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Effect of INM and plant geometry on nitrogen uptake of rice (*Oryza sativa* L.) varieties under SRI technique

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Abstract
The present investigation was conducted at Agronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during *Kharif* seasons with the objective to know the effect of integrated nutrient management and plant geometry on phenotypic and yield attributes of rice varieties. The study comprised six treatments of integrated nutrient management (F_0: Control, F_1: Recommended Dose of Fertilizer (120:60:60) F_2: 50% Recommended Dose of Fertilizer + 50% Vermicompost, F_3: 75% Recommended Dose of Fertilizer + 25% N through Vermicompost, F_4: 50% Recommended Dose of Fertilizer + 50% N through FYM F_5: 75% Recommended Dose of Fertilizer + 25% N through FYM) with two varieties namely NDR-359 and Sarju 52 and two plant geometry (a) S_1: 20 cm X 20 cm. (b) S_2: 30 cm X 30 cm. The study revealed that the maximum nitrogen uptake by crop recorded in F_2 (50% Recommended Dose of Fertilizer + 50% N through vermicompost). The application of 50% Recommended Dose of Fertilizer + 50% N through vermicompost (F_2) was at par with F_4 (50% Recommended Dose of Fertilizer + 50% N through FYM).

Keywords: Rice, nutrient uptake, SRI

Introduction
SRI system of cultivation is slowly gaining momentum all over the world including India. There is ample scope to increase productivity of rice by altering the environmental conditions that modify microclimate and soil conditions, which ultimately reflect phenotypic expression with the Genotype x Environment interactions. One of the sound principles of SRI is, wider spacing of plants leading to greater root growth and better tillering potential. The total area of rice crop in India is 39.54 m ha, production is 106.33 million tonnes and average productivity is 2.69 t ha^{-1} (Anonymous, 2023) [1]. Uttar Pradesh is an important rice growing state in the country. The area and production of rice in this state is about 5.86 million hectares and production 15.30 million tonnes with an average productivity of 2.57 tonnes per hectare, respectively (Anonymous, 2015).
Application of vermicompost in combination with NPK fertilizers results in higher content of total Nitrogen compared to FYM in combination with NPK fertilizers are control. It also resulted in higher content of phosphorus significantly (Kale *et al.*, 1992) [5]. The casting by Earthworms was seen to improve, the soil organic matter and nutrient status by recycling available nutrients especially N, P, K, Ca and Mg.
In association with this most of the scientist concluded that 50% organic sources and 50% from inorganic sources and 50% from inorganic sources is the best combination in rice based cropping system to improve soil physico-chemical properties, yield and nutrient uptake capacity of rice (Wolie and Admassu, 2016 and Sharma, 2013) [11, 8].

Materials and Methods
Geographically the experimental site is situated at 26.47^0 North latitude and 81.12^0 East longitude at an elevation of 113 m. from mean sea level in the Indo Gangatic Plain Zone of eastern Uttar Pradesh. The area falls under sub tropical zone which in characterized by hot and dry summer with cold winters. Rain is more often confined to the period from July to September with occasional winter and summer rain.

The experimental field was well leveled having good irrigation and drainage facilities.

Treatments Detail

A. Varieties: 2

V_1-NDR-359

V_2- Sarju 52

B. Integrated Nutrient Management

F_0: Control

F_1: RDF (120:60:60)

F_2: 50% RDF + 50% N through vermicompost

F_3: 75% RDF + 25% N through vermicompost

F_4: 50% RDF + 50% N through FYM

F_5: 75% RDF + 25% N through FYM

C. Plant geometry

S_1: 20 cm × 20 cm.

S_2: 30 cm × 30 cm

Field Layout

The present investigation was carried out with 24 treatment combination made with six nutrient management levels, two varieties and two levels of plant geometry, in rice which were allocated in Factorial Randomized Block Design with 3 replications. Each replication was separated by 1m alley, while each plot was separated by 0.5m bund space. The individual plot size was 18 m^2 (6 m length × 3 m breadth). The plant geometry was 20 cm×20 cm. row to row and plant to plant distance maintaining 15 lines with 30 hills per row in each plot. and 30 cm × 30 cm, line to line and plant to plant distance maintaining 10 lines with 20 hills per row in each plot. The central eleven rows were considered as net plot rows for yield calculation and taking observations. Two rows on each side of net plot rows were used to take destructive sample for growth analysis. The remaining two rows on each side of destructive rows were considered as border row.

The mean annual rainfall ranges from 1000-1200mm. Weather pattern during the cropping seasons was recorded at the meteorological observatory of the university situated near the experimental field, are given in Table-1& 2.

Table 1: Weekly Meteorological weather data during crop period (June, 2015 to Dec, 2015)

Month	Meteorological week	Temperature (°C)		R.H. (%) Even.	Total rainfall (mm)	Sun shine (hrs)
		Min.	Max.			
June, 15	23	26.6	42.4	27.3	0.0	6.9
	24	27.7	39.7	44.4	7.4	6.5
	25	28.0	39.0	45.1	6.4	7.8
	26	25.4	33.0	67.9	183.5	2.0
July, 15	27	26.7	34.4	62.9	28.0	3.9
	28	25.4	32.7	74.7	140.4	4.2
	29	27.0	32.9	70.7	28.0	4.8
	30	26.6	33.9	69.6	2.0	4.8
Aug., 15	31	26.0	33.0	69.9	6.8	3.5
	32	25.9	36.4	66.9	13.8	5.7
	33	26.5	35.4	71.6	29.2	4.3
	34	25.8	34.2	67.3	23.6	6.5
	35	26.2	34.9	71.1	0.0	6.6
Sept., 15	36	24.6	36.6	51.1	0.0	8.1
	37	25.7	36.1	64.0	0.0	5.5
	38	25.9	35.8	59.4	15.2	6.9
	39	22.4	35.9	50.4	0.0	6.8
Oct., 15	40	21.1	36.3	47.0	0.0	6.9
	41	20.4	34.2	46.9	0.0	7.3
	42	19.2	35.0	52.1	0.0	7.3
	43	16.3	33.2	52.1	0.0	6.1
	44	13.8	30.0	53.0	0.0	4.7
Nov., 15	45	13.2	33.6	44.0	0.0	4.7
	46	12.4	30.8	43.3	0.0	4.8
	47	11.1	30.8	43.6	0.0	5.7
	48	12.5	29.5	51.3	0.0	4.6
Dec.,15	49	9.4	26.6	64.47	0.0	3.5
	50	7.7	23.9	59.3	0.0	3.3

Table 2: Weekly Meteorological weather data during crop period (June, 2016 to Dec, 2016)

Month	Meteorological week	Temperature (°C)		R.H. (%) Even.	Total rainfall (mm)	Sun shine (hrs)
		Min.	Max.			
June, 16	23	25.5	49.4	76.9	12.8	8.4
	24	27.1	43.0	75.6	87.7	7.1
	25	27.0	46.6	84.7	4.5	5.2
	26	27.4	44.5	80.4	1.2	5.1
July, 16	27	25.8	30.4	91.9	0.0	3.0
	28	27.2	42.4	88.3	168.5	4.0
	29	24.9	30.4	91.9	5.0	0.0
	30	26.0	31	90.3	114.8	0.4
Aug., 16	31	25.9	33.2	89.0	27.6	2.9
	32	25.9	44.4	86.6	62.6	2.5
	33	25.9	30.2	92.4	21.8	2.5
	34	26.3	44.2	87.4	71.8	4.9
	35	26.9	44.0	87.1	3.2	5.9
Sept., 16	36	26.5	50.9	87.3	15.0	7.7
	37	26.1	43.4	92.3	2.2	0.2
	38	25.8	43.7	92.1	69.2	1.6
	39	24.3	37.7	95.7	0	1.0
Oct., 16	40	25.7	48.7	89.9	76.2	5.1
	41	21.8	45.1	92.3	9.8	5.1
	42	18.0	37.1	93.1	25.3	5.9
	43	16.5	38.7	92.0	0	3.5
	44	14.1	31.0	65.4	0	2.6
Nov., 16	45	12.7	29.7	67.2	0	1.5
	46	11.8	29.0	67.4	0	1.8
	47	11.1	27.3	79.9	0	2.4
	48	12.2	25.8	86.6	0	1.1
Dec.,16	49	11.7	19.2	99.1	0	1.7
	50	9.0	19.5	73.8	0	1.5

Nitrogen uptake by crop (kgha^{-1})

The nitrogen uptake was determine in straw and grain as described by Jackson (1973) [4]. The percentage of nitrogen was multiplied with grain and straw yield obtain nitrogen uptake in seed and content in plant respectively.

$$\text{Nitrogent uptake (kg/ha)} = \frac{\text{Nitrogen content in grain \% x Grain yield (kg/ ha)}}{100}$$

$$\text{Nitrogen uptake (kg/ha)} = \frac{\text{Nitrogen content in straw \% x Straw yield (kg/ha)}}{100}$$

$$\text{Total Nitrogen uptake (kg/ha)} = \frac{\text{Nitrogen content in grain \% x Grain yield (kg/ ha)}}{100}$$

Results and Discussion

Total nitrogen uptake by crop significantly differed due to integration of different nutrient source and highest nitrogen uptake 93.53 and 99.05 kgha^{-1} was recorded in F_2 (50% Recommended Dose of Fertilizer + 50% N-vermicompost), which was significantly superior over the F_1- Recommended Dose of Fertilizer (120:60:60), F_3 (75% Recommended Dose of Fertilizer + 25% N-vermicompost) and F_4 (50% Recommended Dose of Fertilizer + 50% N-FYM) but at par with F_4 INM during second years. Among the varieties, maximum uptake of N by the crop was recorded with variety NDR-359 (Table-3).The uptake of N by rice was also significantly affected by the different Plant geometry. S_1 (20 cm × 20 cm) recorded the highest uptake of nitrogen by the plants which was significantly superior over the S_2 (30 cm×30 cm) during both of the years and pooled, respectively.

One time basal application at panicle initiation stage caused increase in plant K uptake and proportion from elongation stage to heading stage as well as number of filled grains/panicle. Combined application of K and N had a remarkable positive reciprocal effect on crops and was an important approach in improving K use efficiency was also reported by Li *et al.* (2009). The higher nitrogen uptake due to proper growth and establishment of roots higher absorption of mineral nutrients from the soil, transport of more nutrients to sink (seed), vigorous plant growth and higher seed and straw yields under proper availability of nitrogen. The overall increase in uptake of nitrogen was the cumulative effect of rise in their concentration in plant tissues and in yield levels. Rabeya *et al.* (1997) [7] observed that the application of organic manures and biofertilizers in addition to the recommended dose of fertilizers significantly increased uptake of N, P, Ca and S by paddy crop. Prakash *et al.* (2002) [6] also observed that total N, P and K uptake was higher in rice cultivar Pusa Basmati-1 treated with organic fertilizer in combination with chemical fertilizers as compared to those treated with chemical fertilizers alone. Beneficial effect of organic materials on nutrient uptake was also reported by Singh *et al.* (2002) [9], Bhat *et al.* (2005) [2], Das & Ram (2006) [3] and Sowmya *et al.*, (2011) [10].

Table 3: Effect of INM, varieties and plant geometry on N uptake of rice under SRI technique.

Treatment	Total N uptake (kg ha^{-1})		
	2015	2016	**Pooled**
Nutrients management			
F_0: Control	59.61	63.16	61.38
F_1: RDF (120:60:60)	78.78	83.58	81.18
F_2: 50% RDF + 50% N-Vermicompost	93.53	99.05	96.29
F_3: 75% RDF + 25% N-Vermicompost	84.62	89.77	87.19
F_4: 50% RDF + 50% N-FYM	89.02	94.38	91.70
F_5: 75% RDF + 25%N- FYM	80.91	85.85	83.38
SEm±	1.55	1.65	1.13
CD at 5%	4.42	4.72	3.18
Varieties			
V_1:NDR-359	V_1:NDR-359	V_1:NDR-359	V_1:NDR-359
V_2: Sarju 52	V_2: Sarju 52	V_2: Sarju 52	V_2: Sarju 52
SEm±	SEm±	SEm±	SEm±
CD at 5%	CD at 5%	CD at 5%	CD at 5%
Plant geometry			
S_1: 20 cm × 20 cm	S_1: 20 cm × 20 cm	S_1: 20 cm × 20 cm	S_1: 20 cm × 20 cm
S_2: 30 cm × 30 cm	S_2: 30 cm × 30 cm	S_2: 30 cm × 30 cm	S_2: 30 cm × 30 cm
SEm±	SEm±	SEm±	SEm±
CD at 5%	CD at 5%	CD at 5%	CD at 5%

Conclusion

In conclusion, the integration of different nutrient sources significantly influenced the total nitrogen uptake by the crop, with the highest uptake recorded in F2 (50% Recommended Dose of Fertilizer + 50% N-vermicompost). Variety NDR-359 exhibited the maximum uptake of nitrogen. Plant geometry also played a significant role, with S1 (20 cm × 20 cm) outperforming S2 (30 cm × 30 cm) in nitrogen uptake. Basal application at the panicle initiation stage increased plant potassium uptake and the number of filled grains per panicle. Combined application of potassium and nitrogen showed a positive reciprocal effect on crops, enhancing potassium use efficiency. The higher nitrogen uptake was attributed to improved root growth, increased nutrient absorption, and vigorous plant growth, leading to higher yields. Studies have consistently shown the beneficial effects of organic materials on nutrient uptake, underscoring the importance of integrating organic fertilizers with chemical fertilizers for sustainable agriculture practices.

References

1. Anonymous. Economics survey of India, Economic Division Ministry of Finance, Government of India, New Delhi; c2023. p. 45-55.
2. Bhat JA, Chakrabortty S, Sharma DP, Thomus T. Effect of integrated nutrient management on soil properties, nutrient uptake growth and yield of rice (*Oryza sativa* L.). Environment and Ecology. 2005;23(2):390-394.
3. Das DK, Ram N. The nature of humid substances under long-term manuring and fertilization in a rice wheat system. International Rice Research Notes. 2006;31(1):29-31.
4. Jackson ML. Soil chemical analysis. Prentice Hall of India; Pvt. Ltd. New Delhi. 1973; pp 151-153.
5. Kale RD, Mollesh BC, Bano K, Bagyaraj DJ. Influence of vermicompost application available micronutrient and selected microbial population in a paddy field, soil biology and biochemistry. 1992;24:1317-1320.
6. Prakash YS, Bhadoria PBS, Rakshit A, Waish A. Response of basmati rice to integrated nutrient sources in lateritic soil of eastern India. Italian Journal of Agronomy. 2002;6(2):143-150.
7. Rabeya K, Sahu SK, Mitra GN. Yield maximization of rice through integrated nutrient management on aerie usrochrept. Journal of Indian Society of Soil Science. 1997;45(2):346-397.
8. Sharma R. Effect of Long Term Integrated Nutrient Management System on Soil and Crop Productivity in Rice-Wheat Crop Sequence. Ph.D. Dissertation; c2013. p. 155.
9. Singh RN, Kumar B, Prasad J, Singh S. Integrated nutrient management practices and their effect on rice crop in farmers fields. Journal of Research, Birsa Agricultural University. 2002;14(1):65-67.
10. Sowmya C, Ramana MV, Kumar M. Effect of systems of rice cultivation and nutrient management options on yield, nutrient uptake and economics of rice. Crop Research (Hisar). 2011;42(2):63-69.
11. Wolie AW, Admassu MA. Effects of Integrated Nutrient Management on Rice (*Oryza sativa* L) Yield and Yield Attributes, Nutrient Uptake and Some Physico-Chemical Properties of Soil: A Review. Journal of Biology, Agriculture and Healthcare. 2016;6:20-26.