SHORT Research Article

**Influence of Age of Seedlings and Planting Geometry On Yield And Economics of Rice (*Oryza sativa* L.)**

**Abstract**

A field study was carried out during the *Kharif* season of 2024 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The experimental site had sandy loam soil with a pH of 7.8. The soil contained 0.72% organic carbon and available nutrients of 178.48 kg nitrogen, 27 kg phosphorus, and 233 kg potassium per hectare. The experiment was arranged in a Randomized Block Design consisting of ten treatments, each replicated three times. Among the treatments, the combination of 28-day-old seedlings planted at a spacing of 30 cm x 10 cm produced the highest results, including grain yield of 6.66 t/ha, straw yield of 14.89 t/ha, and a harvest index of 30.57%. This treatment also achieved the best economic returns with a gross income of INR 181,341.85 per hectare, net income of INR 134,295.85 per hectare, and a benefit-cost ratio of 2.85.

***Key words***: Economics, Spacing, Seedlings, Rice and Yield.

**Introduction**

Rice (*Oryza sativa* L.) stands as the most vital cereal crop for many developing countries and serves as the main food source for over three billion people, which is more than half of the global population. Mainly two types of rice i.e., non-scented and scented are grown in the country. Scented rice gives a distinctive scent due to the presence of natural chemical compounds and having a unique quality feature, excellent cooking and eating quality characters, long slender grains with delicate curvature and remarkable linear elongation **(**Rani *et al*., 2001). It can be used just like conventional rice for cooking, but adds a new dimension of flavour and aroma to meals. Apart from special natural fragrance, scented rice also has high nutritional value and contains many kinds of amino acids, proteins, alkaloids, vitamin B1 and vitamin B2 and other essential nutrients for human beings (Jiankai *et al*., 2016). The cultivation of scented rice varieties becoming popular due to its aroma, cooking qualities and higher export potential (Mhaskar *et al*., 2005).

India is major rice growing country in world with an area of 407.34 lakh hectares, having production 1132.59.79 lakh tonnes and productivity of 2780 kg/ha (Anonymous 2023-24). In Uttar Pradesh 57.32 lakh ha and production 158.65 lakh tonnes with an average productivity of 2768 kg/ha (Anonymous 2023-24), is the most crucial cereal food crop of India, which occupies about 24% of gross cropped area of the country. Rice accounts for about 42% of the country’s total food grain production and approximately 45% of its overall cereal output. India (2010) yield of rice was 120.62 MT 44 M ha followed by China (197.21 MT) and in year 2024-25 the Area, Production, Productivity in Uttar Pradesh and India was 5.73 million ha., 15.86 million tonnes, 2768 kg/ha and 40.73 million Hectares, 11.32 million tonnes, 2780 kg/ha respectively (Anonymous 2023-24).

Planting geometry in rice significantly affects the tiller production, number of panicles per m2, total biomass and grain yield. Proper plant spacing plays a crucial role in the growth and yield of rice. Maintaining an ideal plant population through suitable planting geometry is one of the most effective non-monetary practices for boosting rice productivity (Siddiqui *et al*., 1999). The arrangement of plants in the field significantly affects the development of tillers and the number of spikelets formed per panicle (Mahato *et al*., 2017). Crop yield decreased with increase in plant population above optimum level, while on the other hand yield also decreased due to lesser plant population below optimum level due to inability to intercept maximum solar radiation (Mahajan *et al*., 2010). Plant spacing determines the rice stand per unit area. Closer spacing in rice cultivation can make intercultural operations like hand weeding, fertilizer use, and pesticide application more difficult. It also leads to increased competition among plants for vital resources such as nutrients, water, sunlight, and air, which can result in weaker, thinner plants and ultimately lower yields. On the other hand, proper planting geometry and spatial arrangement help maximize the early vigour of the crop by improving soil aeration and creating favourable conditions for healthy crop establishment (Shukla *et al*., 2014).

When rice seedlings remain in nursery beds for too long, the primary tiller buds at the lower nodes of the main stem may begin to degenerate, which reduces the plant’s ability to produce tillers (Mobasser *et al*., 2007). Transplanting seedlings at an earlier stage generally leads to better growth, as the plants experience less transplant shock and have shorter phyllochron intervals—time between the appearances of successive leaves. These shorter intervals encourage the development of more tillers per hill, especially under favourable conditions (Singh *et al*., 2012). Timely transplanting ensures normal tillering and healthy plant development, while delayed transplanting can negatively impact tiller formation during the vegetative phase (Mobasser *et al*., 2007).

Improving fertility levels in the nursery significantly enhanced seedling length, dry weight, root number, and root length. Stronger seedlings with better early growth and higher nutrient uptake have been shown to play a key role in supporting healthy crop development and ultimately boosting grain yield. Using healthy and vigorous seedlings with sufficient nitrogenous fertilizers in the nursery resulted in more productive tillers and a higher grain yield, partly by better stress tolerance and decreased seedling mortality after transplanting.

**2. MATERIALS AND METHODS**

The experiment was conducted during the Kharif season of 2024 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The farm is located at a latitude of 25°39'42" N and a longitude of 81°67'56" E, with an elevation of 98 meters above mean sea level.

The study was designed using a Randomized Block Design (RBD) with ten different treatments to assess the influence of seedling age and spacing on crop performance. The treatments were as follows:

* T1: 14-day-old seedlings with 20 cm ×10 cm spacing
* T2: 14-day-old seedlings with 20 cm ×20 cm spacing
* T3: 14-day-old seedlings with 30 cm ×10 cm spacing
* T4: 21-day-old seedlings with 20 cm ×10 cm spacing
* T5: 21-day-old seedlings with 20 cm ×20 cm spacing
* T6: 21-day-old seedlings with 30 cm ×10 cm spacing
* T7: 28-day-old seedlings with 20 cm ×10 cm spacing
* T8: 28-day-old seedlings with 20 cm ×20 cm spacing
* T9: 28-day-old seedlings with 30 cm ×10 cm spacing
* T10: Control plot (no specific treatment)

Variety - Np moti 360

The soil in the experimental plot was sandy loam in texture, with a pH of 7.8. It had 0.72% organic carbon and contained 178.48 kg/ha of available nitrogen, 27 kg/ha of phosphorus, and 233 kg/ha of potassium. A recommended dose of 120 kg/ha nitrogen, 60 kg/ha phosphorus, and 60 kg/ha potassium was applied.

Observations related to various crop parameters, particularly yield, were collected and analyzed using analysis of variance (ANOVA) following the method suggested by Gomez and Gomez (1976). Economic analysis was performed using standard mathematical approaches.

**3. RESULTS AND DISCUSSION:**

**3.1 Yield parameters**

In Table 1 data pertaining to yield parameters of growing as influence of age of seedlings and planting geometry on rice has been exhibited.

**3.1.1 Test weight (g):**

At harvest, there was no significant difference among the treatments. However, the highest test weight (18.68 g) was recorded in treatment (21 Days age of seedling + 30x10 cm).

**3.1.2 Grain yield (t/ha)**

The data Obtained that treatment (28 Days age of seedling + 30x10 cm) was recorded significantly highest grain yield (6.66 t/ha) which was superior over all other treatments. However, the treatment (28 Days age of seedling + 20 cm x 20 cm) (5.41 t/ha) was found to be statistically at par with the treatment (28 Days age of seedling + 30x10 cm).

The notable improvement in grain yield can be attributed to the reduced transplanting shock experienced by younger seedlings (28 days old) compared to older ones. Because younger seedlings suffer less root damage during uprooting and transplanting, they tend to establish more quickly and grow more vigorously. Similar observations were reported by Chaudhari *et al*. (2015) and Vishwakarma *et al.* (2015). Additionally, the results indicated that planting geometry had a significant impact, with the spacing of 30 cm × 10 cm producing taller plants than other configurations. This could be due to better resource availability—such as light, air circulation, and nutrients—within the wider spacing, allowing plants to utilize these elements more effectively. Comparable findings regarding dry matter accumulation were also noted by Pol (2003) and Rasool *et al.* (2013).

**3.1.3 Straw yield (t/ha)**

The data Obtained that treatment (28 Days age of seedling + 30 cm x 10 cm) was recorded significantly maximum yield (14.89 t/ha) which was superior over all other treatments. However, the treatment (28 Days age of seedling + 20x20 cm) (13.96 t/ha) and treatment (28 Days age of seedling + 20 cm x10 cm) (13.79 t/ha) was found to be statistically at par with the treatment (28 Days age of seedling + 30 cm x10 cm).

The significantly higher yield observed in the study can be linked to the fact that younger seedlings (28 days old) experienced less root damage during uprooting and transplanting compared to older seedlings. This allowed for better establishment and growth after transplanting. Similar observations were also made by Chaudhari *et al*. (2015) and Vishwakarma *et al*. (2015). Additionally, plant height was found to be significantly greater at the spacing of 30 cm × 10 cm compared to other planting geometries. This could be attributed to improved resource availability—such as sunlight, air flow, and nutrients—from the relatively larger area provided to each plant. Supporting findings related to dry matter accumulation were also reported by Pol (2003) and Rasool *et al*. (2013).

**3.1.4 Harvest index (%)**

Highest harvest index (31.75%) was recorded in treatment 4 (21 Days age of seedling + 20x10 cm), though there was no significant difference among the treatments.

**3.2 ECONOMICS**

In Table 2 data presented to economics of growing as effect of age of seedlings and planting geometry on rice has been exhibited.

**3.2.1 Cost of Cultivation (INR/ha)**

The lowest cost of cultivation was found in the control plot (INR 47046/ha) was observed treatment all different age of seedlings and planting geometry.

**3.2.2 Gross return**

Gross return (INR 181341.85/ ha) was found to be highest in treatment (28 Days age of seedling + 30x10 cm) as compared to other treatment.

**3.2.3 Net return (INR/ha)**

Net return (INR 134295.85/ha) was found to be highest in treatment (28 Days age of seedling + 30x10 cm) as compared to other treatment.

**3.2.4 B:C ratio (B:C)**

Benefit cost ratio (2.85) was found to be highest in treatment (28 Days age of seedling + 30x10 cm) and minimum benefit cost ratio (1.08) was found to be in treatment 10 (Control) as compared to other treatments.

Higher benefit cost ratio was recorded with the application of different age of seedlings and planting geometry might be due to higher grain and strove yield which resulted in increases the gross return, ultimately increases the benefit ratio. Similar result was recorded by Pol (2003) and Rasool *et al*., (2013).

**CONCULSION**

Based on the finding it is concluded that 28 Days age of seedling + 30x10 cm produce significantly higher, test weight, grain yield and straw yield and also recorded gross return (INR 181341.85/ha), net return (INR 134295.85/ha) and B:C ratio (2.85).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Treatment combination** | **Test weight**  **(g)** | **Grain Yield**  **(t/ha)** | **Straw Yield**  **(t/ha)** | **Harvest Index**  **(%)** |  |  | |
| 1. | 14 Days age of seedling + 20x10 cm | 17.51 | 3.45 | 9.67 | 26.25 |  |  |
| 2. | 14 Days age of seedling + 20x20 cm | 17.55 | 3.89 | 10.81 | 25.49 |  |  |
| 3. | 14 Days age of seedling + 30x10 cm | 17.31 | 4.44 | 11.24 | 27.99 |  |  |
| 4. | 21 Days age of seedling + 20x10 cm | 17.92 | 5.20 | 11.10 | 31.75 |  |  |
| 5. | 21 Days age of seedling + 20x20 cm | 18.62 | 5.44 | 12.10 | 31.08 |  |  |
| 6. | 21 Days age of seedling + 30x10 cm | 18.68 | 5.96 | 13.09 | 31.16 |  |  |
| 7. | 28 Days age of seedling + 20x10 cm | 17.28 | 4.98 | 13.79 | 26.57 |  |  |
| 8. | 28 Days age of seedling + 20x20 cm | 17.70 | 5.41 | 13.96 | 27.96 |  |  |
| 9. | 28 Days age of seedling + 30x10 cm | 18.31 | 6.66 | 14.89 | 30.57 |  |  |
| 10. | Control plot | 16.42 | 2.68 | 9.29 | 22.42 |  |  |
|  | F-test | **S** | **S** | **S** | **NS** |  |  |
|  | SEm(±) | 0.65 | 0.41 | 0.78 | 0.48 |  |  |
|  | CD (p=0.05) | 1.92 | 1.21 | 2.32 | - |  |  |

**Table 1. Influence Of Age Of Seedlings And Planting Geometry On Yield Of Rice.**

**Table 2. Influence Of Age Of Seedlings And Planting Geometry On Economics Of Rice.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Treatment combinations** | **Cost of cultivation**  **(INR/ha)** | **Gross return**  **(INR/ha)** | **Net return**  **(INR/ha)** | **B:C** |
| 1. | 14 Days age of seedling + 20x10 cm | 47046 | 97817.50 | 50771.50 | 1.08 |
| 2. | 14 Days age of seedling + 20x20 cm | 47046 | 110171.30 | 63125.30 | 1.34 |
| 3. | 14 Days age of seedling + 30x10 cm | 47046 | 123571.81 | 76525.81 | 1.63 |
| 4. | 21 Days age of seedling + 20x10 cm | 47046 | 140395.59 | 93349.59 | 1.98 |
| 5. | 21 Days age of seedling + 20x20 cm | 47046 | 148012.23 | 100966.23 | 2.15 |
| 6. | 21 Days age of seedling + 30x10 cm | 47046 | 161700.91 | 114654.91 | 2.44 |
| 7. | 28 Days age of seedling + 20x10 cm | 47046 | 140838.71 | 93792.71 | 1.99 |
| 8. | 28 Days age of seedling + 20x20 cm | 47046 | 151092.54 | 104046.54 | 2.21 |
| 9. | 28 Days age of seedling + 30x10 cm | 47046 | 181341.85 | 134295.85 | 2.85 |
| 10. | Control plot | 47046 | 79504.85 | 50771.50 | 1.08 |

**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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