Research Paper

Effect of Nitrogen, FYM and Carbamate Pesticide on Nitrogen Transformation

OP BANSAL*
Chemistry Department, DS College, Aligarh-202001

(Received on 14 December 2005; Accepted on 6 June 2006)

A laboratory incubation study was conducted to investigate the effect of N-Phenyl (ethyl carbomyl) propyl carbamate on nitrogen transformation in allluvial soil of Aligarh. The NH_4-N content in soil increased upto 7d of incubation in all the treatments of N, FYM and pesticide and thereafter it declined. Application of pesticide helped in releasing higher NH_4-N content in soil than control upto 7 d incubation. The NO_3-N content in soil increased after 7 d incubation under all the treatments, it became almost stable after 63 d of incubation. Application of nitrogen, FYM increased NO_3-N content in soil and maximum increase was observed in between 7 and 14 d of incubation. Application of pesticide decreased NO_3-N content upto 28d of incubation in soil. The increase in ammoniating bacterial population and decrease in nitrification indicate that carbamate pesticide affects nitrifying bacterial population.

Key Words: N-phenyl (ethyl carbamoyl) propyl carbamate, Soil, FYM, N-transformation

Introduction

Indian soils are universally deficient in plant available N and its application holds a key to the sustained higher crop productivity. The very survival of an ever-increasing population depends on the effective and continued use of nitrogenous fertilizers. Soil-N reserves are no longer adequate to meet the nitrogen requirement of crops. Therefore, to get higher yields, application of nitrogenous fertilizer is indispensable. The recovery of applied N fertilizers for a crop varies from less than 30 to 80% depending upon the soil and climatic conditions. Application of FYM and pesticides also affect nitrogen transformation and mineralization process [1].

Information regarding effect of carbamate pesticides on nitrogen transformation is very scanty. The purpose of present study was planned to study N-Phenyl (ethyl carbamoyl) propyl carbamate (a weedicide) on nitrogen transformation in presence of added FYM.

Material and Methods

The soil used in study (0-25 cm) was collected from central lowland type III, alluvial (typic ustochrept) of Aligarh district. The soil was air dried, crushed and sieved. The physico-chemical properties of soil were: silt – 48%, clay 15.6%, pH (1:2.5) 8.0, organic carbon 9.1 g kg^{-1}, ammonium-nitrogen 11.2 and nitrate-nitrogen 65.2 mg kg^{-1} respectively. The treatments consisted of three levels of well rotted FYM (0, 5, 10 mg kg^{-1} soil) (total N content in FYM is 0.98%), four levels of nitrogen (0, 100, 200, 500, mg urea-N kg^{-1} soil) and three levels of N-Phenyl (ethyl carbamoyl) propyl carbamate (0, 100, 200 mg kg^{-1} soil). All the treatments were replicated thrice. The experiments were conducted in plastic pots with 100 g of soil. The pots were wetted to field capacity after treating the soil as per treatment combination and incubated at 30^0 C. Total weight of each pots was recorded just before the incubation. Moisture level at field capacity was maintained by weighing each of the pots everyday.

The soil samples were analysed for NH_4-N and NO_3-N contents at 0, 7, 14, 21, 28, 35, 42, 48, 56, 63, 70, 77, 84, 91 days of incubation by Onken and Sunderman [2] method.

Results and Discussion

The results presented in Table 1 indicate maximum concentration of NH_4-N on 7^{th} day of application of urea and then decrease significantly upto the 91d of incubation. The increase in NH_4-N content on 7^{th} d was 12.2–34.4; 39.2–106.6; 42.4 to 196.8; 46–1 to 466.2 mg kg^{-1} soil in control, 100, 200, 500 mg kg^{-1} soil treatments respectively. In between 7-14 d of incubation the NH_4-N content in soil decreased from 106.6 to 34.8; 196.8 to 94.3; 466.2 to 314.2 mg kg^{-1} soil, at 100, 200, 500 mg N kg^{-1} soil respectively. The increase in NH_4-N content in soil under control on 7^{th} d of incubation may be due to mineralisation of native organic matter in soil and in urea-N amended soils due to mineralization and hydrolysis of urea. Similar results are also reported by Gupta and Narwal [3]; Basumatary and Talukdar [4]; Duhan et al. [5].

Application of FYM significantly increased the NH_4-N content in soils on 7^{th} d of application (Table 1) and extent of increase was 15.1-92.4 mg kg^{-1} soil with 10mg of FYM kg^{-1} soil. The amount of NH_4-N declined to 61.4 mg kg^{-1} soil in between 7-14 d of incubation. The

* *Author for correspondence – E-mail: drop31@rediffmail.com*

Table 1. Effect of nitrogen, FYM and N-phenyl (ethyl carbamoyl) propyl carbamate on NH4-N content (mg kg^{-1}) in soil

Amount added Kg^{-1} soil	Incubation period (d)														
	0	7	14	21	28	35	42	49	56	63	70	77	84	91	Mean
Nitrogen															
0 mg	12.2	34.4	26.7	19.4	16.6	14.1	10.2	8.9	8.0	7.1	6.2	6.0	5.8	5.8	12.9
100 mg	39.2	106.6	34.8	28.8	24.5	18.4	14.2	11.3	10.4	9.6	8.0	7.4	6.6	6.6	23.3
200 mg	42.4	196.8	94.3	66.6	41.5	30.6	25.5	20.0	15.6	13.2	10.0	8.8	7.6	7.2	41.4
500 mg	46.1	466.2	314.2	174.0	111.4	76.5	66.6	44.2	30.4	26.1	19.4	14.4	13.2	12.0	101.1
Mean	35.1	226.0	117.5	72.2	48.5	34.9	29.1	21.1	16.1	14.0	10.9	6.1	8.3	7.9	
CD (0.05)Days = 0.24; dose = 0.12															
FYM															
0g	14.8	46.5	29.6	21.4	18.6	15.4	11.7	9.4	8.3	7.5	6.5	6.0	5.8	5.8	14.2
5g	15.1	83.6	50.6	38.8	26.1	20.5	15.8	13.3	11.2	9.6	7.5	6.8	6.2	6.2	20.8
10g	15.1	92.4	61.4	45.4	38.4	30.7	23.2	19.6	16.5	13.2	11.5	10.0	8.8	8.8	26.8
Mean	15.0	74.2	47.2	35.2	27.7	22.2	16.9	14.1	12.0	10.1	8.5	7.6	6.9	6.9	
CD (0.05)days = 0.22; dose = 0.11															
N-Phenyl (ethyl carbamoyl) propyl carbamate															
0mg	14.8	35.8	28.9	20.4	17.8	15.0	10.9	9.2	8.2	7.4	6.3	6.0	5.8	5.8	13.7
100mg	15.4	62.4	34.6	34.8	25.1	19.0	13.7	12.1	10.9	8.6	7.1	6.4	6.0	6.0	18.7
200mg	15.3	76.4	50.1	43.6	34.4	28.4	21.4	18.4	15.2	12.4	10.8	9.2	8.0	8.0	25.1
Mean	15.2	58.2	37.9	32.9	25.8	20.8	15.3	13.2	11.8	9.5	8.1	7.2	6.6	6.6	
CD (0.05)Days = 0.25; dose = 0.12															

NH_4-N content in soil throughout the experiment was more in FYM amended soil then in control which may be due to increased microbial population and N content (preliminary studies by the author indicate that microbial population got increased by addition of FYM and lower doses of carbamate pesticides). Similar inferences were also concluded by Imagawa et al [6]; Singh et al [7].

Effect of different doses of N-phenyl (ethyl carbamoyl) propyl carbamate (Table 1) indicate that NH_4-N content increases significantly upto 7th d of incubation. The extent of increase in NH_4-N was 15.3 to 68.4 mg kg^{-1} soil with 200 mg of pesticide kg^{-1} soil and then decreased to 50.1 mg kg^{-1} on 14th d of incubation. The NH_4-N content increased with increase in pesticide concentration. After 42 d of incubation the pesticide has no appreciable effect of NH_4-N content in soil as compared to control. The initial increase in NH_4-N content with the pesticides may be due to increase in ammoniafying bacterial population and/or adverse effect on the nitrifying bacteria (nitrosomonal and nitrobactor) [8]. The preliminary studies by the author indicate that ammoniafying bacterial population increased upto 7d of incubation in presence of different dose of nitrogen, FYM and lower doses of carbamate pesticides. The decrease in NH_4-N content inbetween 7-14 d of incubation in presence of pesticide may be due to fixation of NH_4^+ ion to clay complex [9] and due to nitifrication [10].

$$NH_3 \longrightarrow HNO_2 \longrightarrow HNO_3$$

Nitrate-N Content

An examination of Table 2 indicate that NO_3-N increased from 71.2 to 83.7 mg kg^{-1} soil in absolute control during the experiment period, the concentration increased upto 63 d and then became almost stable. Application of all the doses of nitrogen resulted in increase in NO_3-N content in soil, there was a maximum increase in between 7 and 14 d of incubation. The NO_3-N content in soil became almost stable at 64 d at all the studied N levels, increase in NO_3-N content after 7 d may be due to nitrification. Similar results were also reported by Gupta et al. [11]; Santhy et al. [12].

Application of FYM significantly increased NO_3-N content upto 91 d of application over control. The maximum increase was in between 7-14 d of application (Table 2). The NO_3-N content was more with 10 mg FYM kg^{-1} soil application. The increase in NO_3-N may be due more mineralisation of nitrogen by FYM [13] [14].

Application of different doses of pesticide significantly decreased the NO_3-N content in soil over pesticide control (Table 2) upto 28d of incubation thereafter it increases. The decrease in NO_3-N content in soil with pesticide may be due to poor nitrification and adverse effect of pesticide on nitrifying bacteria. The increase in NO_3-N content after 28 d of incubation may be due to dissipation of pesticide and decomposition of NO_3-N [15].

Conclusion

The laboratory experiment carried out to study the effect of N-phenyl (ethyl carbamoyl) propyl carbamate on N transformation in presence and absence of added FYM and nitrogen revealed that application of pesticide did not affect the ammoniafication process adversely. Pesticide application resulted in reduced rate of nitrification.

Table 2. Effect of nitrogen, FYM and N-phenyl (ethyl carbamoyl) propyl carbamate on NO_3-N content (mg kg^{-1}) in soil

Amount added	Incubation period (d)														
kg^{-1} Soil	0	7	14	21	28	35	42	49	56	63	70	77	84	91	Mean
Nitrogen															
0mg	71.2	72.1	73.8	75.2	76.4	77.8	79.4	80.6	81.5	82.4	83.3	83.5	83.7	83.7	78.9
100mg	71.6	72.4	128.4	132.6	136.7	141.6	144.8	147.4	148.2	149.0	150.4	151.0	151.8	151.8	133.4
200mg	72.0	73.0	164.2	191.2	215.4	225.4	230.3	235.5	248.1	250.3	253.2	254.4	256.0	256.2	108.9
500 mg	72.4	73.8	206.4	333.3	384.4	409.4	416.6	434.6	446.2	449.3	456.5	461.2	462.3	463.4	362.1
Mean	71.8	72.8	143.2	183.1	203.2	213.5	217.8	224.5	231.0	232.8	235.8	237.6	238.4	238.8	
CD (0.05)Days = 0.39 = 0.39; dose = 0.16															
FYM															
0g	71.2	72.8	83.4	91.2	94.0	97.2	1005	102.6	103.7	104.5	105.5	106.0	106.2	106.2	96.0
5g	71.4	72.8	106.6	117.5	129.8	134.0	139.0	141.5	143.6	145.2	147.3	148.0	148.5	148.6	28.2
10g	71.6	74.0	120.4	136.5	144.4	151.2	158.5	161.9	164.2	167.5	169.1	170.5	171.5	171.5	145.2
Mean	71.4	73.0	103.5	115.1	122.7	127.5	132.7	135.3	137.2	139.1	140.6	142.1	142.1		
CD (0.5)Days = 0.36; dose = 0.15															
N-Phenyl (ethyl carbamoyl) propyl carbamate															
0mg	71.2	71.8	89.5	93.5	96.0	98.7	102.7	104.1	105.2	106.0	107.1	107.4	107.6	107.6	97.4
100mg	70.8	70.1	81.2	78.0	75.6	85.7	101.1	116.5	138.2	149.6	150.5	151.6	152.0	152.0	130.9
200mg	71.4	71.0	78.4	74.7	71.2	82.1	96.2	121.5	152.4	165.0	166.6	168.2	169.2	169.2	143.9
Mean	71.1	71.0	83.0	82.1	80.9	88.8	100.0	114.0	131.9	140.2	141.4	142.4	142.9	142.9	
CD (0.05)Days = 0.38; dose = 0.19															

References

1. RK Pandey and SN Rai *Indian J Agric Chemistry* **26** (1993) 123
2. AB Onken and HD Sunderman *Agron J* **59** (1971) 49-51
3. AP Gupta and RP Narwal *J Indian Soc Soil Sci* **36** (1988) 352-355
4. A Basumatary and MC Talukdar *J Indian Soc Soil Sci* **46** (1998) 451-453
5. BS Duhan, D Kataria, JP Singh, MS Kuhad and SS Dahiya *J Indian Soc Soil Sci* **53** (2005) 184-187
6. M Imagawa, S Kewai, T Kinoshita, H Myumi and H Oshima *Res Bull Aichiken Agric Res Centre* **21** (1989) 281-288
7. Muneshwar Singh, VP Singh and K Sammi Reddy *J Indian Soc Soil Sci* **49** (2001) 430-435
8. VN Singh and CR Prasad *J Indian Soc Soil Sci* **39** (1991) 183-185
9. K Susan John and A Abraham *J Indian Soc Soil Sci* **43** (1995) 47-51
10. RL Donahue, RW Miller and JC Schickluna (Eds) *Soil and Plant Nutrition an Introduction to Soil and Plant Growth* Prentice Hall Inc. Englewood Cliffs NJ (1977) pp 123-141
11. RK Gupta, BR Arora and KN Sharma *J Indian Soc Soil Sci* **51** (2003) 203-205
12. P Santhy, Jayasree, S Shankar, P Muthuvel and D Selvi *J Indian Soc Soil Sci* **46** (1998) 395-398
13. T Sarin, Y Tanaka and A Kitagawa *Nara Agricultural Experiment Station* **22** (1991) 57-64
14. RK Gupta, KN Sharma, Bijay Singh, Y Singh and BR Arora *J Indian Soc Soil Sci* **53** (2005) 74-80
15. AC Das, A Chakravarty, P Sukul and D Mukherjee *Microbial Res* **150** (1995) 187-194