



ISSN Print: 2664-6064  
 ISSN Online: 2664-6072  
 NAAS Rating (2025): 4.69  
 IJAN 2025; 7(9): 93-95  
[www.agriculturejournal.net](http://www.agriculturejournal.net)  
 Received: 07-06-2025  
 Accepted: 11-07-2025

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## Effect of sources and levels of organic manures on periodical release rate of nitrate nitrogen and soil properties of entisol

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**DOI:** <https://www.doi.org/10.33545/26646064.2025.v7.i9b.291>

### Abstract

An incubation study was conducted during 2024-2025 with three sources of organic manures viz., FYM, vermicompost and pressmud compost and three levels of organic manures, i.e., 2, 4 and 6 t ha<sup>-1</sup> along with a separate control treatment. The soil samples were analysed periodically at 15 days intervals for the release of nitrate nitrogen up to 90 days of incubation (DAI). Vermicompost application at 6 t ha<sup>-1</sup> recorded the highest NO<sub>3</sub><sup>-</sup>-N over all the incubation period and it was followed by PMC 6 t ha<sup>-1</sup>. The periodical release of NO<sub>3</sub><sup>-</sup>-N was maximum during 30-45 days of incubation and gradually declined thereafter in all the treatments. The highest release of NO<sub>3</sub><sup>-</sup>-N was exhibited by vermicompost application at 6 t ha<sup>-1</sup> (24.86 mg kg<sup>-1</sup>) and it was followed by PMC at the rate of 6 t ha<sup>-1</sup> (22.55 mg kg<sup>-1</sup>) at 30-45 days of incubation.

Among sources, the Significantly higher soil organic carbon (0.48%), available nitrogen (193.15 kg ha<sup>-1</sup>) and phosphorus (25.65 kg ha<sup>-1</sup>) were recorded with application of FYM, vermicompost and PMC, respectively. Whereas application of vermicompost level @ 6 t ha<sup>-1</sup> recorded significantly the highest available nitrogen (215.66 kg ha<sup>-1</sup>), while the highest available phosphorus (28.46 kg ha<sup>-1</sup>) was reported with application of PMC @ 6 t ha<sup>-1</sup>.

**Keywords:** Organic manures, Release rate, Nitrate nitrogen, Soil properties

### Introduction

Nitrogen is the most crucial macronutrient for achieving good crop production and quality. It is the main component of chlorophyll, nucleic acids, and amino acids. Plants acquire N in large amounts from the soil, compared to other macro and micro elements (Shafreen *et al.*, 2021) [4]. Nitrogen mineralized from the SOM and crop residues makes a substantial contribution to N uptake by the plant. Nitrogen release from organic manures is influenced by several factors, including the type and composition of the manure, soil microbiota, and environmental conditions. Understanding the N mineralization capability of various organic sources can improve the efficiency of nitrogen utilization. The degree to which organic residues are mineralized in accordance with crop requirements determines how suitable they are as a source of nitrogen.

In India, Entisol is found in significant amounts, particularly in regions with alluvial deposits, such as the Indo-Gangetic Plains, coastal areas, and river valleys. These soils are characterized by their lack of distinct horizons and are often used for agriculture due to their fertility and ease of cultivation (Sehgal, 1996) [3]. Generally speaking, it is a relatively less profitable land for plant growth, so it needs efforts to increase its productivity by fertilizing.

### Material and Methods

An incubation study was undertaken at the Division of Soil Science, RSCM College of Agriculture, Kolhapur, during 2024-2025. The experiment was laid out in FCRD design with three sources and three levels of organic manure, along with a separate control treatment. The sources of organic manures are FYM, vermicompost and pressmud compost, and the levels are 2, 4 and 6 t ha<sup>-1</sup>. The experimental soil was neutral in reaction, low in available nitrogen, medium in phosphorus and high in potassium.

The incubation study was conducted for 90 days by use and discard method. The soil samples were collected at 0, 15, 30, 45, 60, 75 and 90 days after incubation (DAI) and analysed for nitrate nitrogen. After completion of incubation, the soil samples were analysed for soil chemical properties *viz.* pH, EC, OC, CaCO<sub>3</sub>, available N, P and K.

## Results and Discussion

### Effect on periodical release of Nitrate nitrogen (NO<sub>3</sub><sup>-</sup>-N)

Periodical release of nitrate nitrogen during the incubation period is presented in Table 1 and Fig.1. The data in context to periodical release of NO<sub>3</sub><sup>-</sup>-N indicated that the rate of its release was slow in the initial stage of incubation, followed by sharp increase, reaching its maximum rate during 30-45 days of incubation and gradual decline thereafter in all the incubation treatments. This indicated that the rate of mineralization of N is not uniform throughout the incubation period, which could be attributed to the rate of decomposition at a particular period. Periodical release of maximum NO<sub>3</sub><sup>-</sup>-N nitrogen was exhibited by vermicompost applied at 6 t ha<sup>-1</sup> (24.86 mg kg<sup>-1</sup>) and it was followed by PMC at the rate of 6 t ha<sup>-1</sup> (22.55 mg kg<sup>-1</sup>) at 30-45 days of incubation.

According to Mishra *et al.*, (2016) [1], the percentage of N-mineralization from all organic amendments increased during the initial 45 days of incubation, followed by a gradual decline. The highest concentration of NO<sub>3</sub><sup>-</sup>-N at 45 days is linked to the nitrification of residual NH<sub>4</sub><sup>+</sup>-N and increased activity of microbial enzymes.

### Effect on soil properties

The effect of different sources, levels of organic manures and their interactions on soil pH, CaCO<sub>3</sub> and available potassium was non-significant at 90 days of incubation (Table 2). However, the soil EC was significantly higher with the application of manures @ 6 t ha<sup>-1</sup>. After completion of 90 days incubation, significantly higher soil organic carbon (0.48%), available N (193.15 kg ha<sup>-1</sup>) and available phosphorus (25.65 kg ha<sup>-1</sup>) were recorded with application of FYM, vermicompost and PMC, respectively.

Manure application at the rate of 6 t ha<sup>-1</sup> was found statistically superior for soil organic carbon (0.48%), available N (204.84 kg ha<sup>-1</sup>) and available phosphorus (24.95 kg ha<sup>-1</sup>) at the end of incubation. An increase in organic matter may have resulted in the enhancement of organic carbon in the soil. The results agree with Mohini *et al.*, (2022) [2], who observed that the highest organic carbon content was observed with the application of Soil + FYM.

The interaction effect of source and levels of manure was significant for available nitrogen and available phosphorus at 90 days of incubation. Significantly the highest available nitrogen (215.66 kg ha<sup>-1</sup>) was reported with the treatment receiving vermicompost @ 6 t ha<sup>-1</sup>, while application PMC @ 6 t ha<sup>-1</sup> showed significantly the highest available phosphorus (28.46 kg ha<sup>-1</sup>) over the rest of the combinations. All the combinations of different sources and levels of manure were found to be statistically superior to control treatments.

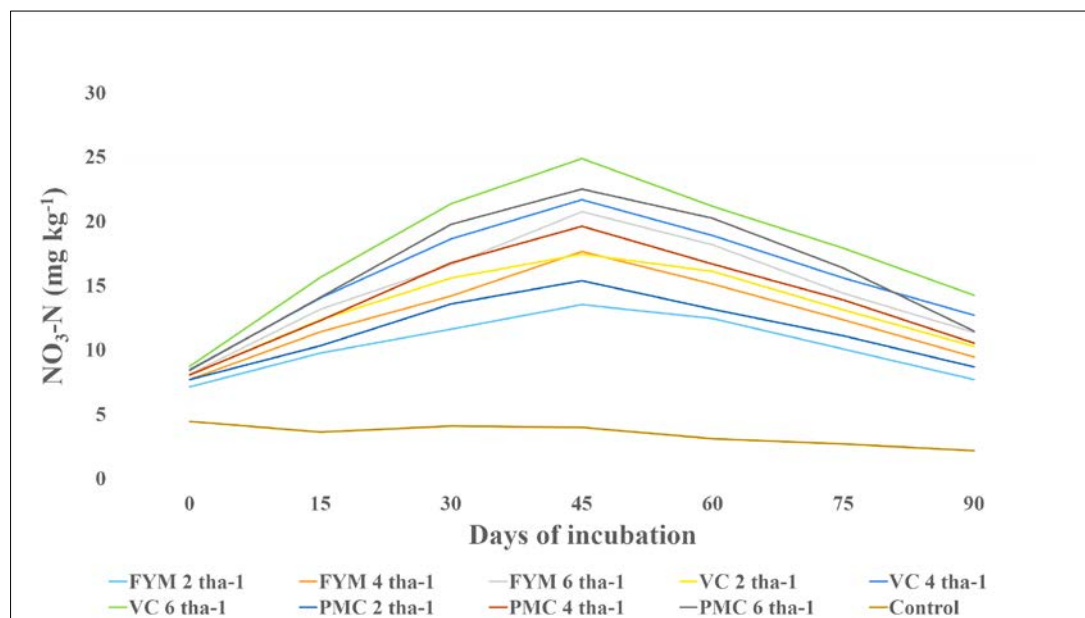
**Table 1:** Effect of different sources and levels of organic manures on release of periodical nitrate nitrogen (NO<sub>3</sub>-N) during incubation

No.	Treatments		NO <sub>3</sub> -N (mg kg <sup>-1</sup> )						
			Days of incubation						
			0	0-15	15-30	30-45	45-60	60-75	75-90
1	M <sub>1</sub> L <sub>1</sub>	FYM 2 tha <sup>-1</sup>	7.11	9.74	11.59	13.5	12.43	10.06	7.68
2	M <sub>1</sub> L <sub>2</sub>	FYM 4 tha <sup>-1</sup>	7.67	11.41	14.18	17.65	15.14	12.31	9.44
3	M <sub>1</sub> L <sub>3</sub>	FYM 6 tha <sup>-1</sup>	8.11	13.18	16.59	20.72	18.18	14.38	11.35
4	M <sub>2</sub> L <sub>1</sub>	VC 2 tha <sup>-1</sup>	8.04	12.34	15.56	17.44	16.11	13.12	10.28
5	M <sub>2</sub> L <sub>2</sub>	VC 4 tha <sup>-1</sup>	8.44	14.02	18.6	21.67	18.87	15.57	12.71
6	M <sub>2</sub> L <sub>3</sub>	VC 6 tha <sup>-1</sup>	8.73	15.65	21.36	24.86	21.15	17.88	14.23
7	M <sub>3</sub> L <sub>1</sub>	PMC 2 tha <sup>-1</sup>	7.69	10.34	13.56	15.35	13.14	11.08	8.64
8	M <sub>3</sub> L <sub>2</sub>	PMC 4 tha <sup>-1</sup>	8.0	12.26	16.75	19.61	16.67	13.86	10.51
9	M <sub>3</sub> L <sub>3</sub>	PMC 6 tha <sup>-1</sup>	8.43	14.06	19.75	22.52	20.21	16.34	11.43
10		Control	4.44	3.59	4.09	3.97	3.09	2.66	2.18

**Table 2:** Effect of different sources and levels of organic manures on Soil properties after incubation

A. Sources		Soil properties						
		pH	EC (dS m <sup>-1</sup> )	OC (%)	CaCO <sub>3</sub> (%)	Av.N (kg ha <sup>-1</sup> )	Av.P (kg ha <sup>-1</sup> )	Av.K (kg ha <sup>-1</sup> )
M <sub>1</sub> -FYM		6.72	0.34	0.48	4.8	178.74	19.22	293.65
M <sub>2</sub> -Vermicompost		6.73	0.33	0.45	4.87	193.15	23.75	304.61
M <sub>3</sub> -PMC		6.70	0.35	0.46	4.83	183.11	25.65	301.60
SEm±		0.03	0.01	0.01	0.09	3.21	0.59	4.46
CD @ 0.05		NS	NS	0.02	NS	6.75	1.24	NS
B. Levels								
L <sub>1</sub> - 2 t ha <sup>-1</sup>		6.73	0.31	0.45	4.92	163.40	20.79	295.00
L <sub>2</sub> - 4 t ha <sup>-1</sup>		6.72	0.34	0.46	4.84	185.78	22.88	299.89
L <sub>3</sub> - 6 t ha <sup>-1</sup>		6.71	0.37	0.48	4.74	205.84	24.95	304.96
SEm±		0.03	0.01	0.008	0.1	3.41	0.62	4.51
CD @ 0.05		NS	0.02	0.02	NS	7.16	1.31	NS
Sources & levels Interaction								
M <sub>1</sub> L <sub>1</sub>	FYM 2 tha <sup>-1</sup>	6.73	0.32	0.46	4.88	158.29	18.39	288.66
M <sub>1</sub> L <sub>2</sub>	FYM 4 tha <sup>-1</sup>	6.72	0.34	0.48	4.80	179.52	19.16	293.76
M <sub>1</sub> L <sub>3</sub>	FYM 6 tha <sup>-1</sup>	6.71	0.37	0.49	4.72	198.42	20.10	298.52
M <sub>2</sub> L <sub>1</sub>	VC 2 tha <sup>-1</sup>	6.74	0.30	0.44	4.97	169.83	21.29	300.30

M <sub>2</sub> L <sub>2</sub>	VC 4 tha <sup>-1</sup>	6.72	0.33	0.45	4.87	193.96	23.69	303.95
M <sub>2</sub> L <sub>3</sub>	VC 6 tha <sup>-1</sup>	6.72	0.35	0.47	4.77	215.66	26.28	309.57
M <sub>3</sub> L <sub>1</sub>	PMC 2 tha <sup>-1</sup>	6.71	0.33	0.45	4.92	162.07	22.69	296.05
M <sub>3</sub> L <sub>2</sub>	PMC 4 tha <sup>-1</sup>	6.70	0.36	0.46	4.84	183.85	25.79	301.95
M <sub>3</sub> L <sub>3</sub>	PMC 6 tha <sup>-1</sup>	6.70	0.39	0.47	4.74	203.43	28.46	306.80
Control		6.74	0.27	0.41	5.09	142.73	17.96	280.67
SEm±		0.04	0.03	0.012	0.14	4.82	0.88	6.38
CD @ 0.05		NS	NS	NS	NS	10.12	1.86	NS
<b>Control vs rest</b>								
SEm±		0.04	0.01	0.010	0.12	4.15	0.76	5.49
CD @ 0.05		NS	0.03	0.021	0.26	8.71	1.60	11.10



**Fig 1:** Periodical release of nitrate nitrogen during incubation

## Conclusion

The maximum release rate of NO<sub>3</sub><sup>-</sup>-N from different sources of organic manures was at 30-45 days of incubation, whereas the application of vermicompost @ 6.0 t ha<sup>-1</sup> was superior for higher release of nitrate nitrogen and soil available nitrogen in Entisol.

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