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Effect of Methods of Crop Establishment and Nitrogen Levels on Growth and Yield of Rice (*Oryza sativa* L.)

Abhinesh Verma, Sudhakar Singh*, Deepak Pandey, S. S. Chanda, P. K. Singh and Gajendra Singh

Department of Agronomy, Chandra BhanuGupt Agriculture Post Graduate College, Bakshi KaTalab, Lucknow, U.P. -266201, India

**Corresponding author*

Abstract

An experiment entitled "Effect of methods of crop establishment and nitrogen levels on growth and yield of rice (*Oryza sativa* L.)''a field experiment was conducted *Kharif* season-2023 at the Agronomy Research Farm of Shardhya Bhagwati Singh Agriculture Research Farm, Chandra Bhanu Gupta Krishi Mahavidyalaya, B.K.T. Lucknow (Uttar Pradesh). The experiment was laid out in split plot design with three replications. The treatment consisted of three methods of crop establishment (M_1-Random transplanting conventional (30 days old seedling), M_2-Transplanting (20 x 10 cm)-21 days old seedling and M_3- SRI (25 x 25 cm)-12 days old seedling were kept in main plots and four nitrogen levels (N_0- 0 kg N ha^{-1}, N_1- 60 kg N ha^{-1},N_2-120 kg N ha^{-1}, and N_3-180 kg Nha^{-1}) in sub plots with three replications. The experimental site was silty loam having medium organic carbon (0.45%) and available nitrogen (376.0 kg/ha.), phosphorous (25.54 kg/ha.) and potassium (165.84 kg/ha.). All the growth parameters, development studies, yield attributes and yield of rice were significantly higher under SRI method as compared to other methods of crop establishment. Among nitrogen levels all growth parameters, development studies, yield attributes and yield of rice were significantly higher under 180 kg N ha^{-1} being statistically at par with 120 kg N ha^{-1} and found to be significantly superior over other nitrogen levels. Test weight (1000-grain weight) did not influence significantly due to methods of crop establishment and nitrogen levels. The nitrogen, phosphorus and potash content (%), and its uptake (kg ha^{-1}) in grain and straw were obtained higher under SRI method with combination 180 kg N ha^{-1} however, it was being at par with 120 kg N ha^{-1} and found to be significantly superior over other nitrogen levels. The Protein content (%), and protein yield (kg ha^{-1}) in grain and straw were obtained higher under SRI method with combination 180 kg N ha^{-1} however, it was being at par with 120 kg N ha^{-1} and found to be significantly superior over other nitrogen levels. The maximum net return (Rs. 106168.88) and B:C ratio (2.05) was obtained under SRI with application of 180 kg N ha^{-1} (M_3N_3). Therefore, this combination was proved to be more remunerative than other treatment combinations.

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Keywords

Crop establishment, Nitrogen, Growth, Yield, Economics.

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world and it is the most staple food in South-East-Asia and at present more than half of the world population depend on this crop (Prasad *et al.*, 2010). World-wide, India stand first in rice producing area and second in production after China. India is the world's second largest producer of rice. India has the largest acreage under rice about 46.2 million ha. of land area for cultivation of rice and production of rice is estimated at 130.3 million tonnes with average productivity of 2809 kg ha^{-1} in the year 2021-2022. (Directorate of Economics & statistics, 2021-22). In U.P it is grown on area of about 5.58 million ha. with the production of 15.66 million tonnes and productivity of 2759 kg/ha. The average productivity of rice in the Uttar Pradesh is low as compared to Punjab (4366 kg/ha.), Tamil-Nadu (3574 kg/ha.), Andhra Pradesh (3395 kg/ha.) and West Bengal (2984 kg/ha.) (Anonymous, 2022). In 21st century there will be need of about 250 million tonnes of food grains to feed the rapidly increasing population.

There are different methods of establishment namely, Direct Seeded Rice, Transplanting rice and System Rice Intensification of are used by farmers for the cultivation of rice. Among these methods transplanting method is commonly used in different areas, while system of System of Rice Intensification (SRI) is a water saving technology of cultivation. It is reported that the rice yield is obtained in this method is more than normal transplanting method. The SRI was developed by Jesuit Henri De Laulanie (1993) at Medagascar.

Method of crop establishment largely affects the performance of rice as a result of its growth and development. Transplanting requires more labour (25 persons ha^{-1} day^{-1}) and water content. It is reported that approximately 3000-5000 liters of water is needed to produce 1 kg of rice by conventional transplanting method of rice cultivation as the puddling operation which is required for preparation of land in transplanting consumes about 20-40 % of the total water required for growing of crop and subsequently creates difficulties in preparing the seed bed for succeeding crop in rotation. In transplanting, the major operations like nursery preparation and management, pulling of nursery, transporting and finally, the distribution of the seedlings in the main field consumes about 30-40% of the total cost of cultivation (Rani and Jayakiran, 2010).

Among the fertilizer, N is most important for proper growth and development (Ranjan *et al.,* 2021), The N use efficiency has been found to be around 30-40% in rice with the current practices, Nitrogen nutrition due to the considerable impact on growth parameters and physiological traits of rice is important. Nitrogen (N) is typically the nutrient that often limits rice yield and hence the nutrient needed in largest quantity among the fertilizer, Appropriate doses of N fertilizer and establishment method are the need for increase N use efficiency (NUE) in Rice (Ranjan and Yadav, 2019). The efficient fertilizer management can increase crop yield and reduce production cost. Excess amount of nitrogen fertilizer results in lodging of plant, prolonging growing period, delaying maturity and reducing yield (Uddin, 2003). Nitrogen fertilizer is one of the most important nutrients that determine rice yield, It positively influences tiller development yield and yield components. Wang-Dan Ying *et al*., (2008) reported that rice yield was significantly increased by N application most of the cultivars reached that highest yield when N was applied at 150-225 kg/ha. Nitrogen is one of the most important plant nutrients and plays a vital role in plant photosynthesis and biomass production. Increasing panicle numbers in per unit area is the main factor of yield increment as a result of nitrogen application (Bindra *et al.,* 2000; Laroo and Shivay, 2011). Nitrogen is the most important and yield-limiting nutrient in rice production worldwide (Lin *et al.,* 2006). Nitrogen is normally a key factor in achieving optimum lowland rice grain yields (Fageria *et al.,* 1980). It is, however, one of the most expensive inputs and if used improperly, can pollute the ground water. Rice consumes maximum nitrogenous fertilizers in India. More than 60% of the nitrogen applied to the rice field is lost to the environment in the form of nitrate, ammonia and nitrous oxide. Split application of nitrogen reduces the rapid nitrogen emission to the environment.

Materials and Methods

A field experiment entitled "Effect of methods of crop establishment and levels of nitrogen on growth and yield of rice (*Oryza sativa* L.)" was conducted *Kharif* season-2023 at the Agronomy Research Farm of Shardhya Bhagwati Singh Agriculture Research Farm, Chandra Bhanu Gupta Krishi Mahavidyalaya, B.K.T. Lucknow (Uttar Pradesh) during the *Kharif* season-2023. The experimental site was silty loam having medium organic carbon (0.45%) and available nitrogen (376.0 kg/ha.), phosphorous (25.54 kg/ha.) and potassium (165.84 kg/ha.). The experiment was laid out in split plot design with three replications.

The treatment consisted of three methods of crop establishment (M_1-Random transplanting conventional (30 days old seedling), M_2-Transplanting (20 x 10 cm)-21 days old seedling and M_3- SRI (25 x 25 cm)-12 days old seedling were kept in main plots and four nitrogen levels (N_0- 0 kg N ha^{-1}, N_1- 60 kg N ha^{-1}, N_2-120 kg N ha^{-1}, and N_3-180 kg N ha^{-1}) in sub plots with three replications. The rice was fertilized with a common dose of P and K @ 60 kg and 40 kg/ha., respectives and supplied through SSP and MOP fertilizer. The hay dose of nitrogen through Urea as per treatment was applied at the time of field preparation. The rest dose of nitrogen was top-dressed in two splits i.e. tilling and panicle initiations stage and calculated on the basis of net plot size and as per treatments taken per plot. Healthy and bold seed of rice variety SHIUAT-1 @ 35kg/ha for random methods and Normal transplanting and for SRI @ 5 kg/ha were sown on 4 June 2023 in puddled soil. The moisture will be maintained in seedbed properly 2-3 days intervals, which ensured proper growth of seedlings. In M_1 plot, (Farmer method of transplanting), 25 days old seedling hill^{-1}, M_2 plot (crop establishment was done through transplanting), 21 days old seedling at the 20x10 cm hill space and in M_3 plot (SRI methods) the transplanting was done with 12 days old seedling and one seedling/hill at the 25x25 cm hill space. The crop was irrigated as and when required. All improved cultural practices were used to raise the crop. The data on plant height and no. of tillers were recorded from the area already marked and tagged. From three plant in each plot sample from dry matter accumulation was recorded by cutting of plants 1 hill from random, transplanting and SRI methods. The sample for dry matter accumulation were first sun dried and then kept in hot air oven 72^{o}C ± 0.5^{0}C for 48 hours till the constant weight was achieved. Leaf area index was estimated by using the formula by Watson (1952). LAI= (Leaf area per plant (cm^2))/ Ground area (cm^2)). Yield attributes were recorded from 3 panicles selected randomly from each plot at harvest of crop. Grain and straw yield of rice were recorded at harvest, and harvest index (%) was calculated as grain yield divided by total biological yield and multiplied by hundred. The soil and plant analysis were done by using standard laboratory method. The uptake of nutrient was calculated by multiply nutrient content (%) in grain and straw yield. Economic of different treatment was work out on the basis of prevailing market prices.

Results and Discussion

Growth attributes

Plant height, number of tillers, dry matter accumulation and leaf area index of rice were affected significantly due to methods of crop establishment and nitrogen levels (Table1). Increasing the methods of crop establishment up to SRI method increased the plant height, number of tillers, dry matter accumulation and leaf area index significantly over rest of the other methods of crop establishment. The maximum plant height (129.21 cm), number of tillers (415.50 m^2), dry matter accumulation (76.81 q/ha) and leaf area index (4.470) was recorded significantly with SRI method over rest of the other methods of crop establishment. The higher plant height under SRI methods was because of better sunlight absorption, better aeration and nutrient availability of rice plant resulted higher growth of plant in terms of plant height on the other hand, the younger seedling (10-12 days old) having better ability to establish quickly and higher cell enlargement and all elongation due to higher menistematic cell activity result in higher plant height as compare to normal transplanting of 21 days old seedling and random transplanting treatment. Similar results were obtained by Shekhar *et al.,* (2009).

Among the application of nitrogen levels @ 180 kg N/ha recorded taller plant, higher no. of tillers, dry matter accumulation and leaf area index as compared to other nitrogen levels treatment. The highest plant height (126.60 cm), number of tillers (387.32 m^2), dry matter accumulation (74.15 q/ha) and leaf area index (45.24) was recorded with the application of 180 kg N/ha. The increase in plant height due to levels of nitrogen was because of higher supply of nitrogen to plant at 180 kg/ha which enhanced the menistematic tissue activity resulted higher cell elongation and cell enlargement consequently increasing plant height under the present study was reported by Kumar *et al.,* (2023).

Development Studies

An examination of the data revealed that days taken to 50% stages and maturity was significantly affected due to method of crop establishment and nitrogen levels (Table-2). The maximum days taken to 50% flowering (80.85) and maturity (115.56) was taken under SRI method which was followed by transplanting with 21 days old seedling.

Among the nitrogen levels 180 kg N/ha. recorded maximum days taken to 50% flowering and maturity as compared to other nitrogen levels treatment. The maximum days taken to 50% flowering (76.73) and maturity (117.48) was taken under 180 kg N/ha. It also evident from the data that application of 180 kg N ha^{-1} resulted in significantly higher days to maturity followed by application of nitrogen as 120 kg N ha^{-1}. Similar trends in variation in respect of days to 50% flowering and maturity in transplanted rice has also been reported by Rai and Kushwaha (2008).

Yield attributes

Yield attributes characters like number of panicles (m^{-2}), length of panicle (cm), no. of grain panicle^{-1}, panicle weight (g), grain weight panicle^{-1} (g), and test weight (g) were affected significantly due to different methods of crop establishment and nitrogen levels (Table-3). Maximum number of panicles m^{-2} (402.83), length of panicle (25.37 cm), no. of grain panicle^{-1} (217), panicle weight (4.55 g), grain weight panicle^{-1} (4.36 g), and test weight (22.58 g) was recorded under SRI method which was significantly higher over other methods of crop establishment while at par with random transplanting conventional. Yield attributing characters are the function of growth and development that develop during vegetative phase of the plant. Due to better partitioning of photosynthates from source to sink as a result of better growth owing to favorable growing conditions might have resulted to better development and higher value of yield attributes. These findings are well supported by Thakur *et al.,* (2009) and Singh *et al.,* (2002).

Table.1 Growth attributes of rice as affected by methods of crop establishment and nitrogen levels (at harvest stage)

Treatments	Plant height (cm)	No. of tillers (m^2)	Dry matter accumulation (q/ha.)	Leaf area index
Method of crop establishment				
M_1- Random Transplanting Conventional	120.75	318.16	62.54	3.121
M_2- Transplanting	123.15	322.25	72.22	4.043
M_3-SRI	129.21	415.50	76.81	4.470
SE(m) ±	0.06	0.45	0.16	0.014
C.D (P= 0.05)	0.26	1.85	0.67	0.056
Nitrogen levels (kg ha^{-1})				
N_0-0	119.37	266.88	66.65	2.749
N_1-60	122.68	360.66	69.71	3.885
N_2-120	126.26	386.11	71.85	4.497
N_3-180	126.60	387.32	74.15	4.524
SE(m) ±	0.12	0.42	0.37	0.014

Table.2 Days taken to 50% flowering and Days taken to maturity of rice as affected by method of crop establishment and nitrogen levels

Treatment Crop	Days taken to 50% flowering	Days taken to maturity
Method of crop establishment		
M_1- Random Transplanting Conventional	70.58	98.37
M_2- Transplanting	72.04	108.89
M_3- SRI	80.85	115.56
SE(m) ±	0.12	0.06
C.D (P = 0.05)	0.51	0.26
Nitrogen levels (kg/ha^{-1})		
N_0- 0	72.55	99.59
N_1- 60	73.91	105.20
N_2- 120	74.78	111.17
N_3- 180	76.73	117.48
SE (m)	0.09	0.06
C.D (P = 0.05)	0.29	0.19

Table.3 Yield attributes of rice as affected by different method of crop establishment and nitrogen levels

Treatments	No. of panicle (m^2)	Panicle length (cm)	No. of grains panicle^{-1}	Panicle wt.(g)	Grain wt. panicle^{-1}	Test wt. (g)	Grain yield (q/ha)	Straw yield (q/ha)
Method of crop establishment								
M_1- Random Transplanting Conventional	366.91	21.80	171.16	2.94	2.76	19.45	41.02	61.95
M_2- Transplanting	378.58	23.29	209.58	3.45	3.14	21.78	48.59	70.46
M_3-SRI	402.83	25.37	217.00	4.55	4.36	22.58	58.53	76.86
SE(m) ±	0.60	0.016	0.46	0.027	0.032	0.036	0.11	0.06
C.D (P= 0.05)	2.44	0.066	1.87	0.111	0.12	0.14	0.46	0.27
Nitrogen levels (kg ha^{-1})								
N_0-0	373.00	21.88	180.11	3.22	3.02	20.16	46.37	66.37
N_1-60	379.44	22.83	195.66	3.54	3.26	21.00	48.48	68.58
N_2-120	386.22	23.92	206.11	3.77	3.54	21.55	50.34	70.82
N_3-180	392.44	25.32	215.11	4.06	3.86	22.36	52.32	73.25
SE(m) ±	0.39	0.088	0.54	0.025	0.025	0.041	0.09	0.12
C.D (P= 0.05)	1.17	0.26	1.63	0.074	0.074	0.12	0.28	0.37

Table.4 Effect of methods of establishment and nitrogen levels on economics of each treatment combinations

Treatment combination	Net return (Rs.ha^{-1})	B:Cratio
M_1N_0	55650.68	1.17
M_1N_1	56918.25	1.18
M_1N_2	61143.01	1.23
M_1N_3	63208.26	1.25
M_2N_0	69166.8	1.42
M_2N_1	75324.35	1.51
M_2N_2	78393.91	1.54
M_2N_3	85327.38	1.64
M_3N_0	94718.48	1.95
M_3N_1	99023.86	1.99
M_3N_2	103110.3	2.03
M_3N_3	106168.88	2.05

Among the nitrogen levels 180 kg N/ha. recorded maximum all yield attributes as compared to other nitrogen levels treatment. The maximum number of panicles m^{-2} (392.44), panicle length (25.32 cm), no. of grains panicle^{-1} (215), panicle weight (4.06 g), grain weight panicle^{-1} (3.86 g), test weight (22.36 g) over other nitrogen levels.

The results of present investigation in respect of these yield attributes are in agreement with the findings of Pariyani and Naik (2004) who reported the response of rice crop to nitrogen in augmenting the yield attributes to a certain level of its application.

Yield Studies

The data pertaining to grain yield and straw yield of experimental crop of rice as affected by methods of crop establishment and nitrogen levels (Table-3). The highest grain yield (58.53 q/ha^{-1}) and straw yield (76.86 q ha^{-1}) was obtained by SRI method. Yield is the functions of complex inter relationship of growth in vegetative phase and yield attributes as well. Higher yield under SRI method was due to better crop growth and development resulting to in higher value of yield attributes which had direct bearing on the grain yield. Higher number of panicles per unit area, panicle size and filled grains percentage in case of SRI method as compared to other method of crop establishment might be responsible for superiority of this treatment over other in respect of grain yield. Similar results have been reported by Krishna *et al.,* (2008).

As regard to nitrogen levels, data revealed that the crop sown with 180 kg N ha^{-1} produced significantly higher grain yield (52.32), straw yield (73.25 q ha^{-1}). This might be due to adequate nitrogen availability which contributed to increase dry matter accumulation. Better vegetative growth coupled with high yield attributes resulted into higher grain yield in 180 kg N ha^{-1}. Similar results have been reported by Rao *et al.,* (2014) and Krishna *et al.,* (2008).

Economics

Maximum net return and benefit: cost ratio (Rs. 106168.88/ha., and 2.05) was recorded with treatment combination M_3N_3 (SRI + 180 kg N ha^{-1}) which was followed by M_3N_2 (SRI + 120 kg N ha^{-1}) with net return (Rs.103110.3/ha) and B:C ratio (2.03). However, the lowest and net income (Rs.55650.68/ha) and B:C ratio (1.18) was obtained with M_1N_0 (Random transplanting conventional + 0 kg N ha^{-1}) treatment. This was mainly because of lower grain and straw yield recorded with this treatment. The higher net return and benefit: cost ratio with M_3N_3 (SRI + 180 kg N ha^{-1}) was mainly because of higher yield as compared to rest of the treatments. In respect of B:C ratio, SRI method along with 180 kg N ha^{-1} showed highest values (2.05).

Conclusion

The SRI (System of Rice Intensification) method was found to be statistically supreme. Term of growth, yield attributes and yield over transplanted at 20 x 10 cm. Crop fertilized 180 kg N ha^{-1} gave statistically higher growth parameter, yield attributes and yield over rest levels of N 120 kg N ha^{-1} treatment. Thus, rice may be established by SRI (25x25 cm) with 12-15 days old seedling and fertilized with 180 kg N/ha to obtain higher yield and benefit: cost ratio.

References

Agricultural Statistics at a Glance (2018). Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India.

Anonymous, 2022. Economic Survey 2022-23. Statistical Appendix, 37 - 40.

Anonymous, 2022. FAO 2022. World Food and Agriculture – Statistical Yearbook 2022. Rome, 165 - 166.

Bindra, A. D., Kalia, B. D., and Kumar, S. (2000). Effect of nitrogen levels and dates of transplanting on growth, yield and yield attributes of scented rice. *Advance Agriculture Research* 10:45-48.

Fageria NK (1980) Influence of phosphorus application on growth, yield and nutrient uptake by irrigated rice. Revista Brasileira de Ciência do Solo 4:26–31

Krishna, A., Biradorpatil, N. K. and Chanappagoudar, B. B. (2008). Influence of SRI cultivation on seed yield and quality Karnataka. *Journal of Agriculture science* 421 (3): 1369-1372.

Kumar, D.M., Srinivas, T., Rao, L.V.S., Suneetha, Y., Sundaram, R.M., Kumari, V.P. and Ratnam, T.V. (2023). Generation mean analysis for yield and yield component traits in inter- specific cross of rice (Oryza sativa L.). Agricultural Science Digest. http://dx.doi.org/10.18805/ag.D-5722

Laroo, N. and Shivay, Y. S. (2011). Effect of nitrogen and sulphur levels on growth and productivity of scented rice. *Current Advances in Agriculture Science* 3 (1): 45-48.

Lin, X., Zhou, W., Zhu, D., Chen, H., & Zhang, Y. (2006). Nitrogen accumulation, remobilization and partitioning in rice (*Oryza sativa* L.) under an improved irrigation practice. *Field Crops Research*, 96 (2-3), 448-454. http://dx.doi.org/10.1016/j.fcr.2005.09.003

Pariyani, A. K. and Naik, K. R. (2004). Effect of nitrogen levels and seedling number on yield attributes and yield of rice hybrids. *Journal of Soils and Crops*, 14 (2): 234-236.

Prasad, P.V.V., K.J. Boote, L.H. Allen, J.E. Sheehy, J.M.G. Thomas, 2006. Species, ecotype and cultivar differences in spikelet fertility and harvest index of rice in response to high temperature stress. Field Crops Research, Volume 95, Issues 2–3, 398-411. https://doi.org/10.1016/j.fcr.2005.04.008

Rai HK and Kushwaha HS. 2008. Effect of planting dates and soil water regimes on growth and Yield of upland rice. Oryza-An International Journal on Rice. 45(2):129-132

Rani T S, Jayakiran K. 2010. Evaluation of different planting techniques for economic feasibility in rice. Electronic Journal of Environmental, Agricultural & Food Chemistry, 9, 150–153.

Ranjan, R. and Yadav, R. (2019). Targeting nitrogen use efficiency for sustained production of cereal crop. J.Plant Nutr., 51(2): 85-91.

Ranjan, S., Kumar, S., Sow, S. and Dutta, S.K. (2021). Impact of Integrated Nutrient Management in Rice (Oryza sativa) on Grain and Protein Yield of Succeeding Wheat (Triticum aestivum) in Long Term Rice-Wheat Cropping System. Biological Forum – An International Journal, 13(3a): 448-450.

Rao, G. J. and Rao, K. T. (2014). Effect of planting time on growth, yield and incident of insect pest of rice. 27: 497-500.

Shekhar, J. (2009) Productivity and economics of rice (*Oryza sativa*) in system of rice intensification in North- Western Himalaya. Indian. J. Agron 54 (4): 423- 427.

Singh B, Singh Y, Ladha JK, Bronson KF, Balasubramanian V, Singh J, Khind CS. 2002. Chlorophyll meter– and leaf color chart–based nitrogen management for rice and wheat in northwestern India. Agronomy Journal 94, 821–829.

Thakur, A. K., Chaudhari, S. K., Singh, R. and Kumar, A. (2009). Performance of rice varieties at different spacing grown by system of rice intensification in eastern India. *Indian Journal of Agriculture Sciences*, 79 (6): 443-47.

Uddin, M. H. 2003. Effect of plant spacing and nitrogen level on yield of transplant aman rice cv. BRRI dhan 39. M.Sc. Thesis, Dept. Argon., Bangladesh Argil. Univ., Mymensingh. 44.

Wang- Dan Ying Zhang-Xiu Fu, Shao-GuoSheng; Xu-ChunMei (2008). Response of grain yield of different Japonica rice cultivars to amount of nitrogen application in high-fertility paddy field. *Acta-Agronomica-Sinica*. 34 (9): 1623-1628. https://doi.org/10.3724/SP.J.1006.2008.01623

Watson, D. (1952). The Physiological Basis of Variation in Yield. Advances in Agronomy, 4, 101-145. http://dx.doi.org/10.1016/S0065-2113(08)60307-7

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