**Evaluation of Rice Cultivars for Performance Under Direct-Seeded Rice System in the Foothills of Siruvani**

**ABSTRACT**

Direct seeded rice is a resource efficient technique which by pass traditional transplanted rice thereby reducing labour and expenditure in cultivation. Var. Bhavani (medium duration) has been a widely cultivated rice variety in the Coimbatore region for decades due to its endurance and yield. The study was designed to replace the dominant variety in the local environment and compare the performance of several cultivars to the local check variety in a direct-seeded rice ecosystem. A field experiment was conducted during the *Kharif* season of 2024 at the South Farm of the Karunya Institute of Technology and Sciences, Division of Agronomy, Coimbatore. The experiment was laid out in a randomized block design and replicated three times. The treatments consisted of 15 rice cultivars: Check variety Bhavani (T1), TV 472 (T2), CR 1009 sub 1 (T3), Improved White Ponni (T4), TRY 3 (T5), TKM 13 (T6), CO 52 (T7), CO 56 (T8), CO 57 (T9), Karuppu Kavuni (T10), ADT 54 (T11), ADT 52 (T12), KKLR 2 (T13), BPT 5204 (T14), and Paiyur 1 (T15). Recorded the growth and yield attributes of different rice cultivars at various phenological stages, which were examined using analysis of variance. The results showed that the Check variety Bhavani (T1) produced a significantly higher number of tillers (23.10), number of productive tillers (17.03), and grain yield (4582 kg ha⁻¹), which were statistically on par with rice varieties TKM 13 and CR 1009 Sub 1 under evaluation, implying that these varieties could be a suitable substitute for Bhavani in the study area (Foot hills of Siruvani).

Keywords: *Direct seeded rice (DSR), different cultivars, Bhavani, foothills of Siruvani*

**1. INTRODUCTION**

Rice is the main staple food for about half of the world's population, feeding over 3.5 billion people and providing an essential source of daily calorie intake throughout Asia (Mohidem *et al.,* 2022). In addition, rice is a key source of zinc and other vital micronutrients for millions across Asia, given its frequent consumption in comparison to other cereals. China produced approximately 146 million metric tons of milled rice in the crop year 2022 - 2023, more than any other country. India stood in second place with more than 135 million metric tons of milled rice that year (Statista, 2025). Puddled transplanted rice (PTR) and direct-seeded rice (DSR) are two traditional Asian rice cultivation methods. Although effective, the transplanted rice system requires additional inputs. Water sustainability is a concern, as it contributes to methane emissions and non-renewable energy consumption. (Nayak *et al.,* 2021). DSR technology enhances water use efficiency and reduces labor demands by over 83% compared to traditional techniques. (Sandhu *et al.,* 2021).

DSR is considered one of the most efficient, sustainable, and economical rice production systems used today (Sharda *et al.,* 2017). DSR has been utilized in India for many years and has experienced substantial growth in recent decades. Short and medium duration rice varieties are preferred for DSR in upland and medium land (Kumar *et al.,* 2024). DSR includes directly placing seeds into the main field, making it a viable alternative to PTR. Dry-DSR (DDSR), wet-DSR (WDSR), and water seeding are the three primary ways of DSR cultivation. DDSR involves sowing seeds in fields with ideal moisture conditions, which promotes better germination before the monsoon arrives, resulting in timely establishment and increased yield (Chaudhary *et al.,* 2023). WDSR primarily entails planting sprouted seeds on puddled beds with a drum seeder, offering benefits such as reduced labor costs and drudgery while ensuring timely and improved crop establishment, and it requires a meticulously leveled field and efficient weed management for successful implementation (Jat *et al.,* 2022). When compared to standard paddy transplantation procedures, WDSR saved 18.0%-19.5% of the water (Kumar *et al.,* 2021).

Despite the potential advantages of DSR, limited research has focused on the performance of different cultivars under DSR conditions in unique agro-climatic context of the Siruvani foothills. Hence, this study objective is to evaluate the adaptability and performance of selected rice cultivars under practices in the region.

**2. MATERIALS AND METHOD**

**2.1 Experimental Details**

A field experiment was carried out at Karunya Institute of Technology and Sciences, Instructional Farm (South) in Coimbatore, Tamil Nadu, during the *Kharif* season of 2024. The farm is situated at 10.935 ° N latitude and 76.75 ° E longitude, with an elevation of 467 meters above sea level. The trial was conducted with fifteen promising rice cultivars replicated thrice with RCBD design. The weather data was collected from the agro-meteorological unit, and soil data was acquired from the soil analysis at Karunya Institute of Technology and Sciences. The soil at the experimental site had a clay loam texture, a pH of 7.34, an EC of 0.13 dS m⁻¹, a low Nitrogen concentration of roughly 193 kg ha⁻¹, medium Carbon (0.72%), medium Phosphorus (16.3 kg ha⁻¹) and high Potassium (403 kg ha⁻¹). During the cropping season, the average maximum temperature was 30.2°C, and the average minimum temperature was 20.5°C. During the experiment, the average number of bright daylight hours was 5.4 hours, and the average daily evaporation rate was 5.1 mm per day. Treatments of various cultivars were chosen for direct-seeded rice production to study their effects on rice growth and yield. The experiment comprised of fifteen treatments, each representing a different rice variety, including both traditional and improved types. The check variety used for comparison was Bhavani (T1). The other varieties evaluated in the study were TV 472 (T2), CR 1009 sub 1 (T3), Improved White Ponni (T4), TRY 3 (T5), TKM 13 (T6), CO 52 (T7), CO 56 (T8), CO 57 (T9), Karuppu Kavuni (T10), ADT 54 (T11), ADT 52 (T12), KKLR 2 (T13), BPT 5204 (T14), and Paiyur 1 (T15).

DSR on wet conditions: three days prior to direct sowing, the land had been prepared by puddling twice with a cage-wheel tractor. Each plot (5 x 4 m) was separated from surrounding plots by 1 m wide waterways and buffer bunds (30 cm wide) to prevent water transfer from one plot to another. The recommended fertilizer dose (150:50:50 N:P:K) was applied to all treatments in the research area using the broadcasting method in four splits at the basal, active tillering, panicle initiation, and heading stages. Irrigation was initiated when the soil reached field capacity. The irrigation was done with a 7-10 day gap on water availability. When weeds exceeded the threshold level, manual weeding was performed as needed. Manual weeding was conducted at 10 – days interval or when weed growth exceeded economic threshold levels. Irrigation and buffer channels were also manually weeded throughout the season.

**2.2 Observations and Analysis**

The phenological stages of the medium-duration variety are active tillering (30-40 DAS), panicle initiation (50-60 DAS), heading (70-80 DAS), and harvest (120-140 DAS). The observation days were slightly changed in accordance with the cultivars chosen for evaluation. The growth parameters Plant height and the number of tillers were measured at four distinct stages. Yield characteristics, such as the number of productive tillers, grain yield, and straw yield, were observed in the net plot area. Non-destructive observations were taken from five randomly selected tagged plants in each plot.The observed data were statistically analysed for significance using analysis of variance (ANOVA) as per randomized complete block design.

**3. RESULTS AND DISCUSSION**

**3.1 Growth Parameter**

**3.1.1 Plant height (cm)**

Plants' growth can be visually examined by measuring their height, which acts as an indicator. Plant height measurements were taken at several stages, including Active tillering, Panicle initiation, Heading, and Harvest. The average plant height data collected at various phases are shown in (Table 1). Overall, plant height increased rapidly between the Active tillering and Heading stages across all types. However, a minor decrease in plant height was noted during the maturity harvest stages.

Throughout the observation stages, Karuppu kavuni had a higher plant height than all other cultivars. It measured 54.80 cm at active tillering, 92.60 cm at panicle initiation, 152.60 cm during heading, and 149.20 cm during harvest, followed by KKLR 2 and Paiyur 1. CO 57, on the other hand, consistently had the lowest plant height at all observation stages, measuring 30.80 cm at Active tillering, 62.80 cm at Panicle initiation, 85.20 cm at Heading, and 82.80 cm at Harvest. According to research, the height of a rice plant can vary greatly depending on genetics and environmental circumstances, such as plant density and water or nutrient management. Plant height showed a highly significant negative connection, showing that taller plants produce lower yields and lighter grains. Taller plants might use more energy in vertical development at the expense of reproductive production, as reported by (Naeem *et al.,*2024).

**3.1.2 Number of tillers hill-1**

Data on the number of tillers per hill were collected during the crop growth stages of active tillering, panicle initiation, heading, and harvest. The number of tillers per hill increased until the heading stage and then decreased. The DSR technique of cultivation resulted in a substantial variation in the number of tillers throughout the study, as shown in the (Table 1). At each stage of observation, the check variety Bhavani produced the highest number of tillers per hill of 17.10 at the active tillering stage, 20.50 at the Panicle initiation stage, 24.10 at the Heading stage, and 23.10 at Harvest, which was statistically on par with TKM 13, CR 1009 Sub 1, and followed by KKLR 2. The cultivar ADT 52 recorded a lower number of tillers per hill of 10.00 at Active tillering, 12.20 at Panicle initiation, 15.80 at Heading, and 14.60 at Harvest. This was statistically identical to TRY 3. The DSR method as a distribution had the best effect on the total number of tillers and fertile tillers as reported by (Akhgari *et al.,*2011).

**3.2 Yield attributes**

**3.2.1 Productive tillers (hill-1)**

The number of productive tillers differed significantly among rice varieties utilizing the DSR approach. These variations emphasize the effect of variety selection on the number of productive tillers and on the potential yield using the DSR approach. Check variety Bhavani produced the highest number of productive tillers per hill (17.03), which was statistically at par with TKM 13 (16.51). In comparison to the other rice varieties investigated under DSR, TRY 3 (10.63) and ADT 52(10.48) were statistically similar in terms of the lowest tiller count. Tiller number is an important component in crop productivity; maximizing early tiller productivity rather than just increasing tiller numbers is more successful in increasing output. This strategy could result in more effective resource utilization and better grain yields, according to (Kalaitzidis *et al.,* 2025).

**3.2.2 Grain Yield (kg ha-1)**

Grain yields differed significantly between rice varieties evaluated using the DSR technique (Table 2). A comprehensive look at the rice grain yield showed that check variety Bhavani produced a maximum grain yield of (4582 kg ha⁻¹). This was on par with TKM 13 (4345 Kg/ha) and CR 1009 Sub 1 (4297 Kg/ha), which are the other best-performing varieties. The cultivar Karuppu Kavuni produced a minimum grain yield of (1070 kg ha⁻¹), which was statistically comparable to ADT 52 and TRY 3. The highest growth and yield-contributing features, accompanied by higher photosynthates, led to improved source-to-sink conversion, resulting in better grain and straw yields. The results were closely similar to those of (Netam *et al.,* 2016).

**3.2.3 Straw yield (kg ha-1)**

There was a significant influence of straw yield on different rice cultivars evaluated under DSR. Traditional variety Karuppu Kavuni recorded significantly higher straw yield of (8522 kg ha-1) followed by Check variety Bhavani and TKM13 of (7029 kg ha-1 and 7015 kg ha-1). A significantly lower straw yield was recorded in Improved White Ponni with (4970 kg ha-1) followed by BPT 5204 and TV 472. As Sarkar *et al.,* (2016) points out, the variation in straw output can be attributed to large differences in plant height and straw weight between cultivars.

**Table 1. Growth characteristics of different rice cultivars under Wet direct-seeded rice method at four different stages**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Plant Height** | **No. of Tillers** | **Plant Height** | **No. of Tillers** | **Plant Height** | **No. of Tillers** | **Plant Height** | **No. of Tillers** |
| **Active tillering** | | **PI Stage** | | **Heading stage** | | **At Harvest** | |
| T1 – Check variety - Bhavani | 43.2 | 17.10 | 81.7 | 20.50 | 121.2 | 24.10 | 116.3 | 23.10 |
| T2 – TV 472 | 35.2 | 12.60 | 69.8 | 15.50 | 98.4 | 17.00 | 95.8 | 16.00 |
| T3 – CR 1009 sub 1 | 33.2 | 16.30 | 67.1 | 19.00 | 92.9 | 21.80 | 89.3 | 21.00 |
| T4 – Improved White ponni | 39.5 | 11.90 | 73.3 | 15.10 | 97.8 | 17.40 | 94.7 | 16.30 |
| T5 – TRY 3 | 32.7 | 10.30 | 64.6 | 13.40 | 88.8 | 16.30 | 86.1 | 15.50 |
| T6 – TKM 13 | 42.1 | 16.70 | 76.6 | 19.80 | 114.7 | 22.10 | 110.6 | 21.80 |
| T7 – CO 52 | 36.4 | 13.80 | 70.4 | 16.60 | 100.3 | 20.30 | 97.9 | 19.60 |
| T8 – CO 56 | 37.7 | 13.60 | 72.9 | 16.30 | 94.6 | 19.60 | 91.5 | 18.80 |
| T9 – CO 57 | 30.8 | 15.50 | 62.8 | 17.80 | 85.2 | 20.10 | 82.8 | 19.20 |
| T10 – KaruppuKavuni | 54.8 | 10.70 | 92.6 | 13.80 | 152.6 | 16.70 | 149.2 | 15.80 |
| T11 – ADT 54 | 40.5 | 15.20 | 73.5 | 17.60 | 111.5 | 19.10 | 107.9 | 18.30 |
| T12 – ADT 52 | 34.8 | 10.00 | 66.1 | 12.20 | 89.1 | 15.80 | 86.4 | 14.60 |
| T13 – KKLR 2 | 47.3 | 15.60 | 87.5 | 18.70 | 125.1 | 21.00 | 121.4 | 20.50 |
| T14 – BPT 5204 | 32.4 | 12.70 | 63.3 | 15.70 | 86.9 | 17.50 | 84.6 | 16.60 |
| T15 – Paiyur 1 | 44.6 | 12.50 | 89.1 | 15.40 | 123.8 | 17.80 | 120.7 | 16.80 |
| **SE (d)** | **1.95** | **1.44** | **2.88** | **1.57** | **6.28** | **1.66** | **6.04** | **1.72** |
| **CD (p=0.05)** | **3.99** | **2.95** | **4.07** | **3.21** | **12.87** | **3.39** | **12.37** | **3.53** |

**Fig. 1. Influence of wet DSR practice on growth attributes of rice cultivars at different growth stages**

**Table 2. Yield characteristics of different rice cultivars under Wet direct seeded rice method (No. of Productive tillers and Grain Yield)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **No. of Productive tillers** | **Grain Yield (kg ha-1)** | **Straw yield**  **(kg ha-1)** |
| T1 – Check variety - Bhavani | 17.03 | 4582 | 7029 |
| T2 – TV 472 | 11.74 | 2555 | 5264 |
| T3 – CR 1009 sub 1 | 16.27 | 4297 | 6935 |
| T4 – Improved White ponni | 12.62 | 2800 | 4970 |
| T5 – TRY 3 | 10.63 | 1984 | 5778 |
| T6 – TKM 13 | 16.51 | 4345 | 7015 |
| T7 – CO 52 | 14.58 | 3951 | 6910 |
| T8 – CO 56 | 15.03 | 3515 | 6890 |
| T9 – CO 57 | 13.01 | 3484 | 6149 |
| T10 – Karuppu Kavuni | 11.46 | 1070 | 8522 |
| T11 – ADT 54 | 14.16 | 3210 | 6673 |
| T12 – ADT 52 | 10.48 | 1615 | 5504 |
| T13 – KKLR 2 | 15.80 | 4060 | 7011 |
| T14 – BPT 5204 | 12.07 | 2610 | 5020 |
| T15 – Paiyur 1 | 12.87 | 2907 | 5864 |
| **SE (d)** | **1.07** | **308.82** | **369.87** |
| **CD (p=0.05)** | **2.19** | **632.59** | **757.65** |

**Fig. 2. Influence of wet DSR on yield of rice cultivars**

**4. CONCLUSION**

The study's findings revealed that among the fifteen different cultivars, TKM 13 (T6), CR 1009 Sub 1 (T3), KKLR2 (T13), and CO-52 (T7) produced statistically comparable yields as compared to the check variety Bhavani (T1) and had improved growth characteristics under the wet DSR method of cultivation. These varieties can be used as an alternate substitute for the check variety Bhavani by studying climatic adaptability under large-scale production through front line demonstration and commercial release.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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**REFERENCE**

Akhgari, H., & Kaviani, B. (2011). Assessment of direct seeded and transplanting methods of rice cultivars in the northern part of Iran. *African Journal of Agricultural Research*, *6*(31), 6492-6498.

Chaudhary, A., Venkatramanan, V., Kumar Mishra, A., & Sharma, S. (2023). Agronomic and environmental determinants of direct seeded rice in South Asia. *Circular Economy and Sustainability*, *3*(1), 253-290.

Jat, R. K., Meena, V. S., Kumar, M., Jakkula, V. S., Reddy, I. R., & Pandey, A. C. (2022). *Direct Seeded Rice: Strategies to Improve Crop Resilience and Food Security under Adverse Climatic Conditions. Land 2022, 11, 382*.

Kalaitzidis, A., Kadoglidou, K., Mylonas, I., Ghoghoberidze, S., Ninou, E., & Katsantonis, D. (2025). Investigating the Impact of Tillering on Yield and Yield-Related Traits in European Rice Cultivars. *Agriculture*, *15*(6), 616.

Kumar, N., Chhokar, R. S., Meena, R. P., Kharub, A. S., Gill, S. C., Tripathi, S. C., ... & Singh, G. P. (2021). Challenges and opportunities in productivity and sustainability of rice cultivation system: a critical review in Indian perspective. *Cereal research communications*, 1-29.

Kumar A, Verma R L, Sah R P, Satapathy B S, Mohanty S, Tripathi R, Chattopadhyay K, Samantaray S and Nayak A K (2024). Direct Seeded Rice: A Technology for Enhancing Climate Resilience. NRRI research Bulletin No. 50, ICAR-National Rice Research Institute, Cuttack-753006, Odisha, India. pp-32.

Mohidem, N. A., Hashim, N., Shamsudin, R., & Che Man, H. (2022). *Rice for Food Security: Revisiting Its Production, Diversity, Rice Milling Process and Nutrient Content. Agriculture 2022, 12, 741*.

Naeem, A., Ali, M., Jawad, A., Ameen, A., Mehwish, Liaqat, T., ... & Hussain, S. (2024). Assessment of Optimal Seeding Rate for Fine and Coarse Rice Varieties Using the Direct Seeded Rice (DSR) Method. *Seeds*, *4*(1), 1.

Nayak, A. K., Kumar, A., Tripathi, R., Panda, B. B., Mohanty, S., Shahid, M., ... & Swain, P. (2021). Improved Water Management Technologies for Rice Production System. *NRRI Research Bulletin*, (32), 40.

Netam C. R., Singh R.,Thakur A. K. and Netam. A. K. Effect of crop establishment methods and weed management options on weed dynamics and productivity of rice (Oryza sativa L). *Indian J. Agronomy*, 2016; 61 (3): 326- 330.

Sandhu, N., Yadav, S., Kumar Singh, V., & Kumar, A. (2021). Effective crop management and modern breeding strategies to ensure higher crop productivity under direct seeded rice cultivation system: A review. *Agronomy*, *11*(7), 1264.

Sharda, R., Mahajan, G., Siag, M., Singh, A., & Chauhan, B. S. (2017). Performance of drip-irrigated dry-seeded rice (Oryza sativa L.) in South Asia. *Paddy and water environment*, *15*, 93-100.

Sarkar, S. C., Akter, M., Islam, M. R., & Haque, M. M. (2016). Performance of five selected hybrid rice varieties in Aman season. *Journal of Plant Sciences*, *4*(4), 72-79.

Statista (2025) production of milled rice in 2022/2023 – Available at <https://www.statista.com/>