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Effect of liming on available N and Fe content of acid soil

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Nitrogen and iron are required by plants for the growth and metabolic activities. Liming acidic soils has been reported to increase the production of mineral N content with the simultaneous decrease in soil organic matter. Application of N fertilizer may influence the process of Fe transformation in soil. On the other hand, Fe fertilization may also affect the transformation process of different inorganic forms of N in soil. Although considerable amount of research works have been carried out in past to study the influence of Fe on availability of N or vice-versa (Das, 2003), but very little investigation has been carried out to monitor the simultaneous changes of different forms of available N and Fe due to application of N and Fe fertilizers either alone or in combination.

The soil sample (0-15cm depth) used for the present investigation was composite sample of cultivated field under Bidhan Chandra Krishi Viswavidyalaya farm at Jhargram in the district of West Midnapur, West Bengal. Limed soil was prepared as per Sarkar and Saha (2007). The relevant physical and chemical properties of (Table 1) both the soils were analyzed. Each 25 g of the unlimed and limed soils were taken separately in 100ml beakers for the present study. Soils were maintained at 60% moisture holding capacity (MHC). Then the soils were allowed for incubation in the laboratory at room temperature (30 ± 2°C) for a period of 90 days. Five separate sets were maintained for laboratory analysis on 0^{th}, 15^{th}, 45^{th}, 60^{th} and 90^{th} day of incubation. The treatments included in the incubation study for both the unlimed and limed soils were represented as follows:

T_1 = Soil, T_2 = Soil + N at mg Kg^{-1}, T_3 = Soil + Fe at 10 mg Kg^{-1}, T_4 = Soil + N at 75 mg Kg^{-1} + Fe at 10 mg Kg^{-1}

All the treatments were replicated thrice. Exchangeable NH_4^+ and soluble NO_3^- were estimated according to the method of Bremner and Keeney (1966). Iron (exchangeable Fe^{2+} and Fe^{3+}) were estimated by the method of Jackson, 1973.Sources of N was $(NH4)_2SO_4$ and Fe was $FeSO_4$.

Table 1. Physical and chemical characteristics of limed and unlimed soil

Sl. No.	Characteristics	Soil		Methods adopted
		Unlimed	Limed	
1	pH (soil : water : : 1:2.5)	5.30	6.85	Glass electrode pH meter (Black, 1965)
2	EC(dsm^{-1})	0.18	0.26	Electrical conductivity bridge, (Black, 1965)
3	Moisture holding capacity (%)	42.04	43.68	Keen-Rackzoswski method (Piper, 1950)
4	Cation exchange capacity [cmol (p^+) kg^{-1}]	10.90	11.50	Schollenberger and Simon (Jackson, 1967)
5	Clay (%)	22.20	22.20	Hydrometer method
6	Textural classes	Sandy clay loam	Sandy clay loam	
7	Oxidisable organic carbon (%)	0.22	0.20	Walkley and Black method (Jackson, 1967)
8	Total N (mg kg^{-1})	1199.54	1141.52	Stevenson,1996
9	Exchangeable NH_4^+	70.67	72.21	Bremner and Keeney, 1966
10	Soluble NO_3^-	63.66	62.77	Bremner and Keeney, 1966
11	Exchangeable ferrous iron (Fe^{2+})	39.34	38.73	Jackson, 1973
12	Ferric (Fe^{3+}) iron	41.84	41.28	Jackson, 1973
13	Nomenclature according to USDA System of soil classification	Plinth Ustalfs	Plinth Ustalfs	USDA

Short Communication

Irrespective of treatments both available nitrogen and iron tended to decrease with increase in the period of investigation (Table 2). The decrease in available nitrogen with time was due to conversion of certain amount of NH_4^+ to NO_3^- - N or lost from the soil system either through denitrification (Groffman *et al.*, 1988) or volatilization (Freney and Black, 1988) as well as due to immobilization of this fraction to organic forms (Broadbent and Nakashima, 1970). Further more comparatively lesser amount of available nitrogen is decreased over 90 days period of incubation in limed than that of unlimed soil. This trend of results was found due to the production of exchangeable NH_4^+ through mineralization of organic N under congenial limed situation (Ghosh *et al.,* 1990). Liming of acid soil creates a favorable environment for activities of microorganisms (Das, 2004) which in turn consume certain amount of exchangeable Fe^{2+} and Fe^{3+} forms of iron in soil throughout the period of investigation. Close investigation of the data revealed that in general, the amount of available N increased in limed over the unlimed soil treated with or without iron. This is perhaps due to the disappearance of the ill effect of iron on ammonifying bacteria. Further, it is also noted that intensity of decrease over 90 days period is more in limed over the unlimed soil. The present line is in accordance with Das, 2004.

Table 2. Changes in the amount (mg Kg^{-1}) of available nitrogen (NH_4^++NO_3^-) and iron (exchangeable Fe^{2+} + Fe^{3+}) in limed and unlimed soil affected by the application of N and Fe fertilizers.

Treatments	Unlime/ Lime	Incubation period (Days) 0		15		45		60		90	
		N	Fe	N	Fe	N	Fe	N	Fe	N	Fe
Soil	Unlimed	134.33	81.18	120.96	74.34	118.02	68.36	93.82	62.17	76.42	56.55
	Limed	134.98	80.03	117.92	72.37	114.40	66.65	98.43	57.92	77.40	49.54
Soil+N	Unlimed	200.08	79.59	168.40	78.69	150.74	73.39	129.79	64.20	119.47	59.35
	Limed	199.94	81.04	165.94	75.33	148.88	70.96	132.20	59.09	120.06	49.66
Soil+Fe	Unlimed	131.84	97.43	120.31	93.99	107.79	89.62	98.92	84.19	87.48	74.33
	Limed	132.04	95.26	118.31	90.82	110.91	83.62	103.66	75.75	93.04	65.24
Soil+N+Fe	Unlimed	194.68	101.64	160.66	99.61	120.72	90.09	108.64	83.56	69.20	78.06
	Limed	192.86	97.13	155.47	93.49	122.72	81.08	109.85	76.13	101.81	61.98

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