy varieties seed production under organic and inorganic systems in Chhattisgarh plains

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Abstract
The experiment was carried out at AICRP on Seed (Crops), IGKV, Raipur during Kharif Season 2023. The experiment consist of three aromatic rice varieties viz. Dubraj Selection 1, Badshabhog Selection 1 and Vishnubhog Selection 1. The field was layout in Randomised Block design with three replications having three treatments *viz.* ., N_1: Control (No fertilizer and manure), N_2: State recommended dose of N:P:K 60:40:20 kg/ha (Through inorganic fertilizers), N_3: State recommended dose of N:P:K 60:40:20 kg/ha through FYM + *Azospirillum* + 10 kg PSB per ha + 10 kg KSB per ha. The seed yield and seed quality parameters were studied which reveals that the performance of V_3 (Vishnubhog Selection-1) exhibited higher seed yield per plant (4.68 g), seed yield (26.12 q ha^{-1}) with high seed recovery (83.33%), and high germination (88.50%) and C: B ratio (1:1.75) with high Net Monetory returns (30543.08 INR). Likewise, Nutrient management N_3: State recommended dose of N: P: K 60:40:20 kg/ha through FYM + *Azospirillum* + 10 kg PSB per ha exhibited higher seed yield per plant (4.90 g), seed yield (29.92 q ha^{-1}) with high seed recovery (85.89%), and high germination (91.00%). Among the different nutrient management and varietal interaction, V_3 N_3 (V_3: Vishnubhog Selection-1; N_3: State recommended dose of N: P: K: 60:40:20 kg/ha. through FYM + *Azospirillum* + 10 kg PSB per ha) was found highest for seed yield (32.27 q/ ha^{-1}) but the C: B ratio(1:2.17) was maximum for V_3 N_2 (V_3: Vishnubhog Selection-1, N_2: State recommended dose of N:P:K: 60:40:20 kg/ha Inorganic) with highest Net Monetory returns (43454.03 INR) due to low input cost.

Keywords: Rice, organic, inorganic, seed yield, Azospirillum, phosphorus solubilising bacteria (PSB), Potassium solubilising bacteria (KSB), Recommended dose of nutrients (RDN)

Introduction
Rice is the most important and staple food crop for feeding of more than two third population in the world. Rice is only cereal that is eaten as whole grain and human selection down the ages has given preference to quality to cater to the needs of diverse rice based preparations. Rice is intimately involved in the culture as well as the food ways and economy of many societies. Consumer demands for the fine rice varieties are higher due to its good nutritional quality, palatability, taste, cooking quality and aroma (Kaul *et al*., 1982) [1]. Over the past 50 years, agriculture production has increased dramatically, in part through the use of chemical fertilizers and pesticides that increased human and environment health risks (Pradhan, 1992) [5]. Nutrient supply either from organic or inorganic fertilizer is a must but continuous use of inorganic fertilizer to soil had a deleterious effect on soil productivity and steadily declining trend in rice productivity associated mainly with loss of inherent soil fertility & soil texture (Nambiar *et al.*, 1998) [3]. Farmers' at present day observed that fine aromatic rice gradually loses their aroma and other qualities such as yield and taste due to lack of organic matter content in soil, proper cultural management and changes in environment (Singh and Singh, 1997) [7]. The yield of fine rice is lower than that of coarse and medium rice. The reasons for low yield are mainly associated with lack of improved varieties and judicious use of synthetic fertilizers. Extensive research works are necessary to find out appropriate variety and to distinguish the yield parameters with respect of organic and inorganic fertilizers to obtain satisfactory yield and quality of fine rice.]. However, continuous use of inorganic fertilizers can lead to soil degradation, affecting its chemical, physical, and biological

properties (Mahajan *et al*., 2008) [2]. In the light of these concerns, interest has surged in organic fertilizers as alternative nutrient sources (Satyanarayana *et al*., 2002; Mahajan *et al*., 2008) [6, 2]. Therefore, the present study was undertaken to evaluate the seed yield parameters and seed quality characters along with economic study in response to organic and inorganic nutrient management in aromatic rice varieties for optimization of yield and quality characters.

Materials and Methods

The field experiment was conducted during *Kharif* 2023 at AICRP on Seed (Crops), IGKV, Raipur Chhattisgarh. The entire experimental area was ploughed by cultivator in criss cross pattern. The factorial experiment was laid out in a Randomized Block Design having three levels of Nutrient managements *viz*., N_1: Control (No fertilizer and manure), N_2: State recommended dose of N:P:K 60:40:20 kg/ha (Through inorganic fertilizers), N_3: State recommended dose of N:P:K 60:40:20 kg/ha through FYM + *Azospirillum* + 10 kg PSB per ha + 10 kg KSB per ha with 3 aromatic rice varieties *viz*., V_1: Dubraj Selection-1, V_2: Badshabhog Selection-1, andV_3:Vishnubhog Selection-1.

The twelve treatment combinations were replicated in four replications. The aromatic rice varieties were sown on 15th July 2023. The total 48 plots, each with gross size (5× 3 m^2) were prepared. The spacing between the plots and between the replication blocks were 1 meter. The rice was direct sown with row to row spacing 20 cm and plant to plant 10 cm. The five plants were selected randomly from each plot for taking observations. The observations were taken for field emergence (%), plant stand establishment per m^2, plant height at 30 days (cm), plant height at harvest (cm), days to first flowering, days to 50% flowering, number of tillers per m^2, seed yield plant-^{1}(g), 1000-seed weight (g), seed yield ha-^{1} (q), seed recovery % at field level while, seed germination (%), Vigour index, net monitory return and Cost: Benefit Ratio were also determined.

Results

1. Effect of Nutrient Management on Plant growth, Seed yield and Quality attributes

Among the three nutrient management treatment N_3: RDN through FYM + *Azospirilllum* + 10 kg PSB per ha. showed superiority with respect to growth and for seed yield (29.92 qha^{-1}) and most of the yield components traits, days to first flowering (106.33), number of tillers per m^2 (187.67), Seed yield per plant (5.10 g), Seed Recovery (85.89%), Germination (91.00%) and vigour index (1643.30) followed by N_2 (State recommended dose of N:P:K 60:40:20 kg/ha (through inorganic fertilizers)) for seed yield (28.03 qha^{-1}) and its components *viz.*, Field Emergence (90.17), Plant Stand Establishment per m^2 (45.17), Days to first flowering (107.25), Days to 50% Flowering (113.00), 1000 seed weight (14.86 g), vigour index (1525.37), Cost Benefit Ratio (1:2.04) and Net monetary returns (Rs. 38599.11) (Table 1 & 2).The highest net monetary returns was observed in the organic source of nutrients (N_2) is in accordance with Nureti *et al.* (2024).

2. Effect of varietal treatments on Plant growth, Seed yield and Quality attributes

Among the rice varieties V_3 (Vishnubhog Selection-1) and V_1 (Dubraj Selection-1) were at par for yield and most of the yield attributing characters. The rice variety V_3 (Vishnubhog Selection-1) showed superiority for seed yield (26.12 q ha^{-1}) and its components *viz.* Field Emergence (86.50%), Plant Stand establishment per m^2 (42.58), Days to first Flowering (103.58), Days to 50% Flowering (109.67), number of tillers per m^2 (159.00), seed yield plant^{-1} (4.68 g), seed recovery (83.33%), germination (88.50%), Benefit Cost ratio (1:1.75), and Net Monetary returns (30543.08 INR) followed by V_1 (Dubraj Selection-1) for seed yield (24.89 q ha^{-1}) and most of the yield components Field Emergence (86.00%), Plant Stand establishment per m^2 (42.00), Days to 50% Flowering (112.75), Number of tillers per m^2 (154.67), Seed yield per plant (4.39 g), germination (86.67%),Cost Benefit ratio (1:1.63) and Net Monetary returns (25708.90 INR) (Table 1&2). The rice variety V_1 (Dubraj Selection 1) was found superior in terms of plant height at harvest (106.15 cm) and 1000 Seed weight (15.62 g).

3. Interaction effect of varietal treatment with Nutrient on Plant growth, Seed yield and Quality attributes

Two way interactions between aromatic rice varieties and nutrients management were found significant for seed yield and most of the components. Interaction V_3N_3 (V_3: Vishnubhog Selection-1 & N_3: State recommended dose of N:P:K 60:40:20 kg/ha through FYM + *Azospirillum* + 10 kg PSB per ha) showed superiority in terms of seed yield (32.27 qha^{-1}) and its components *viz.*, Plant Stand establishment per m^2 (46.25), Days to first flower (103.25), Days to 50% Flowering (109.50),seed yield per plant (5.49 g), seed recovery % (87.35), germination (91.50%), Vigour Index (1639.80) was at par with V_3N_2 (V_3: Vishnubhog Selection-1 & N_2:State recommended dose of N:P:K 60:40:20 kg/ha Inorganic) for most of the characters *viz.* field emergence (90.00%), Plant Stand Establishment (45.50), Plant height at 30 days (30.65 cm), Days to first flowering (104.25), Days to 50% Flowering (110.25), Plant height at harvest (119.85 cm), Number of tillers per m^2 (171.50), Seed yield per plant (5.33 g), Seed yield per ha (30.70 q/ha), Germination (88.00%). The Cost Benefit ratio was maximum (1:2.17) for V_3N_2 (V_3: Vishnubhog Selection-1 & N_2: State recommended dose of N: P: K 60:40:20 kg/ha Inorganic) with highest Net Monetory returns (Rs.43454.03). The response of three aromatic rice varieties was found maximum with Organic fertilizer (N_3: State recommended dose of N:P:K 60:40:20 kg/ha. through FYM + *Azospirillum* + 10 kg PSB per ha) when compared with Inorganic mode of fertilizer (N_2: State recommended dose of N:P:K 60:40:20 kg/ha) for characters Seed yield per plant (g), Seed yield (q ha^{-1}), number of tillers per m^2, Seed recovery (%), except for characters Field Emergence (%), Plant Stand establishment, 1000 seed weight (g), Germination (%), Vigour Index, Cost Benefit Ratio and Net Monetory returns (Rs.) which performed well (Table 1& 2).

Among the nutrient management the C: B ratio was found to be highest (1:2.04) in N_2 (State recommended dose of N:P:K 60:40:20 kg/ha (Through inorganic fertilizers)) due lower input cost.

The higher input cost of organic fertilizers had resulted in low C: B ratio while the lower input cost of inorganic fertilizer has resulted in higher C: B ratio.

Table 1: Effect of nutrient management on plant growth and seed yield of Rice at IGKV, Raipur during Kharif 2023

Treatment / Varieties	Field emergence (%)	Plant Stand Establishment/ m2	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Plant height at harvest (cm)	No. of tillers/ m2	Seed yield/ plant (g)	1000 Seed Weight (g)	Seed yield (q/ha)	Seed recovery (%)	Seed quality		Benefit Cost ratio	Net monetary returns (Rs.)
												Germination (%)	Vigour index		
V1: Dubraj Selection 1	86.00	42.00	31.32	109.25	112.75	106.15	154.67	4.39	15.62	24.89	80.72	86.67	1420.53	1:1.63	25708.90
V2: Badshabhog Selection 1	84.33	41.00	30.47	107.25	113.08	116.65	154.33	4.13	13.55	22.03	83.05	86.50	1500.87	1:1.47	19251.19
V3: Vishnubhog Selection 1	86.50	42.58	30.93	103.58	109.67	116.73	159.00	4.68	14.68	26.12	83.33	88.50	1478.67	1:1.75	30543.08
Mean	85.61	41.86	30.91	106.69	111.83	113.18	156.00	4.40	14.62	24.35	82.37	87.22	1466.69		25167.72
SEm	0.71	0.50	0.77	0.36	0.20	1.36	3.56	0.08	0.08	0.69	0.57	0.60	22.81		
CD (0.05 P)	2.07	1.47	2.25	1.05	0.59	3.97	10.38	0.22	0.23	2.03	1.65	1.75	66.57		
CV%	2.87	4.16	8.64	1.17	0.63	4.17	7.90	6.01	1.87	9.87	2.38	2.39	5.39		
Nutrient															
N1:Control (No fertilizer and manure)	81.83	35.58	29.65	106.50	112.33	106.42	103.50	3.19	13.94	15.09	79.12	83.50	1231.39	1:1.18	5930.95
N2: State recommended dose of N:P:K fertilizer (inorganic) 60:40:20	90.17	45.17	30.83	107.25	113.00	119.42	176.83	4.90	14.86	28.03	82.09	87.17	1525.37	1:2.04	38599.11
N3:RDN Through FYM/ Neem cake/ Azospirillum, KSB, either sole applications or combination of different sources + 10 kg PSB per ha + 10 kg KSB per ha	84.83	44.83	32.23	106.33	112.00	113.70	187.67	5.10	15.06	29.92	85.89	91.00	1643.30	1:1.63	32086.30
Mean	85.61	41.86	30.91	106.69	112.44	113.18	156.00	4.40	14.62	24.35	82.37	87.22	1466.69		25538.79
S E m	0.71	0.50	0.77	0.36	0.20	1.36	3.56	0.08	0.08	0.69	0.57	0.60	22.81		
CD	2.07	1.47	2.25	1.05	0.59	3.97	10.38	0.22	0.23	2.03	1.65	1.75	66.57		
CV%	2.87	4.16	8.64	1.17	0.63	4.17	7.90	6.01	1.87	9.87	2.38	2.39	5.39		

Table 2: Effect of nutrient management on plant growth and seed yield of Rice at IGKV, Raipur during Kharif 2023

Treatment / Varieties	Field emergence (%)	Plant Stand Establishment/ m2	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Plant height at harvest (cm)	No. of tillers/ m2	Seed yield/ plant (g)	1000 Seed Weight (g)	Seed yield (q/ha)	Seed recovery (%)	Seed quality		Benefit Cost ratio	Net monetary returns (Rs.)
												Germination (%)	Vigour index		
Interactions															
V1N1	83.00	36.75	29.50	107.50	112.75	101.90	90.00	3.04	15.10	15.46	77.90	83.50	1174.86	1:1.19	6488.52
V1N2	90.00	44.50	31.70	110.75	116.00	109.95	183.00	5.00	15.87	28.35	79.85	86.50	1461.32	1:2.02	38028.82
V1N3	85.00	44.75	32.75	109.50	115.00	106.60	191.00	5.12	15.90	30.85	84.41	90.00	1625.40	1:1.66	33635.12
V2N1	80.50	34.00	29.45	108.75	115.00	107.45	100.00	3.31	13.30	14.40	80.76	81.00	1284.90	1:1.14	4656.24
V2N2	90.50	45.50	30.15	106.75	112.75	128.45	176.00	4.37	13.88	25.05	82.47	87.00	1553.00	1:1.81	29794.52
V2N3	82.00	43.50	31.80	106.25	111.50	114.05	187.00	4.70	13.47	26.65	85.91	91.50	1664.70	1:1.41	20928.57
V3N1	82.00	36.00	30.00	103.25	109.25	109.90	120.50	3.24	13.42	15.40	78.70	86.00	1234.40	1:1.27	9107.82
V3N2	90.00	45.50	30.65	104.25	110.25	119.85	171.50	5.33	14.83	30.70	83.95	88.00	1561.80	1:2.17	43454.03
V3N3	87.50	46.25	32.15	103.25	109.50	120.45	185.00	5.49	15.80	32.27	87.35	91.50	1639.80	1:1.65	33396.60
Mean	85.61	41.86	30.91	106.69	112.44	113.18	156.00	4.40	14.62	24.35	82.37	87.22	1466.69		24387.80
S.Em	1.23	0.87	1.34	0.63	0.35	2.36	6.16	0.13	0.14	1.20	0.98	1.04	39.51		
C.D. (0.05P)	3.58	2.54	3.90	1.83	1.02	6.88	17.98	0.39	0.4	3.51	2.86	3.04	115.31		
CV%	2.87	4.16	8.64	1.17	0.63	4.17	7.90	6.01		9.87	2.38	2.39	5.39		

Conclusion

In this study it is concluded that-

1. The main effect V_3 (Vishnubhog Selection-1) exhibited higher seed yield per plant (4.68 g), seed yield (26.12 q ha^{-1}) with high seed recovery (83.33%), and high germination (88.50%) and C: B ratio (1:1.75) with high Net Monetory returns (30543.08 INR).
2. Nutrient management N_3 (State recommended dose of N: P: K 60:40:20 kg/ha through FYM + *Azospirillum* + 10 kg PSB per ha) exhibited higher seed yield per plant (4.90 g), seed yield (29.92 q ha^{-1}) with high seed recovery (85.89%), and high germination (91.00%).
3. The C: B ratio (1:2.04) was recorded highest for the N_2 (Inorganic mode of State recommended dose N:P:K:60:40:20 kg/ha) of fertilizer due to low input cost.
4. The result revealed in the interactions, V_3 N_3 (V_3: Vishnubhog Selection-1 & N_3: State recommended dose of N: P: K: 60:40:20 kg/ha through FYM + *Azospirillum* + 10 kg PSB per ha) was recorded highest seed yield (32.27 q/ ha^{-1}).
5. But the C: B ratio (1:2.17) was maximum for V_3 N_2 (V_3: Vishnubhog Selection-1 & N_2 State recommended dose of N:P:K: 60:40:20 kg/ha Inorganic) with highest Net Monetory returns (43454.03 INR) due to low input cost.
6. Thus we concluded that the seed produced through organic way will be more profitable unless organic seed will fetch the premium prices.

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