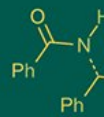


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Influence of gradient levels of Konkani Annapurna Briquette (KAB) fertilizers on growth parameters and yield attributes of rice (*Oryza sativa* L.)

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Abstract

A field experiment was conducted during the *kharif* seasons of 2020 and 2021 to evaluate the effect of gradient levels of Konkani Annapurna Briquette (KAB) fertilizers on growth characters, yield attributes and yield of rice (*Oryza sativa* L.). The experiment was laid out in a randomized block design with three treatments comprising 80% (B₁), 100% (B₂) and 120% (B₃) of the recommended dose of fertilizers (RDF) applied through KAB. The results revealed that growth parameters such as plant height, number of tillers, number of leaves and dry matter accumulation were significantly influenced by KAB levels. The highest values were recorded under B₃, which remained statistically at par with B₂ but significantly superior over B₁ at all growth stages. Yield attributes including number of panicles hill⁻¹, weight of grains panicle⁻¹ and number of filled grains panicle⁻¹ were significantly improved with increasing KAB levels, while panicle length showed non-significant variation. The number of unfilled grains decreased with higher KAB levels. Grain yield was significantly enhanced with increasing levels of KAB fertilizers, with B₃ recording the highest pooled grain yield (52.31 q ha⁻¹), followed by B₂ (49.96 q ha⁻¹) and B₁ (43.18 q ha⁻¹). Straw yield followed a similar trend. The improvement in yield was mainly attributed to enhanced growth and better yield attributes resulting from improved nutrient availability and uptake. The study indicated that application of 100% RDF through KAB is sufficient to achieve optimum growth, yield attributes and productivity of rice, while further increase to 120% RDF resulted in only marginal gains.

Keywords: Rice, KAB fertilizers, growth parameters, yield attributes, briquette fertilizers, nutrient management

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops, serving as a staple food for more than half of the world's population and contributing significantly to global food security. In India, rice occupies a major share of cultivated area and production; however, its productivity is often constrained by inefficient nutrient management and low fertilizer use efficiency, particularly under intensive cropping systems. Nitrogen (N), phosphorus (P), and potassium (K) are key nutrients governing growth characters such as plant height, tillering, leaf production, and dry matter accumulation, which ultimately determine yield formation. However, under conventional fertilizer application methods, a large proportion of applied nutrients is lost through volatilization, leaching, and runoff, resulting in low nutrient use efficiency (Ladha *et al.*, 2016; Rahman and Samanta, 2024) [5, 8]. Therefore, improving nutrient use efficiency while maintaining or enhancing crop productivity remains a major challenge in rice cultivation.

Fertilizer briquette technology, particularly deep placement of urea and NPK briquettes, has emerged as an effective strategy to improve nutrient use efficiency and crop performance. Deep placement ensures that nutrients remain available in the root zone for a longer duration, thereby minimizing losses and enhancing uptake (Savant *et al.*, 2017; IFDC, 2024) [3, 10]. Several studies have reported that briquette application significantly improves growth parameters, yield attributes, and grain yield of rice compared to conventional fertilizer application (Sarker *et al.*, 2021; Naveen *et al.*, 2024) [7, 9]. Konkani Annapurna Briquette

(KAB), a composite fertilizer containing essential nutrients, offers a balanced and efficient nutrient supply for rice cultivation. Application of KAB has been shown to enhance vegetative growth, improve dry matter accumulation, and increase yield attributes such as number of panicles and grains per panicle (Jadhav *et al.*, 2024) ^[4]. Improved nutrient availability through briquette application also promotes better canopy development and photosynthetic efficiency, leading to higher productivity (Lan *et al.*, 2024) ^[6].

Growth characters such as plant height, number of tillers, number of leaves, and dry matter accumulation are important indicators of crop vigor and are closely associated with yield attributes. Enhanced vegetative growth under improved nutrient management leads to better source-sink relationships and efficient partitioning of assimilates towards grain yield (Fageria *et al.*, 2016; Naveen *et al.*, 2024) ^[2, 7]. Although the benefits of briquette fertilizers have been widely reported, information on the response of rice growth characters and yield attributes to gradient levels of Konkani Annapurna Briquette (KAB) is limited under field conditions. In particular, identification of the optimum level of KAB for maximizing growth and yield without excessive fertilizer use remains an important research need. Therefore, the present study was undertaken to evaluate the effect of gradient levels of Konkani Annapurna Briquette (KAB) fertilizers on growth characters, yield attributes, and yield of rice.

Materials and Methods

The field experiment was conducted during the *kharif* seasons of 2020 and 2021 at the Experimental Farm, Department of Agronomy, College of Agriculture, Dr. Balasaheb Sawant Konkani Krishi Vidyapeeth, Dapoli, Maharashtra, India. The soil of the experimental field was lateritic, well-drained and sandy clay loam in texture. Composite soil samples (0-30 cm depth) were collected before the initiation of the experiment and analyzed using standard procedures. The soil was slightly acidic in reaction (pH 5.74), medium in available nitrogen (286 kg ha⁻¹) and

phosphorus (12.9 kg ha⁻¹), high in available potassium (257 kg ha⁻¹), and rich in organic carbon (1.26%). The experiment was laid out in a Randomized Block Design (RBD) with nine replications. The treatments consisted of three gradient levels of Konkani Annapurna Briquettes (KAB). B₁; 80% Recommended Dose of Fertilizers (RDF) through KAB, B₂; 100% RDF through KAB and B₃; 120% RDF through KAB. Rice variety 'Ratnagiri-8' was used for the study. Twenty-four day old seedlings were transplanted at a spacing of 25 cm × 15 cm, maintaining 2-3 seedlings hill⁻¹. Well-decomposed farmyard manure (5 t ha⁻¹) and Glyricidia green biomass (7.5 t ha⁻¹) were incorporated during land preparation. Konkani Annapurna Briquettes (KAB) were applied as per treatment levels (80%, 100% and 120% RDF equivalent to 175 kg ha⁻¹) through deep placement at 5 Days after Transplanting (DAT). Necessary plant protection measures were undertaken to control insect pests and diseases. All other agronomic practices were followed as per recommended package of practices. Observations on various growth parameters were recorded at different stages (30, 60, 90 DAT and at harvest). At harvest, the observations were recorded on Number of panicles hill⁻¹, Panicle length (cm), Weight of grains panicle⁻¹ (g), Number of filled grains panicle⁻¹, Number of unfilled grains panicle⁻¹, Grain yield (q ha⁻¹) and Straw yield (q ha⁻¹). Grain and straw yields were recorded from net plot area and converted to hectare basis. The experimental data were analyzed using analysis of variance (ANOVA) appropriate for Randomized Block Design as described by Gomez and Gomez (1984). The significance of treatment differences was tested using the Critical Difference (CD) at 5% level of probability (P = 0.05).

Results and Discussion

Growth characters

Plant height of rice increased progressively with crop growth and was significantly influenced by gradient levels of Konkani Annapurna Briquette (KAB) fertilizers at all stages during both years.

Table 1: Effect of gradient levels of KAB on Plant height (cm), No. of tillers hill⁻¹, No. of leaves hill⁻¹ and dry matter accumulation (g hill⁻¹) of rice during *Kharif* 2020 & 2021

Treatments	Plant height (cm)							
	30 DAT		60 DAT		90 DAT		At harvest	
	2020	2021	2020	2021	2020	2021	2020	2021
B ₁	20.52	18.27	55.88	52.05	93.39	87.38	95.22	88.55
B ₂	20.94	19.56	59.08	54.65	95.94	90.21	97.51	91.61
B ₃	21.52	19.99	60.27	56.05	97.65	91.57	99.21	92.24
SE	0.36	0.45	0.60	0.62	0.77	0.81	0.67	0.80
CD @ 5%	1.09	1.34	1.80	1.85	2.30	2.42	2.00	2.41
G. M.	20.52	19.27	55.88	54.25	93.39	89.72	95.22	90.80
No. of tillers hill ⁻¹								
B ₁	7.05	6.58	11.02	9.74	11.50	10.56	7.90	7.20
B ₂	7.45	6.91	12.78	11.68	13.13	12.17	8.99	8.40
B ₃	8.04	7.45	13.14	12.18	13.45	12.63	9.27	8.68
SE	0.28	0.30	0.49	0.63	0.51	0.54	0.26	0.29
CD @ 5%	0.85	0.91	1.48	1.88	1.54	1.62	0.79	0.87
G. M.	7.52	6.98	12.31	11.20	12.69	11.79	8.72	8.11
No. of leaves hill ⁻¹								
B ₁	23.62	22.27	35.43	33.09	41.40	37.98	21.92	20.31
B ₂	24.97	23.71	41.07	38.18	47.25	43.75	24.96	23.30
B ₃	26.95	25.19	42.24	39.59	48.42	45.12	25.71	24.01
SE	0.95	0.79	1.59	1.42	1.85	1.90	0.73	0.73
CD @ 5%	2.84	2.38	4.75	4.26	5.54	5.69	2.19	2.19
G. M.	25.18	23.72	39.58	36.95	45.69	42.28	24.20	22.54

Dry matter accumulation (g hill ⁻¹)								
B ₁	5.76	5.49	23.00	21.47	44.87	41.34	51.21	46.33
B ₂	6.21	5.76	25.47	23.75	50.68	47.48	57.81	52.92
B ₃	6.33	5.88	26.01	24.53	52.37	49.06	60.05	55.42
SE	0.21	0.17	0.81	0.75	1.43	1.19	1.90	1.64
CD @ 5%	0.63	0.52	2.42	2.25	4.29	3.57	5.68	4.92
G. M.	6.10	5.71	24.83	23.25	49.31	45.96	56.36	51.56

Treatment B₃ (120% RDF through KAB) recorded the highest plant height at all stages, which remained statistically at par with B₂ (100% RDF) but significantly superior over B₁ (80% RDF). The increase in plant height under higher KAB levels may be attributed to improved nutrient availability, particularly nitrogen, which promotes cell division and elongation, resulting in enhanced vegetative growth. Deep placement of briquettes ensures a sustained supply of nutrients in the root zone, thereby improving nutrient uptake efficiency. These findings are in agreement with Fageria *et al.* (2016) [2], Savant *et al.* (2017) [10], Sarker *et al.* (2021) [9], and Naveen *et al.* (2024) [7], who reported significant improvement in plant height under improved nutrient management and briquette fertilization.

The number of tillers increased up to 60-90 DAT and declined slightly at harvest due to tiller mortality. Treatment B₃ recorded the highest number of tillers at all stages, followed by B₂ and B₁. Higher tiller production under increased KAB levels may be due to enhanced nitrogen availability and improved root growth, which stimulate tiller initiation and survival. The improved tillering capacity also reflects better early crop vigor under higher nutrient supply. Similar results were reported by Sarker *et al.* (2021) [9], Eldridge *et al.* (2022) [1], Naveen *et al.* (2024) [7], and Jadhav *et al.* (2024) [4], who observed increased tiller production under briquette fertilizer application.

The number of leaves increased up to 90 DAT and declined thereafter due to leaf senescence. Treatment B₃ recorded significantly higher number of leaves, which remained

statistically at par with B₂ but superior over B₁. The increase in leaf number under higher KAB levels may be attributed to adequate nitrogen supply, which enhances leaf initiation, expansion, and chlorophyll content, resulting in better canopy development. These findings are supported by Rahman and Samanta (2024) [8], Lan *et al.* (2024) [6], and Jadhav *et al.* (2024) [4], who reported improved leaf production and canopy growth under briquette fertilization. Dry matter accumulation increased continuously from 30 DAT to harvest and was significantly influenced by KAB levels. Treatment B₃ recorded the highest dry matter accumulation at all stages, followed by B₂ and B₁. Higher biomass production under increased KAB levels may be attributed to enhance photosynthetic efficiency, improved leaf area, and sustained nutrient availability, leading to greater assimilate production. These results are in conformity with Eldridge *et al.* (2022) [1], Lan *et al.* (2024) [6], Naveen *et al.* (2024) [7], and Fageria *et al.* (2016) [2], who reported increased dry matter production under improved nutrient management practices.

Yield and yield attributes

The number of panicles increased significantly with increasing KAB levels. Treatment B₃ recorded the highest values, which were at par with B₂ but significantly superior over B₁. This may be attributed to improved tiller survival under better nutrient availability. Panicle length was not significantly influenced by treatments, indicating its strong genetic control.

Table 2: Yield attributes and yield of rice as influenced by different treatments during Kharif 2020, 2021 and pooled data

Treatments	Number of panicles hill ⁻¹			Length of panicle (cm)			Weight of grain panicle ⁻¹ (g)					
	2020	2021	Pooled	2020	2021	Pooled	2020		2021		Pooled	
B ₁	7.68	7.24	7.46	22.89	20.94	21.91	2.57		2.25		2.41	
B ₂	8.92	8.30	8.61	23.03	21.51	22.27	2.92		2.44		2.68	
B ₃	9.12	8.55	8.84	23.25	21.99	22.62	3.01		2.50		2.75	
SE	0.39	0.32	0.33	0.36	0.49	0.39	0.09		0.06		0.06	
CD @ 5%	1.16	0.96	0.98	1.08	1.48	1.18	0.26		0.17		0.18	
G. M.	8.57	8.03	8.30	23.06	21.48	22.27	2.83		2.39		2.61	
Treatments	Number of filled grains panicle ⁻¹			Number of unfilled grains panicle ⁻¹			Grain yield (q ha ⁻¹)			Straw yield (q ha ⁻¹)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
B ₁	133.40	131.51	132.45	29.42	27.50	28.46	45.42	40.93	43.18	54.84	48.91	51.87
B ₂	141.00	137.80	139.40	25.82	23.51	24.67	52.49	47.44	49.96	60.93	55.02	57.97
B ₃	144.63	142.11	143.37	24.24	22.34	23.29	54.70	49.92	52.31	63.18	56.98	60.08
SE	2.46	2.07	2.08	1.13	1.26	1.13	1.71	1.47	1.50	2.02	1.70	1.75
CD @ 5%	7.37	6.21	6.23	3.38	3.77	3.39	5.13	4.41	4.51	6.04	5.10	5.25
G. M.	139.67	137.14	138.41	26.49	24.45	25.47	50.87	46.10	48.48	59.65	53.64	56.64

However, a slight increase was observed with increasing KAB levels. Grain weight panicle⁻¹ increased significantly with KAB levels. Higher values under B₃ may be due to improved assimilate availability during grain filling stages. The number of filled grains increased significantly, while unfilled grains decreased with increasing KAB levels. This indicates improved grain filling due to better nutrient availability and translocation of assimilates. These findings

are supported by Savant *et al.* (2017) [10], Sarker *et al.* (2021) [9], Lan *et al.* (2024) [6], and Jadhav *et al.* (2024) [4].

Grain and straw yields were significantly influenced by gradient levels of KAB fertilizers. Treatment B₃ recorded the highest grain yield (52.31 q ha⁻¹ pooled), which was statistically at par with B₂ but significantly superior over B₁. The increase in grain yield under higher KAB levels may be attributed to improved growth parameters, higher dry matter

accumulation, better yield attributes and enhanced source-sink relationship. Straw yield also followed a similar trend, reflecting improved vegetative growth. These findings are in agreement with Eldridge *et al.* (2022) ^[1], Lan *et al.* (2024) ^[6], Naveen *et al.* (2024) ^[7], Sarker *et al.* (2021) ^[9], and IFDC (2024) ^[3], who reported significant yield improvement under briquette deep placement.

Conclusion

The present study clearly demonstrated that gradient levels of Konkan Annapurna Briquette (KAB) fertilizers significantly influenced growth characters, yield attributes, and productivity of rice (*Oryza sativa* L.) under the agro-climatic conditions of Konkan region. Application of KAB fertilizers markedly improved growth parameters such as plant height, number of tillers, number of leaves, and dry matter accumulation, which in turn enhanced yield attributes including number of panicles, grain weight panicle⁻¹, and number of filled grains. The number of unfilled grains was reduced with increasing KAB levels, indicating improved grain filling and assimilate translocation.

Among the treatments, 120% RDF through KAB (B₃) consistently recorded higher values for growth, yield attributes, and yield; however, it remained statistically at par with 100% RDF (B₂) in most cases. This suggests that 100% RDF through KAB is sufficient to achieve optimum crop growth, yield attributes, and productivity, while further increase to 120% RDF results in only marginal gains. The improvement in productivity under KAB application can be attributed to efficient nutrient availability through deep placement, enhanced nutrient uptake, improved canopy development, and better source-sink relationship. Therefore, it can be concluded that application of 100% recommended dose of nutrients through Konkan Annapurna Briquettes is an effective and sustainable nutrient management strategy for enhancing growth and yield of rice.

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