"RELEASE PATTERN OF CUMULATIVE NITROGEN FRACTIONS IN *ENTISOL* AND *VERTISOL* AS INFLUENCEDBY VARIOUS SOURCES OF NITROGENOUS FERTILIZERS"

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Abstract: *An incubation experiment was conducted to study the release pattern of cumulative nitrogen fractions through Entisol and Vertisol as influencedby the treatments of neem coated urea (NCU), DAP, NPK briquette, NP briquette, urea briquette and crotonylidenediurea (CDU).*

The DAP released significantly highest cumulative NH_4^+-N in both Entisol (153.03 mg kg^{-1}) and Vertisol (154.10 mg kg^{-1}). The NPK briquette alone released highest amount of both cumulative NO_3^--N as well as cumulative mineral N in both Entisol (596.59 mg kg^{-1}and 696.10 mg kg^{-1}) and Vertisol (643.83 mg kg^{-1}and 755.61 mg kg^{-1} respectively).

Key words: *Nitrogen fraction, Entisol, Vertisol, nitrogenous fertilizers.*

Introduction

The improved understanding of N mineralization and N immobilization, along with their continuous changing dynamics may improve our ability to manage N cycling and increase nitrogen use efficiency (NUE) by minimizing N losseswhatever the form and increase the sustainability of agricultural system that utilize typically applied differnt N sources (Cabrera *et al.*, 2005). Nitrogen in the inorganic sources occurs mainly in complex forms e.g., when CDU ($C_6H_{12}N_4O_2$) is placed in the soil, it is degraded into urea and crotonaldehyde through hydrolysis and biological activity (Ozores-Hampton, 2014). Placement of NPK briquette at 10 cm deep maintained higher level of NH_4^+-N and NO_3^--N in soil (More, 1999). However, the information regarding a comparative performance of neem coated urea, DAP, NPK briquette, NP briquette, urea briquette and crotonylidenediurea as a source of N and the release pattern and availability of NH_4^+-N and NO_3^--N from these sources is limited. Therefore, the present study was undertaken to study the release pattern of nitrogen in *Entisol* and *Vertisol* as affected by these sources of nitrogenous fertilizers.

Material and methods

The present laboratory experiment was carried outat Division of Soil Science and Agricultural Chemistry, College of Agriculture, Pune, Maharashtra during year 2017-18to study the release pattern of nitrogen in *Entisol* and*Vertisol* due to effect of various inorganic nitrogenous fertilizers at field capacity moisture regime (0.33 bar).The various physico-chemical properties of soils are analyzed by using various standard methods, the soil properties are given in given in table 1.

There were fourteen treatments in experiment viz. combination of six nitrogenous fertilizers viz. F_1-neem coated urea (NCU), F_2-DAP, F_3-NPK briquette, F_4-NP briquette, F_5-urea briquette and F_6-Crotonylidene diurea (CDU) and F_0-control with two soils viz. *Entisol*(S_1) and *Vertisol*(S_2).For maintaining moisture at field capacity level, double distilled water was used throughout the experiment.The amount of N fertilizers to be added are calculated on the basis of recommended dose of rice crop i.e. 100 kg N per hectare. As 1 ha of soil weight is 2.24×10^6 kg so further calculations were made to determine the quantity of N fertilizers for 1 kg of soil and 200 mg of N was added per kg of soil (table 2).

Table 1: Physico-chemical properties of *Entisol*and *Vertisol*

Sr. No.	Soil properties	*Entisol*	*Vertisol*
A.	**Physical properties**		
1.	Sand (%)	52.50	20.35
2.	Silt (%)	31.75	28.05
3.	Clay (%)	15.75	51.60
4.	Textural class	Sandy loam	Clay
5.	Bulk density (g cm^{-3})	1.45	1.27
6.	Field capacity (%)	29.02	37.60
7.	Permanent wilting point (%)	15.54	20.60
B.	**Chemical properties**		
8.	pH (1:2.5 **;** soil:water)	7.31	8.14
9.	EC (dSm^{-1})	0.12	0.23
10.	Organic carbon (%)	0.28	0.54
11.	$CaCO_3$ equivalent (%)	1.75	8.01
12.	Available nitrogen (kg ha^{-1})	213.24	288.51
13.	Available phosphorous (kg ha^{-1})	34.50	24.38
14.	Available potassium (kg ha^{-1})	329.28	499.52
15.	Ammonical nitrogen (mg kg^{-1})	13.05	19.60
16.	Nitrate nitrogen (mg kg^{-1})	22.60	31.20
17.	Exchangeable cations (meq./100 g)		
	Ca^{2+}	26.29	61.30
	Mg^{2+}	13.80	26.10
	Na^{+}	21.35	29.84
	k^{+}	23.40	21.09

Table 2: Treatment details and Quantity of nitrogenous fertilizers used for incubation studies-

Sources of N fertilizers	Estimated Total N content (%)	Amount of N fertilizers (mg) added to maintain 200 mg N kg^{-1} soil
Neem coated urea	43.05	193.80
DAP	16.10	496.00
NPK briquette	25.66	327.60
NP briquette	32.66	256.00
Urea briquette	42.00	193.80
Crotonylidenediurea (CDU)	32.50	226.00 (micro ml)

Incubation study for 0, 15, 30, 45, 60, 75 and 90 days after addition of nitrogenous fertilizers into soils was carried out at ambient condition. The NH_4^+-N and NO_3^--N in *Entisol* and *Vertisol* are evaluated by method described by Kenney and Nelson (1982). It is determined immediately after sampling at each interval day by taking 5 gm of soil from each incubated bowl. At the same time same weight of soil sample was kept for determining the moisture content for further calculations.

Results and discussion

1. Release pattern of NH_4^+-N: The release of cumulative nitrogen was ranged between 153.03 mg kg^{-1} to 67.22 mg kg^{-1} in *Entisol*while it was ranged between154.10 mg kg^{-1} to 63.58 mg kg^{-1} in *Vertisol*.The highest cumulative NH_4^+-N release found in DAP (154.10 mg kg^{-1}) in *Vertisol*. It is conformity with results of Durgude *et al.* (2008) where highest N recovery was reported in DAP briquettes than urea fertilizer.However the cumulative NH_4^+-N release was in order; DAP >CDU >NCU >NP briquette >NPK briquette >UB >Control in *Entisol* while in *Vertisol* it was DAP >NP briquette >NPK briquette >NCU >UB >CDU >Control.

It is concluded that CDU and NCU performed better in *Entisol* than rest of treatments while NP briquette and NPK briquette performed better in *Vertisol* during incubation. It reflects the suitability of those fertilizers with respect to the concerned soils.

Table 3: Effect of nitrogenous fertilizers on cumulative NH_4^+-Ncontent of *Entisol* (mg kg^{-1})

Nitrogenous fertilizers	Incubation periods (Days)							Cumulative total
	0	15	30	45	60	75	90	
NCU	30.80	26.73	25.50	11.19	7.94	7.30	5.15	114.60
DAP	75.00	24.10	22.73	11.55	8.31	7.22	4.12	153.03
NPK briquette	31.03	20.80	11.80	10.97	8.40	8.67	7.30	98.97
NP briquette	33.83	24.30	12.15	11.35	9.48	8.62	7.03	106.76
UB	29.13	25.20	13.03	9.59	7.04	7.18	3.99	95.16
CDU	44.87	25.50	20.74	12.16	6.14	6.33	5.29	121.04
Control	14.97	13.30	12.98	8.59	7.23	6.95	3.20	67.22

Table 4: Effect of nitrogenous fertilizers on cumulative NH_4^+-Ncontent of *Vertisol* (mg kg^{-1})

Nitrogenous fertilizers	Incubation periods (Days)							Cumulative total
	0	15	30	45	60	75	90	
NCU	14.57	39.51	85.80	86.26	97.42	125.45	126.0	575.01
DAP	15.63	42.86	73.21	76.62	84.67	114.44	115.00	522.43
NPK briquette	36.00	55.87	57.93	76.55	94.97	136.50	138.77	596.59
NP briquette	30.76	53.50	55.73	75.50	94.33	135.10	137.33	582.26
UB	23.33	52.89	53.92	72.83	88.33	129.83	120.77	541.91
CDU	13.47	42.12	55.19	62.17	81.40	106.22	104.53	465.09
Control	8.30	14.52	20.59	18.60	17.34	16.87	16.67	112.89

2. Release pattern of NO_3^--N: The release of cumulative NO_3^--N was ranged between 596.59 mg kg^{-1} to112.89 mg kg^{-1} in *Entisol* while in *Vertisol* it was ranged between 643.83 mg kg^{-1} to 104.07 mg kg^{-1}.The application of NPK briquette in both *Entisol* (596.59 mg kg^{-1}) and *Vertisol* (643.83 mg kg^{-1}) released highest amount cumulative NO_3^--N than the rest of the treatments.

Also the release of cumulative NO_3^--N was in order NPK briquette >NP briquette >NCU >UB >DAP>CDU >Control in *Entisol* and NPK briquette >NP briquette >UB >DAP >NCU >CDU >Control in *Vertisol*. Briquette fertilizers showed the superiority by releasing nitrate nitrogen more slowly than other fertilizer treatments which was in conformity with results of More and Shinde (2002).

Table 5: Effect of nitrogenous fertilizers on cumulative NO_3^--N content of *Entisol* (mg kg^{-1})

Nitrogenous fertilizers	Incubation periods (Days)							Cumulative total
	0	15	30	45	60	75	90	
NCU	29.43	25.88	23.72	10.85	6.84	6.69	5.88	109.29
DAP	78.43	26.47	21.55	9.05	7.37	5.96	5.27	154.10
NPK briquette	31.64	23.93	15.03	15.03	9.60	8.72	7.83	111.79
NP briquette	32.00	27.08	15.58	13.74	8.23	7.60	7.60	111.83
UB	31.13	26.99	18.82	12.50	7.23	6.64	5.94	109.25
CDU	32.80	22.00	19.65	11.66	6.13	5.83	6.02	104.10
Control	14.77	13.39	10.31	8.29	6.30	6.55	3.98	63.58

Table 6: Effect of nitrogenous fertilizers on cumulative NO_3^--N content of *Vertisol*(mg kg^{-1})

Nitrogenous fertilizers	Incubation periods (Days)							Cumulative total
	0	15	30	45	60	75	90	
NCU	45.37	66.24	111.30	97.45	105.36	132.75	131.15	689.61
DAP	90.63	66.95	95.94	88.17	92.98	121.66	119.12	675.46
NPK briquette	67.56	76.67	69.74	87.52	103.37	145.17	146.07	696.10
NP briquette	64.59	77.80	67.88	86.85	103.81	143.72	144.37	689.02
UB	52.46	78.09	66.95	82.42	95.37	137.01	124.75	637.06
CDU	58.33	67.62	75.93	74.33	87.54	112.55	109.83	586.13
Control	23.27	27.82	33.57	27.19	24.57	23.82	19.87	180.11

3. Release pattern of mineral nitrogen (NH_4^+-N+ NO_3^--N): Cumulative mineralN in *Entisol* was ranged from 180.11 mg kg^{-1} to 696.10 mg kg^{-1} and in *Vertisol* it was ranged from 167.65 mg kg^{-1} to 755.61 mg kg^{-1}. In both of the soils viz. *Entisol*(696.10 mg kg^{-1}) and*Vertisol*(755.61 mg kg^{-1}) the application of NPK briquette released highest cumulative mineral nitrogen than rest of the treatments.The release of cumulative mineral N was in order; NPK Briquette >NCU >NP Briquette >UB >DAP >CDU >Control in *Entisol* whereas it was NPK briquette >NP briquette >DAP >UB >NCU >CDU >Control in *Vertisol*.

Table 7: Effect of nitrogenous fertilizers on cumulative mineral N content of *Entisol* (mg kg^{-1})

Nitrogenous fertilizers	Incubation periods (Days)							Cumulative total
	0	15	30	45	60	75	90	
NCU	12.55	35.38	77.16	78.04	87.04	121.68	122.88	534.74
DAP	15.40	70.83	78.48	82.10	94.31	117.92	116.90	575.94
NPK briquette	37.67	62.25	81.63	92.89	95.55	137.01	136.83	643.83
NP briquette	36.96	61.30	80.03	92.33	94.47	136.83	136.57	638.49
UB	25.03	58.56	79.25	81.14	91.88	135.73	132.83	604.43
CDU	12.13	35.92	61.41	61.67	74.64	96.73	97.73	440.24
Control	7.39	13.07	17.88	18.00	17.62	15.10	15.01	104.07

Table 8: Effect of nitrogenous fertilizers on cumulative mineral N content of *Vertisol*(mg kg^{-1})

Nitrogenous fertilizers	Incubation periods (Days)							Cumulative total
	0	15	30	45	60	75	90	
NCU	41.98	61.26	100.88	88.89	93.88	132.75	128.76	648.40
DAP	93.83	97.30	100.03	91.15	101.68	123.89	122.17	730.04
NPK briquette	69.31	86.18	96.66	107.92	105.15	145.73	144.67	755.61
NP briquette	68.96	88.38	95.61	106.08	102.70	144.43	144.17	750.32
UB	56.16	85.55	98.07	93.64	99.11	142.37	138.78	713.68
CDU	44.93	57.92	81.06	73.33	80.77	102.57	103.75	544.34
Control	22.15	26.46	28.19	26.29	23.92	21.65	18.99	167.65

Conclusion

The highest cumulative NH_4^+-N was released from DAP, whereas the highest cumulative NO_3^--N released from NPK briquette.Further it can be concluded thatNPK briquette and NP briquette performed better NO_3^--N and mineral nitrogen release in both of the soils.

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