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Study the effect of biofertilizers on productivity of some local cultivated varieties of rice from Gaurela-Pendra-Marwahi district of Chhattisgarh

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Abstract

The present experiment entitled “Study the effect of Biofertilizers on productivity of some local cultivated varieties of rice from Gaurela-Pendra-Marwahi district of Chhattisgarh” was conducted during *Kharif* season in year 2022-23 and 2023-24 at the village Parasi, block Marwahi, district (Gaurela Pendra Marwahi) under Govt. D.B. Girls P.G. College, Raipur, Chhattisgarh. The field experiment evaluated the impact of biofertilizers on the morphology, grain quality, and yield of two local rice varieties, Vishnubhog (V1) and Jeeraphool (V2), from the Gaurela-Pendra-Marwahi district. Employing a Factorial Randomized Block Design (FRBD) with 12 treatments and three replications, the experiment included two varieties (Factor A) and six organic treatments (Factor B): T₁ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹), T₂ (FYM @10 t ha⁻¹ + Azotobacter @1250 ml ha⁻¹ + PSB @1250 ml ha⁻¹ + KSB @1250 ml ha⁻¹), T₃ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹ + Biofertilizer consortia @1250 ml ha⁻¹), T₄ (FYM @10 t ha⁻¹ + Azospirillum @1250 ml ha⁻¹), T₅ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹ + Azospirillum @1250 ml ha⁻¹), and T₆ (Control). Results indicated that Vishnubhog (V1) significantly outperformed Jeeraphool (V2) in panicle length, seed count per panicle, test weight, grain yield, and harvest index. Among organic treatments, T₂ exhibited the highest values for these parameters, closely followed by T₃, while the control (T₆) consistently recorded the lowest. These findings highlight the efficacy of integrated biofertilizer application, particularly T₂, in enhancing rice productivity and quality, supporting sustainable agriculture in Chhattisgarh.

Keywords: Biofertilizers, rice varieties, Vishnubhog, Jeeraphool, grain quality, yield, morphology, FRBD, FYM, Azotobacter, PSB, KSB, BGA, Azospirillum, Organic treatments, Panicle length, Test weight, Harvest index, Chhattisgarh, Sustainable agriculture

1. Introduction

Rice (*Oryza sativa* L.) is a cornerstone of global food security, serving as a staple for over half of the world's population, particularly in Asia, where it accounts for 90% of global production and consumption (Khush, 2005)^[8]. With 24 species in the genus *Oryza*, the cultivated species *O. sativa* and *O. glaberrima* are predominant, with *O. sativa* being widely grown across diverse agroecological zones, originating from South-East Asia (Veasey *et al.* 2004)^[15]. In India, rice occupies approximately 43.79 million hectares, yielding 115.60 million tonnes with an average productivity of 2578 kg/ha (Directorate of Economics and Statistics, 2021)^[4]. Chhattisgarh, often referred to as the "Rice Bowl of India," contributes significantly to this production, with an estimated 3.70 million hectares under rice cultivation, producing 4.89 million tonnes and achieving a productivity of 3002 kg/ha in 2021 (Directorate of Economics and Statistics, 2021)^[4]. The state is renowned for its rich diversity of indigenous rice varieties, including aromatic types like Vishnubhog and Jeeraphool, which are highly valued for their quality and cultural significance in districts such as Gaurela-Pendra-Marwahi (Singh *et al.* 2008)^[13].

The increasing global demand for sustainable agricultural practices has spotlighted organic farming and biofertilizers as viable alternatives to chemical inputs, which often degrade soil health and environmental quality. Biofertilizers, including nitrogen-fixing bacteria like *Azotobacter* and *Azospirillum*, phosphate-solubilizing bacteria (PSB), potassium-solubilizing

bacteria (KSB), and blue-green algae (BGA), enhance soil fertility by improving nutrient availability and promoting plant growth without adverse environmental impacts (Bhardwaj *et al.* 2014) [2]. For instance, BGA can contribute up to 80 kg N/ha per season in rice ecosystems, particularly under waterlogged conditions, making it a critical input for sustainable rice production (Venkataraman, 1981) [16]. Similarly, Azospirillum enhances nitrogen fixation and produces phytohormones, reducing the need for synthetic nitrogen fertilizers by 20-25% (Bashan & de-Bashan, 2010) [1]. The combined application of organic manures like farmyard manure (FYM) with biofertilizers has been shown to improve soil physical, chemical, and biological properties, ensuring long-term productivity (Dahiphale *et al.* 2003) [3]. This study investigates the effects of biofertilizers on the morphology, grain quality, and yield of Vishnubhog and Jeeraphool rice varieties in Chhattisgarh, aiming to promote sustainable agricultural practices in the region.

2. Materials and Methods

The field experiment was conducted during the *Kharif* season of 2022-23 and 2023-24 at the village Parasi, block Marwahi, district (Gaurela Pendra Marwahi) under Govt. D.B. Girls P.G. College, Raipur, Chhattisgarh, to evaluate the effect of biofertilizers on the morphology, grain quality, and yield of two local rice varieties, Vishnubhog (V1) and Jeeraphool (V2), from the Gaurela-Pendra-Marwahi district. The experiment was designed using a Factorial Randomized Block Design (FRBD) with 12 treatments and three replications. Factor A consisted of two varieties (V1 and V2), while Factor B included six organic treatments: T₁ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹), T₂ (FYM @10 t ha⁻¹ + Azotobacter @1250 ml ha⁻¹ + PSB @1250 ml ha⁻¹ + KSB @1250 ml ha⁻¹), T₃ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹ + Biofertilizer consortia @1250 ml ha⁻¹), T₄ (FYM @10 t ha⁻¹ + Azospirillum @1250 ml ha⁻¹), T₅ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹ + Azospirillum @1250 ml ha⁻¹), and T₆ (Control). The treatments were applied to assess their impact on parameters such as panicle length, seed count per panicle, test weight (1000 seed weight), grain yield, straw yield, and harvest index.

The experimental site was prepared with standard agronomic practices, including land preparation, irrigation, and weed management, to ensure optimal crop growth. Seeds of the two rice varieties were sown, and biofertilizers were applied as per the treatment specifications at the recommended stages of crop development. Data were collected on key morphological and yield-related traits at appropriate growth stages, with measurements recorded for each replication. Statistical analysis was performed to determine significant differences among treatments using the FRBD framework, with the significance of variety and treatment effects evaluated at a 5% probability level (P=0.05). The results were compiled to compare the performance of the varieties and organic treatments, providing insights into the efficacy of biofertilizers in enhancing rice productivity in the region.

3. Results

The data regarding as influenced by effect of biofertilizers on morphology, grain quality and yield of some local cultivated varieties of rice has been presented in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6.

Number of Seeds per Panicle

Vishnubhog (V1) consistently exhibited a higher number of

seeds per panicle compared to Jeeraphool (V2) across both seasons (2022-23: 229.43 vs. 213.03; 2023-24: 249.39 vs. 223.00; pooled mean: 239.41 vs. 218.01). This suggests that Vishnubhog has a genetic predisposition for greater seed-setting capacity, likely due to superior panicle architecture or efficient nutrient assimilation. Similar varietal differences in seed number per panicle were reported by Ghimire *et al.* (2021) [6], who noted that rice varieties treated with biofertilizers like Azolla and NPK exhibited significantly higher filled grains per panicle (114.30) compared to controls, attributed to enhanced nutrient availability and uptake.

Among the organic treatments, T₂ (FYM @10 t ha⁻¹ + Azotobacter @1250 ml ha⁻¹ + PSB @1250 ml ha⁻¹ + KSB @1250 ml ha⁻¹) recorded the highest number of seeds per panicle (2022-23: 237.18; 2023-24: 252.24; pooled mean: 244.71), statistically comparable to T₃ (FYM @10 t ha⁻¹ + BGA @1250 ml ha⁻¹ + Biofertilizer consortia @1250 ml ha⁻¹). The control treatment (T₆) consistently showed the lowest values (2022-23: 201.64; 2023-24: 216.64; pooled mean: 209.14). The superior performance of T₂ and T₃ can be attributed to the synergistic effects of multiple biofertilizers, which enhance nitrogen fixation, phosphate solubilization, and potassium mobilization, thereby improving reproductive efficiency. Subashini *et al.* (2007) [14] reported a gradual increase in rice yield with repeated biofertilizer applications, particularly Azospirillum and BGA, which aligns with the enhanced seed-setting observed in T₂ and T₃. The increased seed number in these treatments may also be linked to the production of growth-promoting substances by Azotobacter, as noted by Bhardwaj *et al.* (2014) [2], which improve root systems and nutrient uptake, facilitating better panicle development.

Test Weight (1000 Seed Weight)

The test weight showed inconsistent varietal differences across seasons. In 2022-23, Jeeraphool (V2) recorded a higher test weight (16.48 g) than Vishnubhog (V1) (16.01 g), but in 2023-24, Vishnubhog outperformed Jeeraphool (18.21 g vs. 16.81 g). The pooled mean indicated non-significant differences, with Vishnubhog slightly higher (17.11 g vs. 16.65 g). These variations suggest environmental influences or genotype-environment interactions affecting seed size and weight, as reported by Saini *et al.* (2023) [12], who observed that rice cultivars under different tillage systems exhibited varying yield attributes due to environmental factors.

For organic treatments, T₂ consistently achieved the highest test weight (2022-23: 17.65 g; 2023-24: 19.65 g; pooled mean: 18.65 g), closely followed by T₃ (17.13 g, 18.73 g, and 17.93 g, respectively), while T₆ (control) recorded the lowest (14.69 g, 15.19 g, and 14.94 g). The higher test weight in T₂ and T₃ is likely due to the combined effect of FYM and biofertilizers, which enhance nutrient availability and improve seed filling. Kumawat *et al.* (2023) [9] found that organic amendments like FYM and biofertilizers significantly increased soil nutrient status, leading to improved grain quality in basmati rice. The role of PSB in solubilizing phosphorus, as highlighted by Ganesh *et al.* (2011) [5], likely contributed to better seed development in these treatments.

Grain Yield

Vishnubhog (V1) outperformed Jeeraphool (V2) in grain yield across both seasons (2022-23: 25.36 vs. 19.65; 2023-24: 26.02 vs. 17.15; pooled mean: 25.69 vs. 18.40). This is consistent with its higher seed number per panicle, indicating better sink capacity. Maw *et al.* (2024) [10] reported a significant positive

correlation between grain yield and yield components like spikelets per panicle in rice treated with organic and inorganic fertilizers, supporting the superior performance of Vishnubhog. Among treatments, T₂ recorded the highest grain yield (2022-23: 26.59; 2023-24: 25.59; pooled mean: 26.09), comparable to T₃ (24.93, 23.93, and 24.43), while T₆ had the lowest (17.99, 16.99, and 17.49). The enhanced yield in T₂ and T₃ is likely due to the combined effects of FYM and biofertilizers, which improve soil fertility and nutrient uptake. Naher *et al.* (2021)^[11] demonstrated that bio-organic fertilizers significantly increased rice biomass and yield, particularly under nutrient-rich conditions. The application of Azotobacter, PSB, and KSB in T₂ likely enhanced nitrogen and nutrient availability, as noted by García-Fraile *et al.* (2015), leading to higher grain yields.

Straw Yield

Jeeraphool (V2) consistently showed higher straw yield than Vishnubhog (V1) (2022-23: 47.73 vs. 36.36; 2023-24: 47.73 vs. 36.86; pooled mean: 47.73 vs. 36.61). This suggests that Jeeraphool allocates more biomass to vegetative growth, potentially due to genetic traits favoring straw production over grain. Jose *et al.* (2023)^[7] observed similar varietal differences in rice, with some varieties showing higher straw yield under organic management due to enhanced vegetative growth. Treatment T₂ recorded the highest straw yield (2022-23: 52.31; 2023-24: 50.31; pooled mean: 51.31), followed closely by T₃ (47.73 across all years), while T₆ was the lowest (32.34, 31.84,

and 32.09). The increased straw yield in T₂ and T₃ is attributed to the nutrient-rich environment provided by FYM and biofertilizers, which promote vegetative growth. Bhardwaj *et al.* (2014)^[12] noted that biofertilizers like Azotobacter and PSB enhance plant growth by improving nutrient cycling and root morphology, supporting higher biomass production.

Harvest Index

Vishnubhog (V1) exhibited a significantly higher harvest index than Jeeraphool (V2) (2022-23: 41.72 vs. 29.14; 2023-24: 41.61 vs. 26.50; pooled mean: 41.62 vs. 27.85), reflecting its greater efficiency in partitioning assimilates to grain rather than straw. This aligns with findings by Saini *et al.* (2023)^[12], who reported higher harvest indices in rice cultivars under conventional tillage due to better grain allocation.

Interestingly, the control treatment (T₆) showed the highest harvest index (2022-23: 37.21; 2023-24: 35.66; pooled mean: 36.41), followed by T₄ and T₃, while T₂ recorded the lowest (33.77, 33.08, and 33.67). The non-significant differences among organic treatments suggest that biofertilizers may not significantly alter the proportion of grain to total biomass compared to the control. This could be due to the higher straw yield in T₂ and T₃, which dilutes the harvest index despite higher grain yields. Subashini *et al.* (2007)^[14] noted that biofertilizer applications sometimes result in higher vegetative biomass, potentially reducing the harvest index in certain rice varieties.

Table 1: Effect of biofertilizers on morphology of some local cultivated varieties of rice in length of panicle per plant.

Treatment Details	Length of panicle per plant		
	2022-23	2023-24	Pooled Mean
Factor A: Variety (V)			
V ₁ : Vishnubhog	31.06	34.11	32.58
V ₂ : Jeeraphool	28.16	30.98	29.57
S.Em±	0.24	0.45	0.27
CD = (P=0.05)	0.70	1.33	0.78
Factor B: Organic Treatment (T)			
T ₁ : FYM @10 t ha ⁻¹ + BGA@1250 ml ha ⁻¹	29.21	32.21	30.71
T ₂ : FYM @10 t ha ⁻¹ +Azotobacter@1250 ml ha ⁻¹ + PSB@ 1250 ml ha ⁻¹ + KSB@ 1250 ml ha ⁻¹	31.91	34.84	33.38
T ₃ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Biofertilizer (consortia) @ 1250 ml ha ⁻¹	30.83	33.68	32.25
T ₄ : FYM @10 t ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	28.42	31.26	29.84
T ₅ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	30.14	33.14	31.64
T ₆ : Control	27.14	30.14	28.64
S.Em±	0.41	0.78	0.46
CD = (P=0.05)	1.21	2.30	1.35
Interaction(VxT)			
V ₁ T ₁	30.83	33.83	32.33
V ₁ T ₂	33.17	36.84	35.00
V ₁ T ₃	32.23	35.23	33.73
V ₁ T ₄	30.04	32.71	31.37
V ₁ T ₅	31.64	34.64	33.14
V ₁ T ₆	28.43	31.43	29.93
V ₂ T ₁	27.60	30.60	29.10
V ₂ T ₂	30.65	32.85	31.75
V ₂ T ₃	29.43	32.13	30.78
V ₂ T ₄	26.81	29.81	28.31
V ₂ T ₅	28.64	31.64	30.14
V ₂ T ₆	25.86	28.86	27.36
S.Em±	0.58	1.11	0.65
CD = (P=0.05)	NS	NS	NS

Table 2: Effect of biofertilizers on morphology of some local cultivated varieties of rice in number of seed per panicle.

Treatment Details	Number of seed per panicle		
	2022-23	2023-24	Pooled Mean
Factor A: Variety (V)			
V ₁ : Vishnubhog	229.43	249.39	239.41
V ₂ : Jeeraphool	213.03	223.00	218.01
S.Em±	2.64	3.08	1.88
CD = (P=0.05)	7.75	9.03	5.50
Factor B: Organic Treatment (T)			
T ₁ : FYM @10 t ha ⁻¹ + BGA@1250 ml ha ⁻¹	219.78	234.55	227.16
T ₂ : FYM @10 t ha ⁻¹ +Azotobactor@1250 ml ha ⁻¹ + PSB@ 1250 ml ha ⁻¹ + KSB@ 1250 ml ha ⁻¹	237.18	252.24	244.71
T ₃ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Biofertilizer (consortia) @ 1250 ml ha ⁻¹	230.28	245.33	237.80
T ₄ : FYM @10 t ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	211.76	226.76	219.26
T ₅ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	226.75	241.64	234.20
T ₆ : Control	201.64	216.64	209.14
S.Em±	4.58	5.33	3.25
CD = (P=0.05)	13.42	15.63	9.53
Interaction (VxT)			
V ₁ T ₁	226.76	246.50	236.63
V ₁ T ₂	245.70	265.84	255.77
V ₁ T ₃	239.13	259.23	249.18
V ₁ T ₄	218.71	238.71	228.71
V ₁ T ₅	235.87	255.64	245.75
V ₁ T ₆	210.43	230.43	220.43
V ₂ T ₁	212.80	222.60	217.70
V ₂ T ₂	228.65	238.65	233.65
V ₂ T ₃	221.43	231.43	226.43
V ₂ T ₄	204.81	214.81	209.81
V ₂ T ₅	217.64	227.64	222.64
V ₂ T ₆	192.86	202.86	197.86
S.Em±	6.47	7.54	4.60
CD = (P=0.05)	NS	NS	NS

Table 3: Effect of biofertilizers on morphology some local cultivated varieties of rice in test weight (1000 seed weight in g).

Treatment Details	Test weight (1000 seed weight in g)		
	2022-23	2023-24	Pooled Mean
Factor A: Variety (V)			
V ₁ : Vishnubhog	16.01	18.21	17.11
V ₂ : Jeeraphool	16.48	16.81	16.65
S.Em±	0.12	0.34	0.17
CD = (P=0.05)	0.34	1.00	NS
Factor B: Organic Treatment (T)			
T ₁ : FYM @10 t ha ⁻¹ + BGA@1250 ml ha ⁻¹	15.95	16.95	16.45
T ₂ : FYM @10 t ha ⁻¹ +Azotobactor@1250 ml ha ⁻¹ + PSB@ 1250 ml ha ⁻¹ + KSB@ 1250 ml ha ⁻¹	17.65	19.65	18.65
T ₃ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Biofertilizer (consortia) @ 1250 ml ha ⁻¹	17.13	18.73	17.93
T ₄ : FYM @10 t ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	15.31	16.31	15.81
T ₅ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	16.74	18.24	17.49
T ₆ : Control	14.69	15.19	14.94
S.Em±	0.20	0.59	0.29
CD = (P=0.05)	0.59	1.73	0.85
Interaction (VxT)			
V ₁ T ₁	15.50	17.50	16.50
V ₁ T ₂	17.75	20.75	19.25
V ₁ T ₃	17.13	19.33	18.23
V ₁ T ₄	14.81	16.81	15.81
V ₁ T ₅	16.64	18.64	17.64
V ₁ T ₆	14.23	16.23	15.23
V ₂ T ₁	16.40	16.40	16.40
V ₂ T ₂	17.55	18.55	18.05
V ₂ T ₃	17.13	18.13	17.63
V ₂ T ₄	15.81	15.81	15.81
V ₂ T ₅	16.84	17.84	17.34
V ₂ T ₆	15.16	14.16	14.66
S.Em±	0.28	0.83	0.41
CD = (P=0.05)	NS	NS	NS

Table 4: Effect of biofertilizers on morphology of some local cultivated varieties of rice in grain yield.

Treatment Details	Grain yield		
	2022-23	2023-24	Pooled Mean
Factor A: Variety (V)			
V ₁ : Vishnubhog	25.36	26.02	25.69
V ₂ : Jeeraphool	19.65	17.15	18.40
S.Em±	0.45	0.44	0.36
CD = (P=0.05)	1.33	1.29	1.07
Factor B: Organic Treatment (T)			
T ₁ : FYM @10 t ha ⁻¹ + BGA@1250 ml ha ⁻¹	21.55	21.05	21.30
T ₂ : FYM @10 t ha ⁻¹ +Azotobactor@1250 ml ha ⁻¹ + PSB@ 1250 ml ha ⁻¹ + KSB@ 1250 ml ha ⁻¹	26.59	25.59	26.09
T ₃ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Biofertilizer (consortia) @ 1250 ml ha ⁻¹	24.93	23.93	24.43
T ₄ : FYM @10 t ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	20.11	19.11	19.61
T ₅ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	23.84	22.84	23.34
T ₆ : Control	17.99	16.99	17.49
S.Em±	0.79	0.76	0.63
CD = (P=0.05)	2.31	2.23	1.85
Interaction(VxT)			
V ₁ T ₁	24.40	25.40	24.90
V ₁ T ₂	29.54	31.54	30.54
V ₁ T ₃	28.33	29.33	28.83
V ₁ T ₄	22.51	22.51	22.51
V ₁ T ₅	26.84	27.84	27.34
V ₁ T ₆	20.53	19.53	20.03
V ₂ T ₁	18.70	16.70	17.70
V ₂ T ₂	23.65	19.65	21.65
V ₂ T ₃	21.53	18.53	20.03
V ₂ T ₄	17.71	15.71	16.71
V ₂ T ₅	20.84	17.84	19.34
V ₂ T ₆	15.46	14.46	14.96
S.Em±	1.11	1.08	0.89
CD = (P=0.05)	NS	3.16	NS

Table 5: Effect of biofertilizers on morphology some local cultivated varieties of rice in straw yield.

Treatment Details	Straw yield		
	2022-23	2023-24	Pooled Mean
Factor A: Variety (V)			
V ₁ : Vishnubhog	36.36	36.86	36.61
V ₂ : Jeeraphool	47.73	47.73	47.73
S.Em±	0.91	0.78	0.61
CD = (P=0.05)	2.67	2.28	1.80
Factor B: Organic Treatment (T)			
T ₁ : FYM @10 t ha ⁻¹ + BGA@1250 ml ha ⁻¹	40.10	41.10	40.60
T ₂ : FYM @10 t ha ⁻¹ +Azotobactor@1250 ml ha ⁻¹ + PSB@ 1250 ml ha ⁻¹ + KSB@ 1250 ml ha ⁻¹	52.31	50.31	51.31
T ₃ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Biofertilizer (consortia) @ 1250 ml ha ⁻¹	47.73	47.73	47.73
T ₄ : FYM @10 t ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	36.21	37.21	36.71
T ₅ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	43.59	45.59	44.59
T ₆ : Control	32.34	31.84	32.09
S.Em±	1.58	1.35	1.06
CD = (P=0.05)	4.62	3.95	3.12
Interaction (VxT)			
V ₁ T ₁	34.60	35.60	35.10
V ₁ T ₂	48.78	45.78	47.28
V ₁ T ₃	43.23	43.23	43.23
V ₁ T ₄	29.71	30.71	30.21
V ₁ T ₅	37.54	40.54	39.04
V ₁ T ₆	24.33	25.33	24.83
V ₂ T ₁	45.60	46.60	46.10
V ₂ T ₂	55.85	54.85	55.35
V ₂ T ₃	52.23	52.23	52.23
V ₂ T ₄	42.71	43.71	43.21
V ₂ T ₅	49.64	50.64	50.14
V ₂ T ₆	40.36	38.36	39.36
S.Em±	2.23	1.90	1.50
CD = (P=0.05)	NS	NS	NS

Table 6: Effect of biofertilizers on morphology some local cultivated varieties of rice in harvest index.

Treatment Details	Harvest index		
	2022-23	2023-24	Pooled Mean
Factor A: Variety (V)			
V ₁ : Vishnubhog	41.72	41.61	41.62
V ₂ : Jeeraphool	29.14	26.50	27.85
S.Em±	0.66	0.64	0.48
CD = (P=0.05)	1.94	1.88	1.40
Factor B: Organic Treatment (T)			
T ₁ : FYM @10 t ha ⁻¹ + BGA@1250 ml ha ⁻¹	35.24	33.93	34.61
T ₂ : FYM @10 t ha ⁻¹ +Azotobacter@1250 ml ha ⁻¹ + PSB@ 1250 ml ha ⁻¹ + KSB@ 1250 ml ha ⁻¹	33.77	33.60	33.67
T ₃ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Biofertilizer (consortia) @ 1250 ml ha ⁻¹	34.33	33.08	33.74
T ₄ : FYM @10 t ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	36.05	34.65	35.30
T ₅ : FYM @10t ha ⁻¹ + BGA@1250 ml ha ⁻¹ + Azospirillum@ 1250 ml ha ⁻¹	35.97	33.42	34.67
T ₆ : Control	37.21	35.66	36.41
S.Em±	1.15	1.11	0.83
CD = (P=0.05)	NS	NS	NS
Interaction (VxT)			
V ₁ T ₁	41.41	41.49	41.47
V ₁ T ₂	37.80	40.84	39.21
V ₁ T ₃	39.52	39.96	39.78
V ₁ T ₄	42.86	42.78	42.73
V ₁ T ₅	42.00	40.73	41.29
V ₁ T ₆	46.73	43.88	45.23
V ₂ T ₁	29.08	26.37	27.76
V ₂ T ₂	29.75	26.36	28.13
V ₂ T ₃	29.13	26.20	27.70
V ₂ T ₄	29.23	26.52	27.88
V ₂ T ₅	29.93	26.11	28.05
V ₂ T ₆	27.70	27.44	27.58
S.Em±	1.62	1.57	1.17
CD = (P=0.05)	NS	NS	NS

4. Conclusion

The results indicate that Vishnubhog (V₁) is superior in seed number per panicle, grain yield, and harvest index, while Jeeraphool (V₂) excels in straw yield. Among organic treatments, T₂ and T₃ consistently outperformed others in most parameters, highlighting the efficacy of combining FYM with biofertilizers like Azotobacter, PSB, KSB, or BGA. These findings underscore the potential of biofertilizers to enhance rice productivity sustainably, aligning with global trends toward eco-friendly agriculture. Further studies should explore long-term effects on soil health and nutrient dynamics to optimize biofertilizer use in rice cultivation.

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6. Conflict of Interest

The authors declare no conflict of interest in the conduct of this study.

7. Future Scope

The findings of this study underscore the potential of biofertilizers in enhancing rice productivity and quality, particularly for local varieties like Vishnubhog and Jeeraphool. Future research could focus on long-term field trials to assess the sustained impact of biofertilizer treatments on soil health, microbial diversity, and nutrient dynamics in rice ecosystems. Exploring the efficacy of these treatments across diverse agro-climatic zones and other rice varieties in Chhattisgarh could further validate their scalability. Additionally, integrating molecular and genomic approaches to understand the interaction between biofertilizers and rice genotypes may provide insights into optimizing nutrient uptake and yield. Investigating the economic feasibility and environmental benefits of large-scale biofertilizer adoption could also guide policy recommendations for sustainable agriculture in the region.

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