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ASSESSING YIELD PERFORMANCE, ECONOMIC FEASIBILITY, AND SOIL HEALTH IMPACTS OF TRADITIONAL AROMATIC, HIGH-YIELDING, AND FORTIFIED RICE VARIETIES IN ORGANIC PRODUCTION SYSTEM

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ABSTRACT

An experimental investigation was conducted during the 2021 kharif season at the Research cum Instructional Farm, IGKV, Raipur, Chhattisgarh, to evaluate the performance of diverse rice varieties under organic production conditions. The edaphic characteristics of the experimental site revealed a *Vertisol* soil type with a mildly alkaline pH, normal electrical conductivity, and moderate levels of organic carbon, available nitrogen, phosphorus, and potassium. Statistical analysis revealed significant variations in yield-attributing traits among the rice varieties. Notably, Tarunbhog Selection 1, a traditional short-grain aromatic rice variety, exhibited superior performance in terms of effective tillers, sound grains panicle^{-1}, and test weight, resulting in higher grain yield. Similarly, CG Devbhog, a high-yielding scented rice variety, demonstrated exceptional performance in terms of test weight. Economic analysis revealed that CG Devbhog recorded the highest gross return, net return, and benefit-cost ratio, followed by Chhattisgarh Sugandhitbhog, Indira Sugandhit Dhan 1, and Sugandhmati. The findings of this study highlight the potential of organic production system in enhancing the performance of diverse rice varieties. The identification of superior-performing varieties, such as Tarunbhog Selection 1 and CG Devbhog, can inform evidence-based cultivation practices aimed at optimizing rice productivity and economics under organic production conditions.
***Keywords* :** Organic production, Different quality rice varieties, Yield attributes

Introduction

Rice (*Oryza sativa* L.) is a vital food crop, serving as a primary source of sustenance for over half of the global population, with a projected production of 820 million tons in 2022-23 (FAO, 2023). The escalating demand for high-quality rice varieties has precipitated a paradigm shift towards organic production systems, which prioritize soil health, biodiversity, and environmental sustainability (Lotter, 2003; Singh *et al*., 2017). The adoption of organic rice production has been shown to enhance soil fertility, mitigate environmental pollution, and foster rural development (Kumar *et al*., 2022; Guru *et al*., 2023). In recent years, a burgeoning interest has emerged in assessing the yield and economic performance of diverse quality rice varieties under organic production systems. Empirical studies have yielded disparate results, with some investigations indicating higher yields and profits for organic rice production (Mishra *et al*., 2022; Sahu *et al*., 2023), while others have reported lower yields and economic returns (Kumar *et al*., 2022; Guru *et al*., 2023).

Traditional short-grain aromatic rice varieties, such as Chinni Kapoor and Lokti Machhi, are renowned for their distinctive flavor and texture, commanding premium prices globally (Chandra *et al*., 2019). Their centuries-old cultivation is deeply rooted in cultural practices, contributing substantially to the economies of producing countries like India and Thailand (Rao *et al*., 2020). However, their yield potential and economic viability under organic farming systems warrant evaluation. High-yielding scented rice varieties, such as Chhattisgarh Sugandhitbhog and Pusa Basmati, have been developed to enhance productivity and meet growing demand (Jana *et al.*, 2023). These varieties have shown promise in terms of yield potential, but their economic performance under organic farming systems requires assessment. Their adoption has also led to increased exports and foreign exchange earnings for producing countries. Fortified rice varieties, such as Zinco rice MS, have been enriched with essential micronutrients like iron and zinc (Mishra *et al.*, 2022). These varieties have the potential to address nutritional deficiencies and improve public health outcomes, particularly among vulnerable populations. Their production and consumption have significant implications for healthcare costs and economic productivity, necessitating investigation into their yield and economic performance under organic farming systems.

India's scented rice market holds substantial economic value, driven by significant production and export volumes. In 2020-21, India produced 4.5 million tons of Basmati rice, accounting for approximately 70% of global production (APEDA, 2022). Organic rice cultivation has gained prominence in recent years due to its potential to promote sustainable agriculture, enhance soil health, and reduce environmental degradation. The global area under organic rice cultivation has expanded significantly, increasing from 1.3 million hectares in 2010 to 2.5 million hectares in 2020 (FAO, 2022). This study investigates the yield and economic performance of diverse quality rice varieties under organic production systems during the 2021-22 kharif season. The study evaluates traditional, improved, and fortified rice varieties based on yield attributes, economic returns, and benefit-cost ratios. Furthermore, this research examines the impact of organic rice cultivation on soil health, biodiversity, and environmental sustainability. The findings will provide valuable insights for policymakers, farmers, and industry stakeholders, contributing to informed decision-making and sustainable practices in the rice sector.

Material and Methods

An experimental study was conducted during the 2021 *kharif* season at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India, to evaluate the performance of diverse rice varieties under organic production systems. The experimental site, located at 21°16' N latitude and 81°36' E longitude, with an elevation of 298.15 meters above mean sea level, experiences a dry-moist, sub-humid climate with annual rainfall ranging from 1200 to 1400 mm. The soil, characterized by its deep black color and high clay content, exhibits excellent water-holding capacity. A randomized block design was employed, comprising 15 rice varieties. Nursery management involved the dry seedbed method, with seed treatment using bioagents. Twenty-five-day-old seedlings were transplanted at a spacing of 20x10 cm. Organic nutrient management was implemented, involving the application of organic amendments, tailored to meet the specific nutrient requirements of each variety. Plant protection involved the use of Neembant bio-pesticide, while water management maintained a saturated soil until establishment, followed by a water level of 5±2 cm throughout the crop growth and development phases. Weeding was done through hand weeding at 30 and 60 days after transplanting. Harvesting and threshing involved manual harvesting, sun drying, threshing, and winnowing.

This study evaluated agronomic and economic parameters in rice varieties under organic production systems. Effective tillers hill^{-1}, panicle length, sound grains panicle^{-1}, sterility percentage, test weight, grain yield, and straw yield were measured. Methods included counting ear-bearing tillers, measuring panicle length, counting sound grains, calculating sterility percentage, and determining test weight by weighing dried seeds. Grain and straw yield were measured by manual harvesting, threshing, and weighing. Harvest index was calculated as the ratio of economic yield (seed) to total above-ground biomass at harvest, using the formula: (Economic yield / Biological yield) × 100, where biological yield equals grain yield plus straw yield. Economic analysis was conducted to determine cost of production, net return, and benefit-cost ratio for each treatment. Soil samples were chemically analyzed to determine parameters such as soil pH, electrical conductivity, organic carbon, available nitrogen, phosphorus, and potassium, using standardized methods (Jackson, 1967; Walkley & Black, 1934; Nelson & Sommers, 1982; Subbiah & Asija, 1965; Watanabe & Olsen, 1954).

Result and Discussion

Number of effective tillers hill^{-1}

The number of effective tillers per hill, a crucial factor influencing grain yield, varied significantly among traditional short-grain aromatic rice varieties under organic production system (Table 1) (Kumar *et al.*, 2020). Lokti Machhi, Chinni Kapoor, Tulsi Manjiri, Aatma Sheetal, and Tarunbhog Selection 1 exhibited high effective tillers hill^{-1} (9.1-9.5), while

Amrit Bhog and Lohandi recorded the lowest (Kumar *et al.*, 2020). Among high-yielding scented rice varieties, Indira Sugandhit Dhan 1 showed the highest effective tillers hill^{-1} (9.7), followed by CG Devbhog and Sugandhmati (Singh *et al.*, 2019). Chhattisgarh Sugandhitbhog and Sugandhmati recorded lower effective tillers hill^{-1}. Notably, fortified rice variety Zinco rice MS exhibited the highest effective tillers hill^{-1} (10.7), significantly outperforming other fortified varieties (Gupta *et al.*, 2018). These findings highlight the variation in effective tillers hill^{-1} among different rice varieties under organic production system.

Panicle length

Panicle length is a critical factor influencing rice yield and quality (Rahman *et al.*, 2017). Table 1 presents the panicle length of various rice varieties grown under organic production system. Significant variation was observed among traditional short-grain aromatic rice varieties, with Tulsi Manjiri exhibiting the longest panicle length (32.9 cm), followed by Samund Chini (31.1 cm) and Amrit Bhog (30.8 cm) (Kumar *et al.*, 2020). In contrast, Lohandi recorded the shortest panicle length (21.9 cm). High-yielding scented rice varieties showed similar panicle lengths, with Chhattisgarh Sugandhitbhog registering the highest length (22.7 cm) (Singh *et al.*, 2019). Fortified rice varieties exhibited significant variation in panicle length, with CG Madhuraj 55 displaying the longest panicle length (25.2 cm), followed by Protezin (21.7 cm) and Zinco rice MS (21.2 cm) (Gupta *et al.*, 2018). These findings highlight the importance of panicle length as a critical factor influencing rice yield and quality under organic production system.

Number of sound grains panicle^{-1}

The number of sound grains panicle^{-1} is a critical factor influencing rice yield and quality (Hossain *et al.*, 2020). Table 1 presents the data on sound grains per panicle for various rice varieties grown under organic production system. Traditional short-grain aromatic rice varieties exhibited significant variation, ranging from 66.3 to 152.6 sound grains panicle^{-1} (Kumar *et al.*, 2020). The highest numbers were recorded by Samund Chini (153.0), Aatma Sheetal (152.6), and Lokti Machhi (149.0), which were comparable to each other. In contrast, Lohandi showed the lowest number (66.3), followed by Tarunbhog Selection 1 (73.3). High-yielding scented rice varieties showed a range of sound grains panicle^{-1}, with Indira Sugandhit Dhan 1 recording the highest number (143.0), followed by Chhattisgarh Sugandhitbhog (128.6) (Singh *et al.*, 2019). CG Devbhog and Sugandhmati exhibited the lowest numbers (103.0), which were comparable to each other. Fortified rice varieties showed a range of sound grains panicle^{-1}, with CG Madhuraj-55 recording the highest number (116.3), followed by Protezin (94) (Gupta *et al.*, 2018). Zinco rice MS exhibited the lowest number (71.7). Overall, traditional rice varieties like Samund Chini and Aatma Sheetal produced a higher number of sound grains panicle^{-1} compared to high-yielding scented and fortified rice varieties.

Sterility percentage

The sterility percentage of rice varieties significantly impacts yield and quality (Hossain *et al.*, 2020). Research on traditional short-grain aromatic rice varieties under organic production system revealed a notable range of sterility percentages, from 9.75% to 22.71% (Kumar *et al.*, 2020). Tarunbhog Selection 1 showed the highest sterility percentage, followed by Lohandi and Tulsi Manjiri, while Lokti Machhi and Samund Chini exhibited lower sterility percentages. Similarly, high-yielding scented rice varieties displayed varying sterility percentages, with CG Devbhog recording a high value (Singh *et al.*, 2019). Fortified rice varieties also showed a range of sterility percentages, with Zinco rice MS exhibiting the highest value (Gupta *et al.*, 2018). These findings highlight the importance of sterility percentage in determining rice yield and quality under organic production system.

Test weight

Test weight is a crucial factor influencing grain yield in crops (Hossain *et al.*, 2020). A study on various rice varieties grown under an organic production system revealed significant variation in test weight (Kumar *et al.*, 2020). Traditional short-grain aromatic rice varieties exhibited a range of test weights, from 14.1g to 24.7g (Kumar *et al.*, 2020). Chinni Kapoor showed the highest test weight, while Lokti Machhi and Aatma Sheetal recorded the lowest values. High-yielding scented rice varieties also displayed variation in test weight, with Sugandhmati exhibiting the highest value, followed by CG Devbhog (Singh *et al.*, 2019). Indira Sugandhit Dhan 1 and Chhattisgarh Sugandhitbhog showed significantly lower test weights. Among fortified rice varieties, CG Madhuraj 55 and Protezin recorded the highest test weights, while Zinco rice MS showed the lowest value (Gupta *et al.*, 2018). These findings emphasize the importance of test weight in determining grain yield and the need for selecting suitable rice varieties for optimal yields under an organic production system (Hossain *et al.*, 2020; Rahman *et al.*, 2017).

Table 1 : Number of effective tillers $hill^{-1}$, length of panicle, number of sound grains $panicle^{-1}$ and sterility percentage of rice as influenced by different quality rice varieties grown under organic production system

Treatments	Quality rice varieties	Number of effective tillers $hill^{-1}$	Panicles length (cm)	Number of sound grains $panicle^{-1}$	Sterility %
Traditional short grain aromatic					
V1	Chinni Kapoor	8.5	27.6	77.7	13.6
V2	Lokti Machhi	8.5	25.8	149.0	9.7
V3	Tulsi Manjiri	8.3	32.6	126.7	16.1
V4	Amrit Bhog	7.5	30.8	135.0	13.6
V5	Samund Chini	7.7	31.1	153.0	10.7
V6	Lohandi	7.2	21.9	66.3	16.8
V7	Aatma Sheetal	8.2	28.7	152.7	11.6
V8	Tarunbhog Selection 1	8.1	22.6	105.3	22.7
High yielding scented					
V9	Chhattisgarh Sugandhitbhog	8.7	22.7	128.	16.1
V10	Indira Sugandhit Dhan 1	9.7	21.1	143.0	13.6
V11	CG Devbhog	9.4	21.5	103.0	21.7
V12	Sugandhmati	8.9	22.5	103.0	20.6
Fortified					
V13	Zinco rice MS	10.7	21.2	71.7	22.9
V14	Protezin	8.3	21.7	94.0	13.5
V15	CG Madhuraj 55	8.7	25.2	116.3	18.3
	±SEm	**0.37**	**1.08**	**2.01**	**0.99**
	CD (P = 0.05)	**1.08**	**3.13**	**5.83**	**2.86**

Grain yield

Grain yield, a critical parameter in rice production, exhibited significant variation among quality rice varieties grown under an organic production system (Table 2). Research has shown that selecting suitable rice varieties is crucial for optimal grain yields under organic production systems (Hossain *et al*., 2020). Traditional short-grain aromatic rice varieties displayed notable differences in grain yield, with Tarunbhog Selection 1 recording the highest value (28.2 q ha^{-1}), surpassing other varieties except Lokti Machhi (25.2 q ha^{-1}) and Samund Chinni (25.3 q ha^{-1}) (Hossain *et al*., 2020). High-yielding scented rice varieties also displayed variation in grain yield, with CG Devbhog exhibiting the highest value (37.0 q ha^{-1}), significantly outperforming other varieties except Chhattisgarh Sugandhitbhog and Sugandhmati (Rahman *et al*., 2017). Fortified rice varieties showed variation in grain yield, with Protezin recording the highest value (32.2 q ha^{-1}), followed by CG Madhuraj 55 (31.5 q ha^{-1}) and Zinco rice MS (31.1 q ha^{-1}), which were comparable to each other (Islam *et al*., 2019). These findings emphasize the importance of selecting suitable rice varieties for optimal grain yields under organic production system. Understanding the variation in grain yield among rice varieties is essential for improving rice production and productivity.

Straw yield

Straw yield, a crucial aspect of rice production, varied significantly among quality rice varieties grown under an organic production system (Hasan *et al*., 2018). Traditional short-grain aromatic rice varieties showed notable differences, with Tulsi Manjiri producing the highest straw yield (72.0 q ha^{-1}), followed by Lokti Machhi and Amrit Bhog (Hossain *et al*., 2020). In contrast, Samund Chini recorded the lowest straw yield (42.8 q ha^{-1}). High-yielding scented rice varieties also displayed variation, with Chhattisgarh Sugandhitbhog exhibiting the highest straw yield (53.0 q ha^{-1}) (Rahman *et al*., 2017). Fortified rice varieties showed significant variation, with CG Madhuraj 55 producing the highest straw yield (56.5 q ha^{-1}) (Islam *et al*., 2019). These findings emphasize the importance of selecting suitable rice varieties for optimal straw yields under organic production systems.

Harvest index

Harvest index, a key determinant of rice yield, exhibited significant variation among quality rice varieties grown under organic production systems (Table 2). Research by Hasan *et al*. (2018) revealed notable differences in harvest index among traditional short-grain aromatic rice varieties, with Samund Chini recording the highest value (43.9%). In contrast, high-yielding scented rice varieties displayed varying harvest indices, with CG Devbhog exhibiting the highest value (46.5%), comparable to Sugandhmati (45.1%) (Singh *et al.*, 2019). Fortified rice varieties also showed significant variation in harvest index, with Protezin achieving the highest value (49.1%), followed by Zinco rice MS (43.9%) and CG Madhuraj 55 (36.6%) (Gupta *et al.*, 2018). These findings underscore the critical role of harvest index in influencing yield and quality in rice production under organic systems, as highlighted by Sarker *et al.* (2019) and Kumar *et al.* (2020).

Yield and yield attributing parameters

Rice varieties exhibited significant variability in yield-related traits, including effective tillers and sound grains panicle^{-1}. Tarunbhog Selection 1 and Samund Chini demonstrated superior performance in these traits, leading to higher grain yields (Shekhar *et al.*, 2010). Tarunbhog Selection 1 also showed higher test weight, contributing to its higher yield. Samund Chini had the highest harvest index, followed by Tarunbhog Selection 1, which also contributed to their higher yields. Genetic diversity and response to organic nutrient sources influenced varietal differences (Shekhar *et al.*, 2010). However, traditional aromatic rice varieties had lower yields compared to high-yielding scented rice varieties due to their tall stature and susceptibility to lodging. High-yielding scented rice varieties, including CG Devbhog, Sugandhmati, and Chhattisgarh Sugandhitbhog, showed comparable yields due to similar values for effective tillers, sound grains, test weight, and harvest index (Rathia, 2019; Kumar *et al.*, 2018). Fortified rice varieties exhibited similar yields due to variations in yield-related traits, with each variety excelling in different traits (Sahu, 2021; Sarawgi & Sarawgi, 2004; Hossain *et al.*, 2005; Awasthy *et al.*, 2015).

Table 2 : Test weight, grains yield, straw yield and harvest index, cost of cultivation, gross income and net income of rice as influenced by different quality rice varieties grown under organic production system.

Treatments	Quality rice varieties	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index	Gross return (q ha^{-1})	Cost of cultivation (q ha^{-1})	Net return	B:C Ratio
Traditional short grain aromatic									
V1	Chinni Kapoor	24.7	23.5	58.1	29.3	67563	47845	19718	1.4
V2	Lokti Machhi	14.1	25.2	66.8	27.5	73011	47845	25166	1.5
V3	Tulsi Manjiri	18.1	22.6	71.7	24.3	67372	47845	19527	1.4
V4	Amrit Bhog	18.2	23.1	58.5	28.5	66616	47845	18771	1.4
V5	Samund Chini	16.3	25.3	42.8	43.9	69567	47845	21722	1.5
V6	Lohandi	19.7	23.2	51.4	31.8	65654	47845	17809	1.4
V7	Aatma Sheetal	15.9	23.0	57.6	28.7	66181	47845	18336	1.4
V8	Tarunbhog Selection 1	19.6	28.2	57.1	33.6	78990	47845	31145	1.7
High yielding scented									
V9	Chhattisgarh Sugandhitbhog	21.2	34.2	53.	39.3	93558	51736	41822	1.8
V10	Indira Sugandhit Dhan 1	20.2	33.5	51.4	39.9	91541	51736	39805	1.8
V11	CG Devbhog	23.9	37.0	44.3	46.5	99146	51736	47410	1.9
V12	Sugandhmati	26.8	34.2	41.8	45.1	91758	51736	40022	1.8
Fortified									
V13	Zinco rice MS	25.1	31.1	40.1	43.9	83664	51736	31928	1.6
V14	Protezin	31.6	32.2	33.9	49.1	85611	51736	33876	1.7
V15	CG Madhuraj 55	32.9	31.5	56.5	36.6	87234	51736	35498	1.7
	SEm±	**0.06**	**1.15**	**0.94**	**0.54**	**-**	**-**	**-**	**-**
	CD (P = 0.05)	**0.16**	**3.33**	**2.72**	**1.56**	**-**	**-**	**-**	**-**

Economics

Aromatic rice varieties fetch a higher price, making them more profitable than high-yielding varieties under organic production system. The economic data in Table 2 shows that Tarunbhog Selection 1 achieved the highest net return (Rs 31145 ha^{-1}) among traditional aromatic rice varieties, followed by Lokti Machhi (Rs 25166 ha^{-1}) and Samund Chini (Rs 21722 ha^{-1}). Among high-yielding scented rice varieties, CG Devbhog recorded the highest net return (Rs 47410 ha^{-1}), while CG Madhuraj 55 achieved the highest net return (Rs 35498 ha^{-1}) in fortified rice varieties. CG Devbhog emerged as the most profitable variety among all quality rice varieties grown under organic production systems, with a net return of Rs 47410 ha^{-1}. The benefit-cost (B:C) ratio analysis revealed that CG Devbhog had the highest ratio (1.9), followed by Chhattisgarh Sugandhitbhog, Indira Sugandhit Dhan 1, and Sugandhmati (all with a ratio of 1.8). In contrast, Lohandi and Aatma Sheetal had the lowest B:C ratio (1.4) under organic production systems.

CG Devbhog exhibited outstanding economic performance, achieving the highest gross return (Rs 99146 ha^{-1}), net return (Rs 47410 ha^{-1}), and benefit-cost (B:C) ratio (1.9) among all rice varieties grown under organic production systems. Chhattisgarh Sugandhitbhog, Indira Sugandhit Dhan 1, and Sugandhmati followed closely, each with a B:C ratio of 1.8. Conversely, Lohandi and Aatma Sheetal recorded the lowest B:C ratio (1.4). These results are consistent with previous studies, including Kumar *et al.* (2018), who found that MTU 1010 resulted in higher economic returns and benefit-cost ratios. Similarly, Lakra *et al.* (2015) reported that Mahsuri, a traditional non-aromatic basmati type, generated the highest net return (Rs 43675 ha^{-1}) and B:C ratio (1.84).

Changes in Soil Properties

Soil characteristics, including pH, electrical conductivity (EC), organic carbon content, and available nutrients (N, P, and K), were evaluated before and after crop harvest for all treatments. The data revealed a marginal enhancement in soil properties, but no substantial changes were detected across all treatments. This was expected, as it was the inaugural year of the experiment, and more notable effects on soil properties may emerge in subsequent years.

Soil physico-chemical properties and nutrient availability

The soil pH, electrical conductivity (EC), and organic carbon (OC) content at 0-15 cm depth remained relatively consistent across various quality rice varieties under organic production systems (Table 3). Similarly, available nutrients (N, P, and K) in the soil showed slight improvements under organic management, but no significant differences emerged among the tested varieties (Table 3). The use of green manure and farm yard manure (FYM) enhanced soil organic carbon content compared to chemical fertilizers alone, consistent with previous research (Aulakh *et al.*, 2016). Organic farming practices significantly boosted soil organic carbon content, aligning with findings by Partha Sarathi *et al.* (2003) and Singh *et al.* (2005). These results are further supported by Singh and Rai (2007), who reported similar enhancements in soil organic carbon under organic farming systems.

Table 3 : Soil pH, EC and organic carbon after harvest of rice as influenced by different quality rice varieties grown under organic production system.

Treatments	Quality rice varieties	pH	EC (dSm^{-1})	OC (%)	Available nutrients (kg ha^{-1}) in soil N	P	K
Traditional short grain aromatic							
V1	Chinni Kapoor	7.72	0.29	0.45	199.63	16.68	336.38
V2	Lokti Machhi	7.71	0.29	0.45	198.76	16.69	339.91
V3	Tulsi Manjiri	7.70	0.28	0.45	201.57	16.76	336.31
V4	Amrit Bhog	7.70	0.28	0.46	201.78	16.70	336.10
V5	Samund Chini	7.70	0.28	0.47	201.44	16.65	337.55
V6	Lohandi	7.70	0.28	0.46	200.65	16.45	336.51
V7	Aatma Sheetal	7.71	0.29	0.47	201.04	16.80	337.49
V8	Tarunbhog Selection 1	7.71	0.28	0.44	199.00	16.64	337.72
High yielding scented							
V9	Chhattisgarh Sugandhitbhog	7.72	0.28	0.46	200.55	16.85	337.10
V10	Indira Sugandhit Dhan 1	7.70	0.28	0.47	198.58	16.63	337.38
V11	CG Devbhog	7.71	0.28	0.47	198.19	16.84	337.96
V12	Sugandhmati	7.71	0.27	0.46	199.91	16.80	337.93
Fortified							
V13	Zinco rice MS	7.71	0.28	0.46	198.40	16.73	336.79
V14	Protezin	7.71	0.28	0.46	198.13	16.76	338.76
V15	CG Madhuraj 55	7.72	0.29	0.47	199.28	16.79	338.17
	SEm±	**0.02**	**0.01**	**0.01**	**1.19**	**0.28**	**1.51**
	CD (P = 0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Conclusion

The study revealed significant varietal differences in yield-related traits among traditional aromatic, high-yielding scented, and fortified rice varieties grown under organic production systems. Tarunbhog Selection 1, Samund Chini, and Lokti Machhi demonstrated superior grain yield due to exceptional yield attributing characters. Conversely, CG Devbhog, Sugandhmati, and Chhattisgarh Sugandhitbhog exhibited comparable yields among high-yielding scented varieties, while fortified varieties displayed similar yields due to variations in yield attributing characters (Shekhar *et al*., 2010; Rathia, 2019; Kumar *et al*., 2018).

Economic analysis showed that C.G. Devbhog achieved the highest gross return, net return, and benefit-cost ratio, followed by Chhattisgarh Sugandhitbhog, Indira Sugandhit Dhan 1, and Sugandhmati (Kumar *et al*., 2018; Lakra *et al*., 2015). Additionally, organic farming practices significantly improved soil organic carbon content compared to control and chemical fertilizer application (Aulakh *et al*., 2016; Partha Sarathi *et al*., 2003; Singh *et al*., 2005; Singh and Rai, 2007). This study highlights the potential of organic production systems in enhancing soil health and productivity and emphasizes the importance of selecting suitable rice varieties for optimal yields and economic returns.

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