

Impact of Different Transplanting Method and Nitrogen Management Practices on Growth and Yield of Rice (*Oriza sativa* L.) cv. Pusa Basmati-1 in Eastern Uttar Pradesh, India

ABSTRACT

A field experiment was carried out during the *kharif* seasons of 2018 and 2019, at Crop Research Farm (CRF), Department of Agronomy, NAI, SHUATS, Prayajraj, U.P. In order to compare the effects of three different transplanting techniques—manual transplantation of 14-day-old seedlings, mechanized transplanting of 14-day-old seedlings, and transplanting of 21-day-old seedlings (SRI) and seven nitrogen management practices *viz.* RDN (100 percent N inorganic), RDN (75 percent N inorganic + 25 percent N through PM), RDN (75 percent N inorganic +25 percent N through VC), RDN (75 percent N inorganic +25 percent N through VC + *Azospirillum* SI), Leaf Color Chart (LCC) based N application, and Soil Test Crop Response (STCR) N application a based-on target Yield. The experiment was set up using a split plot design, with a main plot consisting of three planting techniques and seven nitrogen management techniques as sub plots that were replicated three times. During both of the experiment's years, manual transplantation of 14-day-old seedlings (SRI) resulted in considerably greater growth parameter, yield, and yield attributes while being equivalent to other planting techniques. Comparable to the application of RDN (75 percent N inorganic +25 percent N through PM), RDN (75 percent N inorganic+25 percent N through PM+ *Azospirillum* SI) produced significantly higher growth and yield parameters.

Key words: *Rice, transplanting, nitrogen management, System of Rice Intensification, growth and yield, kharif.*

INTRODUCTION

For more than half of the world's population, rice (*Oriza sativa* L.), which is farmed in a variety of climatic zones, is the most significant cereal crop. In irrigated low land rice, transplanting is the most common and traditional technique of establishment. Due to a lack of labour and water, less rice is being transplanted globally. Therefore, in order to boost rice output, it is necessary to look for alternative crop establishment techniques (Farooq *et al.*, 2009). Because it saves labour and ensures that young seedlings are transplanted in a timely manner, the mechanical transplanting and SRI method of transplanting rice have been identified as the most promising options. By modifying the environmental factors that could alter the microclimate and soil conditions, there is plenty of room to boost rice productivity. Around the world, including India, the SRI technique of cultivation is gradually gaining

popularity. The traditional method of transplanting rice is time- and labor-intensive. Planting is delayed due to a lack of labour at the proper time, which results in a low yield (Awan *et al.*, 2008). In this case, it is essential to cultivate rice using a labor- and space-efficient approach without sacrificing grain production.

In order to get a good yield, most rice soils require nitrogen (N) fertilizer. For major rice-growing tracts, the Prayaraj region of Eastern Uttar Pradesh currently recommends fertilizer N at a predetermined rate and schedule. These "blanket" suggestions have produced good yields, but their ability to increase nutrient usage efficiency is constrained. The limited use of organic manure and uneven use of inorganic nitrogen sources of nitrogen, which can result in numerous nutritional deficits, are significant barriers to achieving increased yields, in addition to improved cultivars and irrigation. The twin aims of fertilizer economy and sustainability should be the focus of nutrient management techniques Dass *et al.* (2012). Combining organic and inorganic sources, such as farmyard manure, chicken manure, green manure, and vermicompost, with biofertilizer and their effective management, has the potential to increase soil health and production while also fulfilling some of the nutrient needs of crops (Chaudhary *et al.*, 2011). Therefore, a field experiment is carried out in this competition to assess the growth and yield of rice under various nitrogen management and transplanting methods.

MATERIAL AND METHOD

The Crop Research Farm (CRF), Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, undertook a field experiment during the *Kharif* seasons of 2018 and 2019. (U.P.). The soil at the test location had a sandy loam texture, a pH of 7.3 and 7.3, an EC of 0.23 and 0.34 dS/m, organic carbon of 0.42 and 0.34 percent, and usable amounts of N, P, and K of 180.6, 189.9, and 238.3 kg/ha, during 2018 and 2019 respectively. The experiment used a split-plot design that was replicated thrice with 21 treatments using three transplanting techniques as the main plot treatments: manual transplanting of 21 days old seedlings (farmers practice), mechanized transplanting of 14 days old seedlings and Manual transplanting of 14 days old seedlings (SRI), and RDN (100 percent N inorganic), RDN (75 percent N inorganic + 25 percent N through PM), RDN (75 percent N inorganic + 25 percent N through VC), RDN (75 percent N inorganic + 25 percent N through VC + *Azospirillum* SI), Leaf Color Chart (LCC) based N application, and Soil Test Crop Response (STCR) based N application (based on target Yield) are seven nitrogen management practises. In the experiment, mechanical transplanting of rice was done using a self-propelled rice transplanter. The transplanter, which has a diesel motor, moves seedlings from mat-style nurseries. Seedlings that were 14 days old were used for SRI and mechanized transplanted rice. Every treatment received the appropriate dose of phosphorus at 60 kg/ha, potassium at 80 kg/ha, and zinc sulphate at 20 kg/ha as a baseline. In LCC-based nitrogen management, the suggested amount of nitrogen was applied anytime the LCC value was discovered to be below the fixed critical level of 3. By using the target yield based

on the initial soil sample values of available N, P, and K as well as the amount of N, P, and K supplied, nitrogen was applied in STCR-based plots. The data on the various growth and yield attributing parameters were statistically analysed using a standard formula (Gomez and Gomez, 1984)

RESULT AND DISCUSSION

Growth attributes

Due to diverse nitrogen management techniques and the transplanting procedure, the growth characteristics of rice were significantly improved. During both the years of experimentation, manual transplantation of 14-day-old seedlings (SRI) (M₃) led to significant plant height (99.57 and 101.85 cm) and dry weight (50.89 and 51.70 g/plant) than mechanical and traditional methods of transplanting. Higher plant height and dry matter production output resulted from the SRI method's wider spacing and decreased competition, which allowed the plant to grow vigorously and to utilize the vital nutrients for plants that are necessary for growth and development (Mohanty *et al.*, 2014). Additionally, during both the years of trial, the application of RDN (75 percent N inorganic +25 percent N via PM + *Azospirillum* SI) (N₄) produced the significantly, highest plant height and dry weight (97.55 and 97.24 cm and 55.09 and 56.68 g/plant, respectively). Increased growth attributes value in the treatment when organic sources were treated with inorganic fertiliser may be related to the organic sources' lower nitrogen loss and longer availability to the crop. Combining organic and inorganic nitrogen fertilizer ensures that it is released quickly at first and then more gradually to keep up with rice growth (Chaudhary *et al.*, 2011). The majority of the nutrients required for plant better growth and development are provided by organic manure, which aids in the creation of new tissues and shoots that ultimately improve plant height and dry matter production in rice crops and also maintain the fertility status of soil.

Yield attributes

The transplanting method and various nitrogen management practices greatly impacted on yield parameters of rice, namely the number of panicle/hill and test weight (table 2). Manual transplanting of 14 days old seedlings (SRI) (M₃), the significantly, highest number of panicle/hill (15.29 and 13.47) and test weight (29.86 and 27.71 g) were noted during the course of two years of the study. The results however, demonstrate that throughout the first and second years of study, mechanical transplanting of 14-day-old seedlings was discovered to be comparable to Manual transplantation at 14-days (SRI) (M₃) in terms of number of panicle/hills, respectively. The greatest number of panicles/hills can be related to the ideal plant population and geometry, which led to the plant having access to more resources (Duttarganvi *et al.*, 2014).

In comparison to RDN @100% or no organics, integrated application of nutrient sources generally produced yield qualities with a much greater value. When comparing the various nitrogen management strategies, the treatment RDN (75 percent N inorganic +25 percent N *via* PM + *Azospirillum* SI) (N₄) produced the highest value of yield attributes, including number of panicle/hill (14.36 and 12.23) and test weight (30.44 and 28.56 g), in the experimental years 2018 and 2019, respectively. Increased panicle and test weight were signs of stimulated vegetative growth caused by adequate and sustained nitrogen supply receiving from organic fertilizer as well biofertilizer. It is a well-known fact that adding organic manure to soil enhances its biological and physical properties. Lower penetration impedance brought on by reduced bulk density (BD) may be to account for improved root development and greater yield qualities. The simultaneous application of nutrients has also been reported to have positive effects by **Kumari *et al.* (2006)** and **Chaudhary *et al.* (2014)**.

Grain and straw yield

Under varied nitrogen management approaches, several transplanting methods produced distinctly different results. Manual transplantation at 14 days (SRI) (M₃) produced significantly greater grain (4.81 and 4.46 t/ha) and straw yield (7.01 and 6.48 t/ha), representing a 16.6% increase in grain yield over traditional transplanting method. Wider spacing and less competition for light, nutrients, and water under the SRI method allowed the plants to grow vigorously and helped to utilize the essential nutrients, important for plant growth and development, which led to higher grain and straw yield, which may have contributed to increase rice productivity under saturation (**Mohanty *et al.*, 2014**). Low growth and production of rice were the end results of insufficient and unbalanced plant nutrients interfering with regular operations. Additionally, significant greater grain and straw yield was observed in RDN (75 percent N inorganic + 25 percent N through PM + *Azospirillum* SI) (N₄). Improved growth, which led to enhanced output and yield characteristics with increased N fertilizer efficiency in rice, was a major factor in integrated systems of organic and inorganic nutrient management (**Sharma *et al.*, 2019**).

CONCLUSION

Thus, it can be concluded that the greatest choice for increasing the productivity and profitability of SRI cultivated rice without endangering the soil health. It is advised that, application of RDN (75 percent N inorganic + 25 percent N through PM) was found to be beneficial for the rice growers of Eastern Uttar Pradesh, India.

FUTURE SCOPE

Innovation and greater crop productivity improvement are needed to meet the continuous rising food demand of expanding human population and the need for eco-friendly agricultural development techniques. There is growing evidence that, SRI principles and practices can provide a strategy for sustainable agriculture in India and elsewhere, when paired with nutritional

sources through, Integrated Nutrient Management. In order to help farmers, development of viable techniques to increase rice yields with less reliance on inputs, this research examines prospects for enhancing agricultural production and food security while reducing the negative effect on soil and the environment.

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Table 1: Growth parameters of rice (*Oryza sativa L.*) under different method of transplanting and nitrogen management practices

Treatments	Plant height (cm)		Dry weight (g/plant)	
	2018	2019	2018	2019
Method of transplanting (M)				
M ₁ : Transplanting of 21 days old seedlings (farmers practice)	81.77	82.88	40.52	45.34
M ₂ : Mechanized transplanting of 14 days old seedlings	93.79	95.38	44.04	49.37
M ₃ : Manual transplanting of 14 days old seedlings (SRI)	99.57	101.85	50.89	52.52
SEm(±)	2.00	2.16	1.22	0.91
CD (P=0.05)	6.92	7.48	4.21	3.13
Nitrogen management practices (N)				
N ₁ : RDN (100% N inorganic)	90.62	93.08	42.42	45.86
N ₂ : RDN (75% N inorganic +25% N through PM)	92.20	94.96	49.00	54.46
N ₃ : RDN (75% N inorganic +25% N through VC)	91.28	92.19	45.05	47.97
N ₄ : RDN (75% N inorganic +25% N through PM + <i>Azospirillum</i> SI)	97.55	97.24	55.09	58.27
N ₅ : RDN (75% N inorganic +25% N through VC + <i>Azospirillum</i> SI)	93.18	93.30	47.00	51.24
N ₆ : Leaf Colour Chart (LCC) based N application	88.96	90.74	39.87	43.75
N ₇ : Soil Test Crop Response (STCR) based N application	88.18	92.08	37.63	41.99
SEm(±)	1.74	1.13	1.30	1.10
CD (P=0.05)	5.05	3.28	3.77	3.18

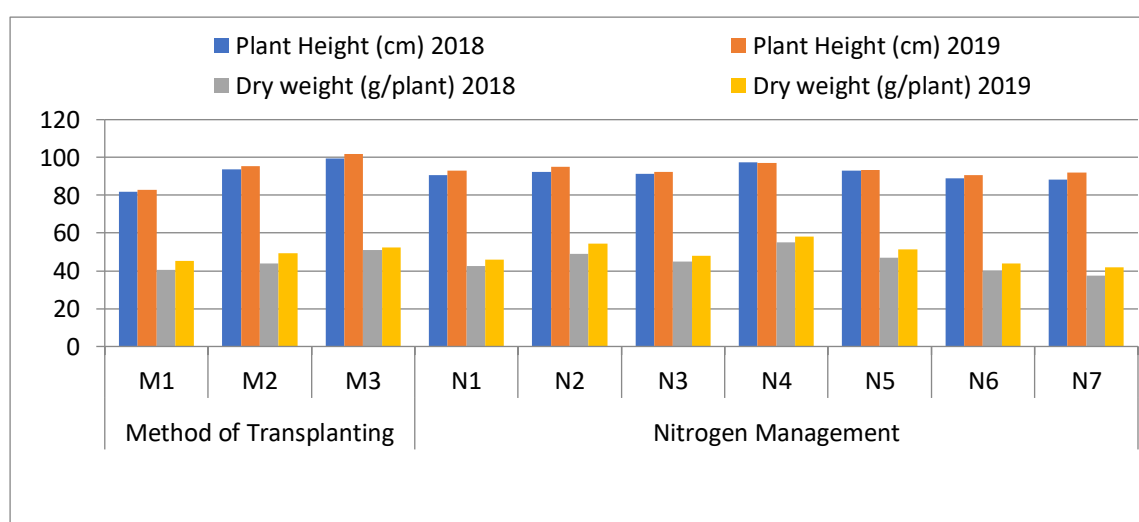


Fig. 1 Growth parameters of rice (*Oryza sativa L.*) under different method of transplanting and nitrogen management practices

Table 2: Yield attributing characters and yield of rice (*Oryza sativa L.*) under different method of transplanting and nitrogen management practices

Treatments	Number of panicle/hills		Test weight (gm)		Grain yield (t/ha)		Straw yield (t/ha)		
	2018	2019	2018	2019	2018	2019	2018	2019	
Method of transplanting (M)									
M ₁ : Transplanting of 21 days old seedlings (farmers practice)	11.41	12.04	26.10	24.62	4.11	3.86	6.19	5.67	
M ₂ : Mechanized transplanting of 14 days old seedlings	14.64	12.71	27.90	25.76	4.43	4.20	6.67	6.43	
M ₃ : Manual transplanting of 14 days old seedlings (SRI)	15.29	13.47	29.86	27.71	4.81	4.46	7.01	6.48	
SEm(±)	0.78	0.11	0.39	0.54	0.06	0.10	0.15	0.17	
CD (P=0.05)	2.70	0.38	1.36	1.85	0.21	0.33	0.53	0.58	
Nitrogen management practices (N)									
N ₁ : RDN (100% N inorganic)	12.62	11.89	27.33	25.67	4.16	3.93	6.47	6.16	
N ₂ : RDN (75% N inorganic +25% N through PM)	13.93	12.94	29.89	27.56	4.83	4.57	7.05	6.41	
N ₃ : RDN (75% N inorganic +25% N through VC)	13.68	12.68	27.11	26.33	4.50	4.22	6.69	6.21	
N ₄ : RDN (75% N inorganic +25% N through PM + <i>Azospirillum</i> SI)	14.36	13.23	30.44	28.56	5.21	4.99	7.12	7.04	
N ₅ : RDN (75% N inorganic +25% N through VC + <i>Azospirillum</i> SI)	13.69	12.70	28.22	26.33	4.74	4.47	6.91	6.36	
N ₆ : Leaf Colour Chart (LCC) based N application	12.99	11.15	25.67	24.11	4.07	3.78	6.20	5.85	
N ₇ : Soil Test Crop Response (STCR) based N application	11.52	10.49	27.00	23.67	3.62	3.24	5.92	5.51	
SEm(±)	0.15	0.14	0.93	0.86	0.15	0.15	0.17	0.25	
CD (P=0.05)	0.47	0.40	2.68	2.49	0.44	0.44	0.50	0.72	

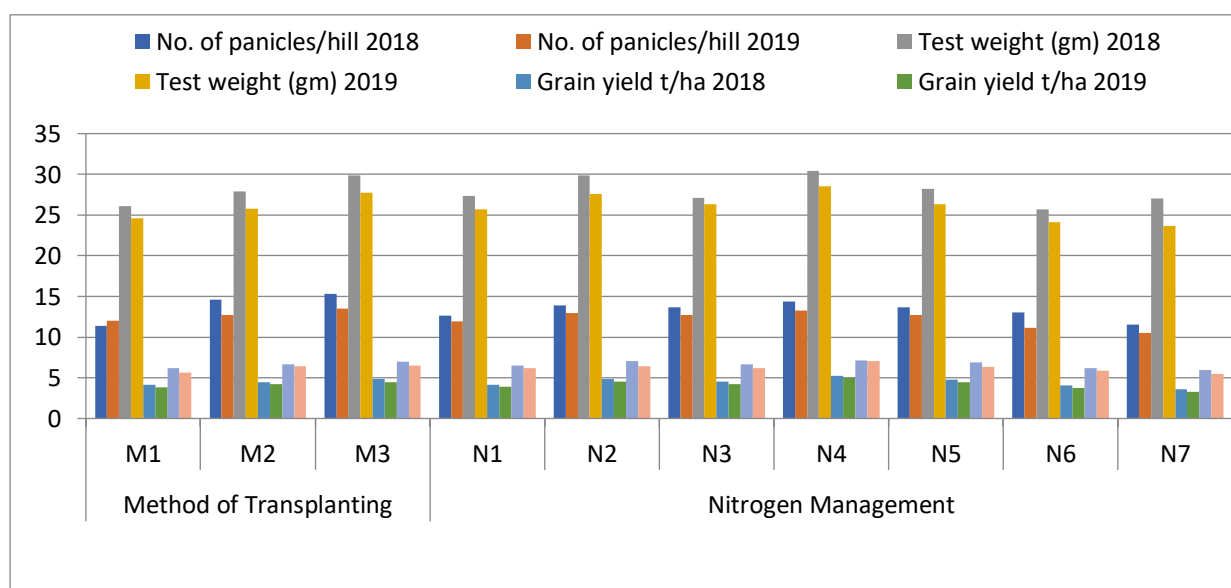


Fig. 2 Yield attributing characters and yield of rice (*Oryza sativa L.*) under different method of transplanting and nitrogen management practices