Original Research Article

**Effect of Age of Seedlings and PlantingGeometryOnYieldAndEconomics of Rice (*Oryza sativa* L.)**

**Abstract**

The field experiment entitled “Effect of age of seedlings and planting geometry on growth and yield of Rice (*Oryza sativa* L.)”was conducted during *kharif* season, 2024 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of the experimental plot was sandy loam in texture, had a pH of 7.8, contained 0.72 per cent organic carbon, and had 178.48 kg of nitrogen, 27 kg of phosphorus, and 233 kg of potassium available per hectare. The experiment was laid out in Randomized Block Design with ten treatments which are replicated thrice. Viz. T1: 14 Days age of seedling + 20x10 cm, T2: 14 Days age of seedling + 20x20 cm, T3: 14 Days age of seedling + 30x10 cm, T4: 21 Days age of seedling + 20x10 cm, T5: 21 Days age of seedling + 20x20 cm, T6: 21 Days age of seedling + 30x10 cm, T7 : 28 Days age of seedling + 20x10 cm, T8: 28 Days age of seedling + 20x20 cm, T9: 28 Days age of seedling + 30x10 cm, T10: Control plot. The results obtained that 28 Days age of seedling + 30x10 cm was recorded significantly higher grain yield (6.66 t/ha), straw yield (14.89 t/ha), and harvest index (30.57%). The aforesaid treatment also recorded gross return (INR 181341.85/ha), net return (INR 134295.85/ha) and B:C ratio (2.85).

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

**Introduction**

Rice (*Oryza sativa* L.) is the most important cereal crop of the developing world and the staple food of more than 3 billion people or more than half of the world’s 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. It contributes 42% of total food grain production and 45% of total cereal production of the country. 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. Thus, plant spacing has an important role on growth and yield of rice. Optimum plant population in a proper planting geometry is most important non-monetary input and plays a major role in yield maximization of rice **(Siddiqui *et al*., 1999).** The planting geometry had great influence on tillering pattern and spikelet formation perpanicles **(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 creates problems in various intercultural operations like hand weeding, fertilizer application, pesticide application etc., and it increases the competition among the plants for essential plant nutrients, water, air and sunlight which ultimately make the plants weaker and thinner, producing lower yield. The planting geometry and spatial configuration exploit the initial vigour of the genotypes with enhanced soil aeration creating favourable condition for better crop establishment **(Shukla *et al*., 2014).**

When seedlings stay for a longer period of time in the nursery beds, the primary tiller buds on the lower nodes of the main culm become degenerated leading to reduced tiller production **(Mobasser*et al*., 2007).** Also, early transplantation allows better plant growth with short phyllochrons interval due to less transplanting shock. This short phyllochrons interval facilitates more number of tillers produced per hill as two phyllochrons produces another tiller later under favorable growing conditions **(Singh *et al*., 2012).** When rice seedlings are transplanted at the right time in terms of age, tillering and growth precede normally but late transplanting results in lower tiller number during vegetative growth **(Mobasser*et al*., 2007).**

The length and dry weight of seedlings, number and length of roots, and growth of seedlings increased significantly by increasing the fertility level in the nursery. Increased seedling vigour and nutrient concentration in the rice plant during early growth stage were shown to be important for improving subsequent plant growth and final 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 Fertilizer is an expensive and precious input. determination of an appropriate dosage of application that would be both economical and appropriate to enhance productivity and consequent profit of the grower under given situation needs intensive study.

**2. MATERIALS AND METHODS**

This experiment was laid out during the *Kharif* season of 2024 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The crop research farm is situated at 250 39” 42” N latitude, 810 67” 56” E longitude and at an altitude of 98 m above mean sea level. The experiment was laid out in Randomized Block Design (RBD) which consisting of ten treatments; T1: 14 Days age of seedling + 20x10 cm, T2: 14 Days age of seedling + 20x20 cm, T3: 14 Days age of seedling + 30x10 cm, T4: 21 Days age of seedling + 20x10 cm, T5: 21 Days age of seedling + 20x20 cm, T6: 21 Days age of seedling + 30x10 cm, T7 : 28 Days age of seedling + 20x10 cm, T8: 28 Days age of seedling + 20x20 cm, T9: 28 Days age of seedling + 30x10 cm, T10: Control plot.The soil of the experimental plot was sandy loam in texture, had a pH of 7.8, contained 0.72 per cent organic carbon, and had 178.48 kg of nitrogen, 27 kg of phosphorus, and 233 kg of potassium available per hectare. The recommended dose of nitrogen (120 kg/ha), phosphorus (60 kg/ha) and potassium (60 kg/ha). Data recorded on different aspects of crop, *viz.,* yield were subjected to statistical analysis by analysis of variance (ANOVA) method. (**Gomez and Gomez, 1976)** and economic data analysis by mathematical method.

**3. RESULTS AND DISCUSSION:**

**3.1 Yield parameters**

In Table 1 data pertaining to yield parameters of growing as effect 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 maximum grain yield (6.66 t/ha) which was superior over all other treatments. However, the treatment (28 Days age of seedling + 20x20 cm) (5.41 t/ha) was found to be statistically at par with the treatment (28 Days age of seedling + 30x10 cm).

The significant and higher number of grain yield attributed to the fact that the trauma of root damage received during uprooting and transplanting of the seedlings was comparatively less under young seedlings (28 days old) than the older seedlings. **Chaudhari *et al*., (2015) and Vishwakarma *et al*., (2015)** reported similar results. Further the results revealed that among ricein respect of other grain yield such as plant height was recorded significantly higher with (30 cm x 10 cm) over rest of planting geometry. This might be due to the availability of more plant for utilise resources such as solar energy, air movement and availability of more nutrients from the larger area. Similar findings related to dry matter were reported **Pol (2003) and Rasool *et al*., (2013).**

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

The data Obtained that treatment (28 Days age of seedling + 30x10 cm) was recorded significantly maximum stover 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 + 20x10 cm) (13.79 t/ha) was found to be statistically at par with the treatment (28 Days age of seedling + 30x10 cm).

The significant and higher number of stover yield attributed to the fact that the trauma of root damage received during uprooting and transplanting of the seedlings was comparatively less under young seedlings (28 days old) than the older seedlings. **Chaudhari *et al*., (2015) and Vishwakarma *et al*., (2015)** reported similar results. Further the results obtained that among ricein respect of other stover yield such as plant height was recorded significantly higher with (30 cm x 10 cm) over rest of planting geometry. This might be due to the availability of more plant for utilise resources such as solar energy, air movement and availability of more nutrients from the larger area. Similar findings related to dry matter were reported **Pol (2003) and Rasool *et al*., (2013).**

**3.1.4 Harvest index (%)**

At harvest, highest test weight (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 pertaining 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)** | **Seed 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. Effect OfAgeOf SeedlingsAndPlantingGeometryOnYieldOf Rice.**

**Table 2. Effect OfAgeOf SeedlingsAndPlantingGeometryOn EconomicsOf 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.

**REFERENCES**

Anonymous. (2023-24). Ministry of Agriculture & Farmers Welfare, Department of Agriculture and Farmers Welfare (DA&FW) <https://upag.gov.in/dash-reports/statewiseapyandpercentagetoallindia>.

Chaudhari, P.R., Patel, A.P, Patel, V.P., Desai, L.J., Patel, J.V., Chaudhari, D.R. and Tandel, D.H. (2015). Effect of age of seedlings and fertilizer management on yield, nutrient content and uptake of rice (*Oryza sativa* L.). *The Bioscan*,**10**(1): 351353.

Gomez, K. A. and Gomez, A. A. (1976). Statistical procedures for agriculture Research, 2nd Edition, John Wiley and Son, New York, 680p.

Jiankai Shen., ZhenyuXie., Zhizhou He., Qiyun Lin. and Ming Yin. (2016). Composition and development prospects of scented rice. *Asian Agricultural Research*, **8** (2): 73-77.

Mahajan, G., Sekhon, N.K., Singh, N., Kaur, R. and Sidhu, A.S. (2010). Yield and nitrogen use efficiency of aromatic rice cultivars in response to nitrogen fertilizer. *Journal of New Seeds.***11** (4): 356-368.

Mahato, M. andAdhikeri, B.B. (2017). Effect of planting geometry on growth of rice varieties. *International Journal of Applied Sciences and Biotechnology*, **5** (4): 423-429.

Mhaskar, N.V., Thorat, S.T. and Bhagat, S.B. (2005). Effect of nitrogen levels on leaf area, leaf area index and grain yield of scented rice varieties. *Soils and Crops*,**15** (1): 218-220.

Mobasser, H.R., Tari, D.B., Vojdani, M., Abadi, R.S. and Eftekhari, A. (2007). Effect of seedling age and planting space on yield and yield components of rice (Neda variety). *Asian J. Plant Sci*.,**6**(2):438-440.

Pol, P.P. (2003). Effect of integrated nutrient management and plant densities on yield maximization of hybrid rice ―Sahyadri under lateritic soil condition, A *Thesis* submitted to Dr. B.S.K.K.V., Dapoli.

Rani, S.N., Mishra, B., Prasad, G.S.V., Rao, P.U., Subbaiah, S.V., Muralidharan, K. and Pasalu, C. (2001). Basmati rice heritage of India. *Indian council of Agricultural Research*, 1-4.

Rasool, F., Habib, R. and Bhat, M.I. (2013). Agronomic evaluation of rice (*Oryza sativa* L.) for plant spacing and seedlings per hill under temperate conditions. *African J.Agric. Res*.,**8** (37):4650-4653.

Shukla, U.N., Srivastava, V.K., Singh, S., Sen, A. and Kumar, V. (2014). Growth, yield and economic potential of rice (*Oryza sativa* L.) as influenced by different age of seedlings, cultivars and weed management under system of rice intensification. *Indian Journal of Agricultural Sciences*, **84** (5): 628-36.

Siddiqui, M.R.H., Lakpale, R. and Tripathi, R.S. (1999). Effect of spacing and fertilizer on medium duration rice varieties*. Indian Journal of Agronomy*, **44** (2): 310-312.

Singh, K.N., Singh, Parmeet, Singh, Lal, Kanth, Raihana, H. and Aga, Farooq, A. (2012). Influence of nursery raising methods, age of seedling and planting dates on rice (*Oryza sativa* L.) under temperate Kashmir. *Indian J. Agron*.,**57**(4): 373-377.

Vishwakarma, A. (2015). Effect of date of transplanting and age of seedling on growth, yield and quality of rice (*Oryza sativa* L.) hybrids under System of Rice Intensification. Ph.D. *Thesis* Banaras Hindu University, Varanasi (Unpublished) India (UP).