**Studies on growth and yield behavior of short grain aromatic traditional, improved scented and fortified quality rice varieties under organic production system**

**ABSTRACT**

An investigation was conducted at the Instructional Cum Research Farm, Department of Agronomy, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh), to evaluate the performance of various quality rice varieties under organic farming conditions. The study utilized a Randomized Block Design with three replications and fifteen treatments, consisting of eight traditional short-grain aromatic, four high-yielding scented, and three fortified rice varieties. The findings showed significant differences in plant height among varieties, with Amrit Bhog, a traditional short-grain aromatic variety, exhibiting the maximum plant height at harvest, while CG Devbhog, a high-yielding scented variety, displayed the minimum plant height. In terms of tiller production, Indira Sughandhit Dhan 1 and Chhattisgarh Sugandhitbhog, both high-yielding scented varieties, showed superior performance, whereas Zinco rice MS, a fortified variety, demonstrated exceptional performance within its group. Amrit Bhog excelled in dry matter accumulation, leaf area, and leaf area index (LAI) across all varieties. Notably, CG Devbhog achieved the highest grain yield (37.0 q ha-1), outperforming all high-yielding scented varieties. Among traditional short-grain aromatic varieties, Tarunbhog Selection 1 and Lokti Machhi produced higher yields, while Protezin, a fortified variety, showed superior performance within its group. This study underscores the potential of diverse quality rice varieties under organic farming conditions in Chhattisgarh's agro-climatic conditions.

***KEY WORDS:*** *Organic rice production, Rice varieties, Grain yield and Agronomic performance*

**INTRODUCTION**

Rice (*Oryza sativa* L.) is a vital food crop, serving as a primary source of sustenance for over half of the global population. India stands as one of the global leading producers and consumers of rice (Kumar *et al*., 2019). The country's rice production sector is predominantly comprised of smallholder farmers, who often struggle to adopt sustainable and profitable farming practices due to various challenges (Singh *et al*., 2018). In recent years, there has been a surge of interest in exploring organic farming and biofortification as innovative strategies to enhance the environmental sustainability and nutritional quality of rice production in India (Bouis & Welch, 2010; ICAR, 2020). Rice is the predominant crop in Chhattisgarh, occupying over 70% of the state's total cropped area (Singh *et al*., 2020). The state's kharif rice production, productivity, and area for the year 2020-21 were 8.34 million tons, 2,433 kg ha-1, and 3.43 million hectares, respectively (*DES*, Government of Chhattisgarh, 2021). At the national level, India's kharif rice production, productivity, and area for the year 2020-21 were 103.45 million tons, 2,656 kg ha-1, and 39.42 million hectares, respectively (Min. of Agri. & FW. 2021). Chhattisgarh contributes approximately 8% to India's total kharif rice production (Singh *et al*., 2020). However, the state's rice productivity is lower than the national average, highlighting the need for improved agricultural practices and technologies to enhance productivity (Kumar *et al*., 2019).

India has solidified its position as a prominent player in the global organic farming sector, ranking ninth worldwide in terms of total arable land dedicated to organic cultivation and boasting the largest number of organic producers globally (APEDA, 2021). During the 2020-21 period, India's production of certified organic products reached approximately 3.49 million tons, showcasing a notable increase from the previous year. The country's export volume and value of organic products also witnessed significant growth, with 0.7489 million tons valued at Rs. 52,870 million (702 million USD) being exported during the same period (APEDA, 2021). The successful implementation of the All-India Network Programme on Organic Farming (AI NPOF) by the Indian Council of Agricultural Research (ICAR) has played a pivotal role in promoting organic farming practices in India, contributing to the country's burgeoning organic sector (ICAR, 2021).

This paper presents a comprehensive examination of the current state of rice production in India, with a particular emphasis on organic farming, aromatic rice, and biofortification. Aromatic rice, a premium segment of rice distinguished by its distinctive fragrance when cooked, commands higher prices in the market due to its exceptional quality (Singh *et al*., 2018; Kumar *et al*., 2019). Biofortification, a process involving the development of nutrient-dense staple food crops through conventional breeding and modern biotechnology, offers a viable approach to enhancing the nutritional value of rice without compromising agronomic performance (Bouis & Welch, 2010). Unlike conventional fortification, biofortification focuses on enhancing nutritional value during the growth stage (Nestel *et al*., 2006). Organic farming, a holistic approach to rice production, prioritizes soil health, biodiversity, and ecosystem services (APEDA, 2020). In contrast, biofortification involves breeding nutrient-dense rice varieties to address micronutrient deficiencies in human populations (Nestel *et al*., 2006). Aromatic rice offers opportunities for smallholder farmers to enhance their livelihood through value-added production (Kumar *et al*., 2019). This paper explores the potential of organic farming, aromatic rice, and biofortification to contribute to a more sustainable and equitable rice production system in India.

**MATERIALS AND METHODS**

A research investigation was carried out during the *kharif* season of 2021 at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh), to assess the performance of diverse rice varieties under organic farming conditions. The experimental site, located at 21º 16' N latitude and 81º 36' E longitude, with an elevation of 298.15 meters above mean sea level, had a *Vertisol* soil type with a mildly alkaline pH, moderate electrical conductivity (0.31 dsm-2), and relatively low levels of organic carbon (0.42%), available nitrogen (204.7 kg ha-1), and available phosphorus (16 kg ha-1), but high levels of available potassium (340.2 kg ha-1). The study employed a Randomized Block Design with three replications and fifteen treatments, consisting of eight traditional short-grain aromatic rice varieties, four high-yielding scented rice varieties, and three fortified rice varieties. The experimental field was prepared using a combination of tractor ploughing, puddling, and leveling. Rice seedlings were raised in a nursery using a dry seedbed method and transplanted to the main field after 25 days, with a spacing of 20 x 10 cm. Organic manures, including Farm Yard Manure, Vermicompost, Neem Cake, and Rock Phosphate, were applied based on the specific nutrient requirements of each variety. Foliar applications of Vermiwash 10% were made at 30 and 50 days after transplanting, and a broad-spectrum bio-pesticide, Neembant 3% liquid ha-1, was applied twice after tillering to control pests. The crop was maintained under saturated conditions during the establishment phase and subsequently at a water level of 5 ± 2 cm throughout the growth period. Weeds were controlled through hand weeding at 30 and 50 days after transplanting. The crop was harvested manually, and the produce was threshed and winnowed to separate the grains from the chaff and straw. The grains were weighed plot-wise to determine the yield. This study aimed to evaluate the performance of various rice varieties under organic production conditions and identify suitable varieties for sustainable rice production.

Growth parameter evaluations were conducted prior to harvest to assess various aspects of rice variety development. Plant density was assessed at 30 days after transplanting (DAT) and at harvest by counting the number of plants in 1 m² areas from four randomly selected spots in each plot, using the formula: Plant density = Area / Plant spacing. Plant height was measured in centimeters from the soil surface to the topmost leaf at 30, 60, and 90 DAT. Tiller production was evaluated by counting the number of tillers from five tagged hills at 30, 60, and 90 DAT, expressing the results as tillers hill-1. Dry matter accumulation was assessed by harvesting one hill per plot, removing roots, and drying the shoot portion in an oven at 65°C for 24-48 hours. The duration from transplanting to 50% flowering was recorded by observing each plot to determine the time taken for 50% of the plants to reach heading stage. Leaf area was measured at 30, 60, and 90 DAT using the formula: Leaf area (cm²) = K × L × W, where K represents the leaf area coefficient (0.75), L is the maximum leaf length, and W is the maximum leaf width. Leaf Area Index (LAI) was calculated using the formula: LAI = Total leaf area per hill (cm²) / Total ground area per hill (cm²), representing the total leaf area in relation to the total ground area.

Crop growth rate (CGR) and relative growth rate (RGR) are crucial metrics for assessing the growth and productivity of rice varieties. CGR represents the total dry matter productivity of the crop per unit land area over a specified time period, measured in g day-1 hill-1. It is calculated using the formula: CGR = (W2 - W1) / (T2 - T1), where W1 and W2 are the dry weights per unit area at the initial and final sampling times, respectively, and T1 and T2 are the corresponding time intervals. RGR, on the other hand, expresses the dry weight increases over a time interval relative to the initial weight. It is measured as the mass increase per aboveground biomass per day, typically in g g-1 day-1 hill-1. The mean RGR is calculated using the formula: RGR = (logeW2 - logeW1) / (T2 – T1), where ln is the natural logarithm, and W1 and W2 are the dry weights of the plant at times T1 and T2, respectively.

**RESULTS AND DISCUSSION**

**Plant height**

The impact of genetic variation on plant height in diverse quality rice varieties was investigated under an organic production system. The results presented in Table 1 demonstrate a gradual increase in plant height with crop age, with the most rapid growth occurring between 30 to 60 days after transplanting (DAT). The growth rate subsequently slowed down between 90 DAT and harvest. Significant differences in plant height were observed among varieties at all growth stages, attributable to their genetic makeup (Lakra *et al*., 2012; Sharma *et al*., 2020; Kumar *et al*., 2019; Gupta *et al*., 2020). The initial growth rate (0-30 DAT) was highest in Tarunbhog Selection 1, closely followed by Samund Chini. At harvest, Amrit Bhog exhibited the maximum plant height (202 cm), surpassing Samund Chini (198 cm) and Chinni Kapoor (194 cm). Among traditional varieties, Tarunbhog Selection-1 had the shortest plant height (163 cm) at harvest, followed by Lohandi (166 cm). In contrast, Indira Sugandhit Dhan-1, a high-yielding scented variety, displayed the highest plant height (140 cm), while CG Devbhog had the lowest (85.9 cm). Among fortified rice varieties, CG Madhuraj 55 had the highest plant height (135.8 cm), whereas Zinco rice MS had the shortest plants (96.7 cm). These findings are consistent with previous research (Lakra *et al*., 2012; Sharma *et al*., 2020; Kumar *et al*., 2019; Gupta *et al*., 2020), highlighting the significant influence of genetic variation on plant height in rice varieties under organic production condition.

**Number of tillers**

The tillering behavior of diverse quality rice varieties exhibited significant variation, emphasizing the crucial role of tillering ability as a key yield attributing character (Kumar *et al*., 2022). The number of tillers hill-1 increased with crop age up to 90 days after transplanting (DAT), followed by a slight reduction at maturity, consistent with previous findings (Singh *et al*., 2020). Among traditional aromatic rice varieties, Lokti Machhi displayed the highest number of tillers hill-1, with a mean value of 11.4, which was comparable to other short-grain traditional aromatic rice varieties, except Amrit Bhog (Kumar *et al*., 2022). In contrast, Chhattisgarh Sugandhitbhog, a high-yielding scented rice variety, produced the highest number of tillers hill-1 at all observation stages, surpassing other high-yielding scented rice varieties. Regarding fortified rice varieties, Zinco rice MS produced the maximum number of tillers hill-1 at all observation stages, including 30, 60, 90 DAT, and at harvest, supporting similar findings by Rathia (2019). These results underscore the significance of genetic variation in determining tillering dynamics in quality rice varieties under organic production system.

**Dry matter accumulation**

The data presented in Table 1 demonstrate a notable progression in dry matter accumulation as the rice varieties mature, emphasizing the crucial role of genetic diversity in influencing dry matter accumulation. Distinct variations in dry matter accumulation were observed among the rice varieties at different growth stages, aligning with previous research findings. Among the traditional short-grain aromatic rice varieties, Chinni Kapoor and Amrit Bhog exhibited exceptional dry matter accumulation, with mean values of 6.7g hill-1 and 6.5g hill-1, respectively. Lohandi displayed remarkable dry matter accumulation at 60 DAT, while Amrit Bhog showed superior accumulation at 90 DAT and at harvest. In contrast, Aatma Sheetal recorded the lowest dry matter accumulation across various stages. High-yielding scented rice varieties, CG Devbhog and Indira Sugandhit Dhan 1, displayed impressive dry matter accumulation at 30 DAT, with mean values of 6g hill-1 and 5.9g hill-1, respectively. Chhattisgarh Sugandhitbhog exhibited higher accumulation at 60 DAT, while CG Devbhog showed superior accumulation at 90 DAT and at harvest. Among fortified rice varieties, Protezin and CG Madhuraj 55 displayed notable dry matter accumulation at 30 DAT, with mean values of 5g hill-1 and 4.5g hill-1, respectively. CG Madhuraj 55 exhibited higher accumulation at 60 DAT, 90 DAT, and at harvest, while Zinco rice MS showed relatively lower accumulation from 30 DAT to harvest. These findings align with previous research highlighting the significance of genetic variation in determining dry matter accumulation in rice varieties under organic production system, supported by the research of Kumar *et al*. (2022) and Singh *et al*. (2019).

**Leaf area**

The data presented in Table 2 reveal substantial genetic diversity in leaf area among various quality rice varieties grown under an organic production system. At 30 days after transplanting (DAT), Tarunbhog Selection 1 exhibited the largest leaf area (353.2 cm2 hill-1), outperforming Tulsi Manjiri and Chinni Kapoor among short-grain aromatic rice varieties. At 60 DAT, Lokti

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1. Plant height, number of tillers and dry matter accumulation of rice as influenced by different quality rice varieties grown under organic production system at various time intervals.** | | | | | | | | | | | | | | | | |
| **Treatments** | **Quality rice varieties** | **Plant height (cm)** | | | | | | | **Number of tillers hill-1** | | | | **Dry matter accumulation (g hill-1)** | | | |
| **30**  **DAT** | | **60**  **DAT** | **90**  **DAT** | **At harvest** | | | **30**  **DAT** | **60**  **DAT** | **90**  **DAT** | **At**  **harvest** | **30**  **DAT** | **60**  **DAT** | **90**  **DAT** | **At**  **harvest** |
| **Traditional short grain aromatic** | | | | | | | | |  |  |  |  |  |  |  |  |
| V1 | Chinni Kapoor | | 55.6 | 97.2 | 172.9 | 193.8 | | 8.5 | | 11.1 | 11.4 | 10.9 | 6.7 | 16.3 | 60.8 | 83.3 |
| V2 | Lokti Machhi | | 48.8 | 84.0 | 146.7 | 171.7 | | 9.3 | | 12.0 | 12.0 | 11.4 | 4.4 | 17.3 | 70.2 | 90.0 |
| V3 | Tulsi Manjiri | | 55.8 | 89.6 | 170.9 | 190.9 | | 8.3 | | 11.1 | 11.7 | 11.3 | 4.9 | 14.3 | 81.0 | 134.5 |
| V4 | Amrit Bhog | | 57.4 | 95.2 | 182.3 | 202.1 | | 7.8 | | 10.3 | 10.7 | 10.5 | 6.5 | 18.4 | 96.2 | 170.5 |
| V5 | Samund Chini | | 57.6 | 98.0 | 175.7 | 198.0 | | 8.8 | | 11.5 | 11.8 | 11.2 | 5.1 | 14.3 | 46.3 | 87.7 |
| V6 | Lohandi | | 51.4 | 103.6 | 144.5 | 165.9 | | 8.6 | | 11.3 | 11.6 | 10.9 | 4.1 | 20.5 | 69.2 | 110.8 |
| V7 | Aatma Sheetal | | 53.1 | 86.8 | 147.5 | 172.8 | | 7.6 | | 10.8 | 11.3 | 10.8 | 4.8 | 12.3 | 70.5 | 95.3 |
| V8 | Tarunbhog Selection 1 | | 59.1 | 115.4 | 142.7 | 162.9 | | 7.9 | | 10.6 | 11.3 | 10.7 | 5.7 | 13.8 | 65.5 | 92.0 |
| **High yielding scented** | | | | | | |  | | |  |  |  |  |  |  |  |
| V9 | Chhattisgarh Sugandhitbhog | | 43.1 | 70.6 | 95.7 | 101.4 | | 9.4 | | 12.1 | 12.5 | 11.7 | 5.6 | 17.7 | 59.2 | 79.5 |
| V10 | Indira Sugandhit Dhan 1 | | 50.7 | 91.0 | 134.7 | 139.9 | | 8.1 | | 10.t | 11.2 | 11.0 | 6.0 | 16.7 | 83.0 | 109.3 |
| V11 | CG Devbhog | | 41.1 | 65.1 | 82.3 | 86.0 | | 6.7 | | 9.4 | 10.1 | 9.7 | 6.1 | 15.0 | 93.5 | 124.7 |
| V12 | Sugandhmati | | 49.6 | 76.7 | 96.8 | 99.4 | | 6.6 | | 9.5 | 10.0 | 9.5 | 4.6 | 16.2 | 54.3 | 75.7 |
| **Fortified** | | | | | | |  | | |  |  |  |  |  |  |  |
| V13 | Zinco rice MS | | 48.9 | 80.8 | 95.7 | 96.7 | | 7.5 | | 10.3 | 10.8 | 10.8 | 4.4 | 14.2 | 56.8 | 61.9 |
| V14 | Protezin | | 46.7 | 76.7 | 95.4 | 98.3 | | 6.7 | | 9.1 | 9.8 | 9.4 | 5.1 | 20.8 | 64.0 | 68.3 |
| V15 | CG Madhuraj 55 | | 53.3 | 103.3 | 133.0 | 135.8 | | 6.5 | | 8.9 | 9.4 | 9.1 | 4.6 | 22.5 | 70.5 | 75.7 |
|  | | | **2.21** | **3.86** | **4.97** | **5.13** | | **0.27** | | **0.34** | **0.28** | **0.27** | **0.14** | **0.28** | **0.77** | **0.43** |
| **CD (P = 0.05)** | | | **6.39** | **11.17** | **14.41** | **14.86** | | **0.80** | | **0.99** | **0.80** | **0.80** | **0.41** | **0.82** | **2.24** | **1.25** |

Machhi displayed the maximum leaf area hill-1, while at 90 DAT, Amrit Bhog recorded the highest leaf area, comparable to other traditional short-grain aromatic rice varieties. Among high-yielding scented rice varieties, CG Devbhog showed notably higher leaf area hill-1 at 30 DAT, but at 60 and 90 DAT, all varieties exhibited similar leaf area hill-1. Fortified rice varieties displayed comparable leaf area hill-1 at all observation stages (Table 2). These findings align with previous research emphasizing the importance of genetic variations in determining leaf area in different quality rice varieties under organic production system. The results suggest that genetic diversity plays a vital role in determining leaf area, a crucial trait for rice productivity.

**Leaf Area Index (LAI)**

The leaf area index (LAI) is a crucial parameter in growth analysis, characterizing crop canopy and photosynthetic activity, with a direct impact on growth and yield parameters (Gupta *et al*., 2018). Table 2 presents data showing an increase in LAI as the crop ages in various quality rice varieties under organic production (Patel *et al*., 2020). Traditional short-grain aromatic rice varieties consistently exhibited higher LAI values compared to high-yielding scented and fortified rice varieties at all observational stages. Within the traditional short-grain aromatic varieties, similar LAI values were observed across all stages, indicating minimal variation among these varieties. Similarly, high-yielding scented and fortified varieties displayed comparable LAI values at all stages, suggesting homogeneity within these groups. These findings align with previous research emphasizing the importance of LAI in determining growth and yield parameters in rice varieties under organic production system (Sharma *et al*., 2017; Bhattacharya *et al*., 2018). The results highlight the significance of LAI as a critical factor influencing rice productivity and underscore the need for further research to explore its potential in optimizing crop management strategies.

**Crop growth rate (CGR)**

Figure 1 presents the crop growth rate (CGR) of various quality rice varieties grown under an organic production system. A comparative analysis of traditional short-grain aromatic rice varieties reveals distinct CGR patterns. Lohandi exhibited the highest CGR during the initial growth stage (30-60 days after transplanting, DAT), while Tulsi Manjiri and Aatma Sheetal display superior CGR during the subsequent growth stage (60-90 DAT). Amrit Bhog and Lohandi demonstrate higher CGR during the maturation phase (90 DAT to harvest). In contrast, high-yielding scented rice varieties exhibit varying CGR dynamics. CG Devbhog records the highest CGR (2.62 g hill-1 day-1) during the active growth stage (60-90 DAT) and maintains a higher CGR (1.04 g hill-1 day-1) during the maturation phase. Conversely, Sugandhmati and Chhattisgarh Sugandhit Dhan 1 exhibit lower CGR values throughout the growth stages. Among fortified rice varieties, CG Madhuraj 55 consistently displays the highest CGR (1.66 g hill-1 day-1) from the initial stage to harvest. In contrast, Zinco rice MS and Chhattisgarh Sugandhitbhog show lower CGR values at different stages. These findings align with previous research on CGR dynamics in rice varieties under organic production system (Joshi *et al*., 2015; Yadav *et al*., 2017; Gangwar *et al*., 2019). The results underscore the importance of CGR as a critical factor influencing rice productivity and highlight the need for further research to explore its potential in optimizing crop management strategies.

**Relative growth rate (RGR)**

Figure 2 presents the relative growth rate (RGR) of various quality rice varieties grown under an organic production system. RGR measures the increase in dry weight per unit of original dry weight over a specific time interval, providing insight into growth efficiency. Notably, the RGR values among all quality rice varieties exhibit minimal variation at all stages, indicating a similar growth pattern. This suggests that genetic diversity among the rice varieties does not significantly impact RGR under organic production conditions. These findings align with previous research on RGR dynamics in rice varieties under organic production systems, which reported similar uniformity in RGR among varieties. The results also support the findings of Bhattacharya *et al*. (2018), who reported that genetic variation does not significantly impact RGR under organic production conditions. The uniformity in RGR among quality rice varieties highlights the significance of environmental factors in influencing growth dynamics, rather than genetic variation. This has important implications for crop management strategies, suggesting that optimizing environmental conditions can lead to improved growth efficiency and productivity. By focusing on environmental factors, farmers and researchers can develop targeted approaches to enhance rice growth and productivity, regardless of genetic variation among varieties.

**Fig.2. Relative growth rate of rice as influenced by different quality rice varieties grown under organic production system at various time intervals**.

**Fig.1. Crop growth rate of rice as influenced by**

**different quality rice varieties grown under**

**organic production system at various time intervals**.

**Grain yield**

The data presented in Table 2 showcasing diverse grain yield performance among quality rice varieties cultivated under an organic production system. A comparative analysis of traditional short-grain aromatic rice varieties reveals that Tarunbhog Selection 1 achieved the highest grain yield (28.2 q ha-1), closely followed by Lokti Machhi (25.2 q ha-1) and Samund Chinni (25.3 q ha-1), which exhibit comparable yields. High-yielding scented rice varieties grown under organic production demonstrate exceptional grain yield in CG Devbhog (37.0 q ha-1), outperforming other varieties, with the exception of Chhattisgarh Sugandhitbhog and Sugandhmati, which display similar yields. Among fortified rice varieties, Protezin attained the highest grain yield (32.2 q ha-1), closely followed by CG Madhuraj 55 (31.5 q ha-1) and Zinco rice MS (31.1 q ha-1), which exhibit statistically similar yields, indicating minimal variation among these varieties. These findings align with previous research on grain yield in rice varieties under organic production system, which reported significant variation in grain yield among varieties. The results emphasize the crucial role of varietal selection in optimizing grain yield under organic production, highlighting the need for targeted approaches to enhance rice productivity.

**Discussion of growth parameters and grain yield**

The current study highlights significant diversity in growth parameters and grain yield among various rice varieties, including traditional aromatic short-grain, high-yielding scented, and fortified types (Gupta *et al*., 2023). Notably, traditional aromatic short-grain rice varieties exhibit pronounced genetic variability, characterized by taller plant heights compared to other groups (Lakra *et al*., 2012; Rathia, 2019). Within this group, Amrit Bhog, Tulsi Manjiri, and Chinni Kapoor displayed comparable plant heights, surpassing other varieties across all groups (Mia & Shamsunddin, 2011). Conversely, Lokti Machhi, Tulsi Manjiri, and Samund Chini exhibit higher tiller numbers. Amrit Bhog demonstrates a superior crop growth rate (CGR), followed closely by Tulsi Manjiri (Sharma & Haloi, 2001). Interestingly, leaf area, leaf area index, and relative growth rate (RGR) remain unaffected by varietal differences within traditional short-grain aromatic rice, potentially due to the genetic makeup of tall-statured rice varieties (Gupta, 2017). High-yielding scented rice varieties exhibit differential responses in plant height and tiller numbers (Sarawgi *et al.*, 2004). However, leaf area index and RGR remain uninfluenced by varietal differences. CG

**Table 2. Leaf area, leaf area index and grain yield of rice as influenced by different quality rice varieties grown under organic production system.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Quality rice varieties** | **Leaf area (cm2) hill-1** | | | | **Leaf area index** | | | **Grain yield**  **(q ha-1)** |
| **30 DAT** | **60 DAT** | | **90 DAT** | **30 DAT** | **60 DAT** | **90 DAT** |
| **Traditional short grain aromatic** | | | | | | | | | |
| V1 | Chinni Kapoor | 299.7 | 662.0 | 982.7 | | 1.5 | 3.3 | 4.9 | 23.5 |
| V2 | Lokti Machhi | 326.6 | 682.2 | 1017.8 | | 1.6 | 3.4 | 5.1 | 25.2 |
| V3 | Tulsi Manjiri | 307.6 | 628.2 | 1010.5 | | 1.5 | 3.1 | 5.1 | 22.6 |
| V4 | Amrit Bhog | 322.5 | 648.6 | 1058.5 | | 1.6 | 3.2 | 5.3 | 23.1 |
| V5 | Samund Chini | 329.7 | 639.0 | 967.7 | | 1.6 | 3.2 | 4.8 | 25.3 |
| V6 | Lohandi | 322.5 | 590.1 | 1050.3 | | 1.6 | 3.0 | 5.3 | 23.2 |
| V7 | Aatma Sheetal | 321.9 | 610.8 | 976.4 | | 1.6 | 3.1 | 4.9 | 23.0 |
| V8 | Tarunbhog Selection 1 | 353.2 | 604.7 | 1037.7 | | 1.8 | 3.0 | 5.2 | 28.2 |
| **High yielding scented** | | | | | | | | | |
| V9 | Chhattisgarh Sugandhitbhog | 272.9 | 543.9 | 848.0 | | 1.4 | 2.7 | 4.2 | 34.2 |
| V10 | Indira Sugandhit Dhan 1 | 252.1 | 538.7 | 854.2 | | 1.3 | 2.7 | 4.3 | 33.5 |
| V11 | CG Devbhog | 322.9 | 567.7 | 844.9 | | 1.6 | 2.8 | 4.2 | 37.0 |
| V12 | Sugandhmati | 252.4 | 546.7 | 893.2 | | 1.3 | 2.7 | 4.5 | 34.2 |
| **Fortified** | | | | | | | | | |
| V13 | Zinco rice MS | 240.6 | 549.0 | 856.8 | | 1.2 | 2.7 | 4.3 | 31.1 |
| V14 | Protezin | 260.9 | 566.5 | 862.2 | | 1.3 | 2.8 | 4.3 | 32.2 |
| V15 | CG Madhuraj 55 | 236.0 | 533.8 | 876.8 | | 1.2 | 2.7 | 4.4 | 31.5 |
|  | | **11.13** | **21.11** | **35.6** | | **0.04** | **0.22** | **0.2** | **1.15** |
| **CD (P = 0.05)** | | **32.24** | **43.24** | **103.1** | | **0.13** | **0.45** | **0.5** | **3.33** |

Devbhog displays a higher CGR, likely attributed to its enhanced response to organic nutrient supply (Patel *et al*., 2019). Similar trends are observed among fortified varieties, where CG Madhuraj 55 excels in most growth parameters, except leaf area index and RGR, due to its superior response to nutrients and genetic potential (Sahu, 2021). The highest grain yield is recorded in CG Devbhog (37.0 q ha-1), significantly outperforming other high-yielding scented rice varieties, except Chhattisgarh Sugandhitbhog (Joshi *et al*., 2015). The lowest grain yield was observed in Tulsi Manjiri (22.6 q ha-1). Varietal differences attributed to genetic variation and disparate responses to organic nutrient sources (Yadav *et al*., 2017; Gangwar *et al*., 2019).

**CONCLUSION**

An experimental study conducted during the 2021 *kharif* season at the Instructional Cum Research Farm, Department of Agronomy, College of Agriculture, Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India, investigated the growth and yield responses of various growth rice varieties under organic production system. The results revealed significant variations in growth parameters and yield among short-grain traditional aromatic, high-yielding scented, and fortified rice varieties. Notably, Tarunbhog Selection 1 exhibited comparable tiller numbers, leaf area, and leaf area index, leading to enhanced source-sink conversion and ultimately resulting in higher rice yields. Among the high-yielding scented rice varieties, CG Devbhog demonstrated superior growth parameters and yield, outperforming other varieties. Similarly, in the fortified varieties, Protezin showed higher yields, attributed to its enhanced response to organic nutrients and genetic potential. These findings underscore the importance of varietal selection in optimizing rice yields under organic production systems, highlighting the need for further research to explore the potential of different quality rice varieties in diverse agro-climatic conditions.

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