Biological Forum – An International Journal **14(4a): 786-788(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Growth Parameters of Rice Crop as influenced by Sources of Nitrogen Management

Pragyan Das* and Bijay Kumar Mohapatra
Department of Agronomy,
Odisha University of Agriculture & Technology, Bhubaneswar (Odisha), India.

(Corresponding author: Pragyan Das)*
(Received 14 August 2022, Accepted 18 October, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Nitrogen management is an important agronomic measure to regulate rice yield and grain quality. A field experiment was conducted at Central Research Station, Odisha University of Agriculture and Technology, Bhubaneswar during *kharif* season of 2021. The experiment was laid out in a randomised block design with four replications comprising of five treatments *viz.*, Soil Test Based Nitrogen Recommendation (STBNR) complete inorganic, Integrated Nutrient Management (INM) (50% organic*+ 50% inorganic) *Organic= 1/3rd FYM+ 1/3rd poultry manure+ 1/3rd neem oil cake, Organic source (1/3rd FYM+ 1/3rd poultry manure+ 1/3rd neem oil cake), Soil Test Based Nitrogen Recommendation (STBNR)+ $ZnSO_4$ @ 25 kg/ha and Integrated Nutrient Management (T2) + $ZnSO_4$ @ 25 kg/ha. The soil was loamy sand, slightly acidic in reaction, medium in organic carbon, available P_2O_5 and K_2O, and low in available nitrogen. The nitrogen management practices influenced the growth parameters *viz;* plant height, dry matter accumulation, and LAI. INM+$ZnSO_4$ treatment recorded higher growth parameters and crop growth indices followed by INM and STBNR+$ZnSO_4$.

Keywords: Nitrogen, Rice, CGR, RGR, Integrated Nutrient Management.

INTRODUCTION

More than half of the world's population relies on rice (*Oryza sativa* L.) as their primary source of nutrition. The Asia-Pacific Region produces and consumes almost 90% of the world's rice. Seventy-five percent of the rice produced in Asia is produced on irrigated land, according to FAO data from 2005. The most significant and widely farmed crop in India is rice, which takes up more than 44 million hectares of land. According to Agriculture Statistics at a Glance (2021), during the 2018–19 growing season, rice was grown in India on an area of 43.79 million hectares, producing 122.27 MT (ranking second only to China) with a productivity of 2659 kg ha^{-1}. About 25% of the nation's overall agricultural exports are made up of rice. It gives roughly 3000 million individuals, most of whom live in developing nations, about 700 calories each day. Nitrogen is an important element for rice growth and yield formation. Appropriate nitrogen application could balance rice yield and grain quality, while excessive nitrogen application would deteriorate food quality. Nitrogen actively encourages vegetative growth as well as encourages the production of chlorophyll, the green pigment necessary for photosynthesis. Plants can manufacture carbohydrates and maintain vegetative development due to chlorophyll's ability to absorb sunlight and transform it into energy. Previous studies have shown that increased leaf area, shoot biomass, and plant height in different crops are all positively correlated with nitrogen fertilizer. Given that it is necessary for the production of the proteins and enzymes involved in photosynthesis, it is an essential part of the photosynthetic machinery (Li *et al.*, 2010 ; Liu *et al.*, 2022). A sufficient nitrogen supply boosts photosynthetic performance, increasing carbon dioxide (CO_2) uptake and resulting in enhanced biomass output. According to research, nitrogen fertilization increases biomass accumulation, stomatal conductance, and net photosynthetic rate in crops like wheat, maize, and rice (Ladha *et al.*, 2005; Zhang *et al.*, 2020). Thus, a study on Growth and crop growth indices under different nitrogen management practices in rice crop was carried out at the Central Research Station, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar.

MATERIAL AND METHOD

The experiment was conducted during *kharif* 2021at the Central Research Station, Odisha University of Agriculture and Technology, Bhubaneswar (20° 26′N, 85°81′E, Odisha. The field was well-drained medium land with loamy sand texture, slightly acidic in reaction (pH 5.67), medium in organic carbon (0.67%), available P_2O_5(15.4 kg/ha), and available K_2O (159.4 kg/ha)and low in available N (187.5 kg/ha).

The experiment was laid out in a randomised block design with four replications. Comprising of Five treatments *viz.*, Soil Test Based Nitrogen Recommendation (STBNR) complete inorganic, Integrated Nutrient Management (INM) (50% organic*+ 50% inorganic) *Organic= 1/3rd FYM+ 1/3rd poultry manure+ 1/3rd neem oil cake, Organic source (1/3rd FYM+ 1/3rd poultry manure+ 1/3rd neem oil cake), Soil Test Based Nitrogen Recommendation

(STBNR)+ $ZnSO_4$ @ 25 kg/ha and Integrated Nutrient Management (T2) + $ZnSO_4$ @ 25 kg/ha.

Rice cv. 'Lalat' was sown in 2021.The field was cross ploughed with tractor drawn cultivator followed by planking for pulverised soil. The treatments were allotted randomly to different experimental units in the replication. The plots were laid out according to the plan of layout and was puddled by power tiller to incorporate the weeds and levelled by repeated laddering. One month old seedlings were manually transplanted at a spacing of 20 cm × 15 cm in the main field as per the design of the layout. The crop was fertilised as per (T1) STBNR i.e., 80-40-40 kg N-P_2O_5-K_2O/ha. 25% more nitrogen was added as the soil was deficient in nitrogen. Hence, 100kg/ha was added. The nitrogen, phosphorous and potassium were applied through Urea (46% N), DAP (18% N, 46% P_2O_5), and MOP (60% K_2O). Full P, 25% N, and 50% K were applied as basal at the time of transplanting. Rest N was split applied at 15 DAT (50%) and panicle initiation (PI) stage (25%) and 50% K at PI stage. In (T2) INM 50% of Nitrogen was applied through Farm Yard Manure, Poultry manure (PM) and Neem Oil Cake (NOC) and 50% STBNR was applied through urea with full P and K dose. In (T3) Complete Organic Nitrogen Source, Farm Yard Manure (FYM), Poultry manure (PM) and Neem Oil Cake (NOC) were evenly applied to supply 1/3rd STBNR each. The phosphorus and potassium requirements were fulfilled by DAP and MOP. Before application, all of them were analysed for their N content as 2.82% in green manure, 1.62 % in VC and 4.48% in NOC. Accordingly, their doses were decided to meet the soil test-based requirement. In (T4) Inorganic + $ZnSO_4$, the crop was fertilised by complete inorganic treatment i.e., T1 along with application of $ZnSO_4$ at 25 Kg/ha at the time of sowing.INM + $ZnSO_4$ (T5), INM (T2) along with application of $ZnSO_4$ at 25 Kg/ha at the time of sowing serves as treatment 5. Pretilachlor was applied for controlling weeds after transplanting.

Five hills were selected randomly from each net plot and labeled for recording periodic observations. However, destructive samples (three hills) were taken from sample rows (second row from the border) for recording leaf area and dry matter production/hill. The growth parameters were recorded at 20 days interval starting from 20 days after transplanting (DAT). The plant height was measured in cm from the ground level up to the growing tip of the plant at 20 days interval starting from the 20 DAT. Leaf area index was calculated by dividing the leaf area per sample plant by the land area occupied by the sample plant. The average land area occupied by each plant was taken as 20 cm x 15 cm. Crop growth rate (CGR), Relative growth rate (RGR), Net assimilation rate (NAR) were calculated as per Radford (1967). All collected data were analyzed with the help of analysis of variance (ANOVA) technique for randomized block design. The treatment variations were tested for significance by 'F' test. The standard error of mean SE (m) ± and critical difference (CD) at 5% probability level were calculated (Gomez and Gomez 1984).

RESULT AND DISCUSIONS

A. Growth parameters

Plant height. The data on mean plant height at various growth stages of the crop are presented in the Table 1. The plant height increased progressively with successive growth stages till harvest, although the rate of increase decreased after 60 DAT. Different nitrogen management practices influenced plant height at different growth stages. At all the stages, INM + $ZnSO_4$ registered higher plant height but was significantly higher at 40 DAT, 80DAT, 100DAT, and at harvest. At 60 DAT INM+ $ZnSO_4$ was at par with STBNR, INM and STBNR+ $ZnSO_4$. Organic management did not show any significant difference and recorded the lowest plant height at all stages. The application of nitrogenous fertilizer, which accelerated the plant's metabolic and physiological activity and caused it to put up more growth by digesting higher amounts of main nutrients, may be responsible for the maximum plant height. This, in turn, boosted the plant height. These findings closely align with those of Kumar *et al*. (2017); Pramanik and Bera (2013).

Dry matter accumulation. Data on dry matter accumulation at different stages of growth of rice are presented in Table 1. Dry matter accumulation increased until harvest but the rate of accumulation decreased after 100DAT. At all the stages, INM + $ZnSO_4$ registered higher plant height but was significantly higher at 20 DAT, 40DAT,80DAT,100DAT and at harvest i.e., 119.62, 352.48,984.58, 1162.94, and 1225.17 respectively. At 60 DAT INM+ $ZnSO_4$ was at par with INM. At harvest, INM +$ZnSO_4$ recorded 18.59, 6.00, 21.60, and 12.04 percent higher dry matter accumulation over STBNR, INM, Organic, and STBNR+ $ZnSO_4$ respectively. Nitrogen is necessary for the quick accumulation of dry matter in a given amount of time and area, which leads to a higher yield of rice leaves and stems. These results were in conformity with Pant *et al.* (2020).

Leaf Area Index. The mean LAI at various growth stages of the crop is presented in Table 1. The data reveal that LAI increased up to 80 DAT, later on, it declined up to harvest irrespective of the treatments. When nitrogen management treatments were taken into account, INM + $ZnSO_4$ was observed to be the superior performer to others at all the stages except at 40 DAT, where it was at par with the INM. A crucial factor for assessing the development and production of crops is the Leaf Area Index (LAI). It measures the amount of photosynthetic surface that is open to light absorption, and as a result, it is directly related to crop growth and yield. In the process of photosynthesis, which creates the energy necessary for plant growth, nitrogen plays a role. Integrated use of inorganic and organic sources of nitrogen increased plant growth. It may be due to increased availability of N, P, and K, improvement of soil physical conditions, and microbial activity of the soil, which led to an increase in plant growth such as plant height and LAI. Similar findings were reported by Gohad (2010); Adhikari and Mishra (2002).

B. Crop growth rate (CGR) and relative growth rate (RGR)

Data on crop growth rate reported in Table 2 reveal that rice attained higher CGR upto 60-80 DAT after which it decreases. Although higher CGR was seen during 60-80 DAT in INM+$ZnSO_4$ with respect to different nitrogen management practices i.e., 19.19 gcm^{-2} day^{-1}. At 100 DAT CGR value of INM + $ZnSO_4$ was at par with INM. In case of RGR, significant difference was observed during later crop growing period from 60-80 DAT till the harvesting stage in the INM+ $ZnSO_4$. From 100 DAT till harvesting significant difference in RGR was seen in INM+ $ZnSO_4$ i.e., 2.93 $g^{-1}g^{-1}day^{-1}$. Adequate nitrogen supply can increase the photosynthetic capacity of the plant, resulting in increased biomass accumulation which in turn increases the CGR and RGR of the plant.

Table 1: Effect of nitrogen management on plant height, dry matter and LAI of rice at different stages.

Treatments	Plant Height (cm)						Dry matter (g m^{-2})						LAI				
	20DAT	40DAT	60DAT	80DAT	100DAT	Harvest	20DAT	40DAT	60DAT	80DAT	100DAT	Harvest	20DAT	40DAT	60DAT	80DAT	100DAT
STBNR	50.10	71.67	100.22	104.70	110.72	113.52	97.82	297.81	497.25	847.57	998.83	1033.12	0.53	2.32	4.42	5.37	3.11
INM	53.90	73.23	102.17	106.52	112.45	114.36	103.27	327.95	587.92	925.91	1102.69	1155.80	0.59	2.52	4.51	5.56	3.25
Organic	49.80	71.05	89.57	100.10	106.66	109.35	90.20	265.17	448.34	831.07	974.74	1007.52	0.46	2.29	4.27	5.18	2.90
STBNR + $ZnSO_4$	52.52	73.02	100.22	105.95	112.74	115.64	100.60	323.90	531.64	889.39	1060.22	1093.48	0.50	2.39	4.40	5.43	3.17
INM + $ZnSO_4$	56.87	80.12	102.52	117.02	125.11	128.48	119.62	352.48	600.70	984.58	1162.94	1225.17	0.64	2.58	4.79	5.71	3.32
SEm (±)	1.574	1.486	2.196	3.132	2.815	2.128	1.863	3.813	7.428	9.383	6.837	9.014	0.014	0.023	0.084	0.013	0.019
CD (0.05)	4.85	4.57	6.76	9.65	8.67	6.56	5.73	11.75	22.88	28.90	21.06	27.77	0.04	0.07	0.26	0.04	0.06

Table 2: Effect of nitrogen management on CGR and RGR of rice at different stage.

Treatments	CGR(g m^{-2} day^{-1})					RGR (g g^{-1} day^{-1})				
	20-40 DAT	40-60 DAT	60-80 DAT	80-100 DAT	100-Harvesting	20-40 DAT	40-60 DAT	60-80 DAT	80-100 DAT	100-Harvesting
STBNR	10.00	9.97	17.52	7.56	1.71	2.37	2.57	2.79	2.85	2.86
INM	11.23	13.00	16.90	8.84	2.66	2.42	2.64	2.83	2.89	2.91
Organic	8.75	9.16	19.14	7.18	1.64	2.33	2.53	2.79	2.84	2.85
STBNR + $ZnSO_4$	11.17	10.39	17.89	8.54	1.66	2.41	2.60	2.81	2.88	2.89
INM + $ZnSO_4$	11.64	12.41	19.19	8.92	3.11	2.44	2.65	2.85	2.92	2.93
SEm (±)	0.224	0.397	0.586	0.713	0.430	0.005	0.006	0.004	0.003	0.002
CD (0.05)	0.69	1.22	1.81	2.20	1.33	0.02	0.02	0.01	0.01	0.01

CONCLUSIONS

Among all the nitrogen management practices INM+$ZnSO_4$ influenced the growth parameters *viz.*, plant height, dry matter accumulation, LAI, and crop growth indices more effectively. The results clearly indicated the need for integrated nitrogen management for optimum growth of rice.

Acknowledgement. I want to thank all the staffs involved in the research experiment. Special thanks to the Central Research Station, Odisha University of Agriculture and Technology, Bhubaneswar where the experiment was conducted.

REFERENCES

Adhikari, N. P. and Mishra, B. N. (2002). Effect of integrated sources of nitrogen on yield of aromatic rice and their residual effect on succeeding. In Extended Summaries: *2nd International Agronomy Congress, 1*, 26-30.

Agricultural statistics at a glance (2021), Government of India, New Delhi.

Gohad, S. (2010). Development of different organic farming practices for scented rice Pusa Basmati-1. MSc (Ag.) thesis Jabalpur

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research, A Willey Inter Science Publication, New York, pp.76-83.

https://www.fao.org/3/cb1447en/cb1447en.pdf

Kumar, S., Bhagat, R. M. and Singh, R. (2017). Response of Rice (*Oryza sativa* L.) to NPK fertilization and organic sources of nutrients in sandy loam soils of Jammu, *Journal of Soil and Water Conservation, 16*(2), 116-120.

Ladha, J. K., Pathak, H., Krupnik, T. J., Six, J. and van Kessel, C. (2005). Efficiency of fertilizer nitrogen in cereal production: Retrospects and prospects. *Advances in Agronomy, 87*, 85-156.

Li, X., Guan, X., Wan, X. and Wei, S. (2010). Effects of long-term inorganic and organic fertilizer treatments on soil enzyme activities and bacterial community structure. *Applied Soil Ecology, 46*(1), 103-110.

Liu, X., Zhang, L., Yu, Y., Qian, C., Li, C., Wei, S. and Gu, W. (2022). Nitrogen and chemical control management improve yield and quality in high-density planting of maize by promoting root-bleeding sap and nutrient absorption. *Frontiers in Plant Science*, *13*, 754232.

Pant, H., Singh, G., Meena, H. M. and Meena, R. K. (2020). Site-specific nutrient management out-yields the recommended blanket nutrient prescription (100% RDF) in maize (*Zea mays* L.). *Soil and Tillage Research*, *199*, 104-187.

Pramanik, K. and Bera, B. (2013). Effect of nitrogen levels on growth and yield of summer sesame (*Sesamum indicum* L.) under red and lateritic soils of West Bengal. *International Journal of Agriculture, Environment and Biotechnology*, *6*(1), 39-44.

Radford, P. J. (1967). Growth analysis formulae-their use and abuse. *Crop Science*, *7*(1), 171-175.

Zhang, H., Li, J. and Chen, J. (2020). Effects of Nitrogen Fertilization on Net Photosynthetic Rate, Stomatal Conductance, and Biomass Accumulation in Rice Plants. *Journal of Plant Nutrition, 43*(3), 362-374.

How to cite this article: Pragyan Das and Bijay Kumar Mohapatra (2022). Growth Parameters of Rice Crop as influenced by Sources of Nitrogen Management. *Biological Forum – An International Journal, 14*(4a): 786-788.