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Short communication

MINERALIZATION OF NITROGEN AND CARBON DURING AEROBIC INCUBATION OF THREE SOILS OF BANGLADESH

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Mineralization of organic matter added or indigenous is one of the most important transformations occurring in soil contributing to the inherent soil fertility status. The most important function of microbial flora is usually considered to be the breakdown of organic materials, a process by which the limited supply of CO_2 available to photosynthesis is replenished and a substantially large part of soil nitrogen is recycled (Alexander 1976). The mineralization of organic nitrogen and organic carbon are related to one another, the two elements being mineralized at parallel rates bringing the ratio of CO_2-C to N_i produced essentially constant at approximately 7 to 15:1. This ratio changes due to the presence or absence of the active flora attacking the nitrogenous compounds (Alexander 1976).

The present work reports on the nitrogen and carbon mineralization capacities of three representative soils of Bangladesh varying in their characteristics and having different types of vegetation on it. Two of the soils are used for cultivated annual crops while the other is mainly used for horticultural crops.

The three soils represented three soil series, viz., Fatki clay loam (texture CL, pH 7.6, org. carbon 0.55%, total N 0.081%), Jamuna alluvium (texture L, pH 7.4, org. carbon 0.56%, total N 0.076%) and Tejgaon silty clay loam (texture SCL, pH 5.2, org. carbon 0.56%, total N 0.069%). Soil samples were collected from the top 25 cm over several acres. Incubation study was done for periods of 0-3 and 0-6 weeks. NH_4^+–, NO_3^-– and NO_2^-–N and CO_2 were analyzed by the method described by Cornfield (1961).

Accumulation of mineral-nitrogen forms and the amounts of carbon mineralized are presented in Table 1.

After 3 and 6 weeks of incubation mineralized nitrogen accumulated entirely as nitrate in all three soils. Nitrite was not detected in any of the soils. After 3 weeks, the Jamuna alluvium series soil accumulated slightly more mineral

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nitrogen than did the Fatki and Tejgaon series soils, while nitrate accumulated in the Fatki and Jamuna alluvium soils was somewhat greater than that in the Tejgaon soil. After 6 weeks, mineral-N and nitrate accumulation were higher in the Jamuna alluvium than in the Fatki and Tejgaon series soils. Over 3 and 6 weeks periods of incubation, CO_2 release decreased in the order Fatki, Jamuna alluvium and Tejgaon series soils.

Table 1. Accumulation of mineral nitrogen* (ppm N on dry soil basis) and release of CO_2 (ppm C on dry soil basis) in soil after incubation.

Soil series	3 weeks incubation				6 weeks incubation			
	NH_4-N	NO_3-N	Min-N	CO_2	NH_4-N	NO_3-N	Min-N	CO_2
Fatki	−5.4[a]	25.6	20.2	379	−5.3	28.8	23.5	523
Jamuna alluvium	−2.7	26.3	23.6	284	−3.1	37.4	34.3	402
Tejgaon	1.7	17.9	19.6	223	−3.2	28.8	25.6	352
L.S.D ($P<0.05$)	1.5	2.5	2.9	29	1.5	2.5	2.9	29

* Mineral-N obtained by substracting initial levels from those after incubation.
[a]Negative levels indicate less mineral-N after incubation than initial.

Organically-bound nitrogen accounted for about 97% of the total nitrogen in the three soils. The extent of nitrogen mineralization and the total notrogen contents of the soils were poorly related suggesting that the organically-bound nitrogen differed in characteristics among the three soils. This may be due to different properties of the organic nitrogenous materials present in the soils and/or to different types of microorganisms responsible for nitrogen mineralization.

The mineralization of organic-C (CO_2 release) was also poorly related to the total carbon contents. The three soils had very similar organic carbon contents, but differed in the extent of mineralization of the element as CO_2.

The accumulation of mineralized nitrogen entirely as NO_3^- in the slightly alkaline Fatki and Jamuna alluvium soils is as expected, since autotrophic nitrification is optimum at these pH levels (Alexander 1976), On the other hand, the accumulation of mineralized nitrogen almost entirely as NO_3 after 3 weeks and entirely as nitrate after 6 weeks' incubation in the Tejgaon series soil (pH 5.2) is unusual in view of the low pH of the soil. Autotrophic nitrification is usually low in temperate region soils of low pH, but Ishaque and Cornfield

(1976) found that when an acid laterite (pH 4.2) from Bangladesh was incubated at aerobic moisture levels a fair proportion of the mineralized nitrogen accumulated as NO_3^-. It is possible that acid-adapted strains of autotrophic nitrifiers are present in the soil. This is confirmed by Bhuiya and Walker (1977), who isolated ammonium-oxidizing bacteria from an acid Bangladesh tea soil having pH 5.2. The isolates were identified as species of *Nitrosolobus*, *Nitrosomonus* and a new species of *Nitrosospira*.

Alternatively, these soils may contain heterotrophic nitrifiers. Several heterotrophic microorganisms ore able to produce NO_2^- and NO_3^- in suitable cultures with organic nitrogenous sources as substrates (Eylar and Schmidt 1959, Dunner 1963, Doxtader and Alexander 1966, Ali *et al.* 1987). Weber and Gainey (1962) found that considerable nitrate accumulated when four semi- tropical US soils of pH 3.9 to 4.9 were subjected to incubation or perfusion, but did not suggest that a heterotrophic process was involved.

It is suggested that in the Fatki and and Jamuna alluvium series soils autotrophic nitrification is probably responsible for nitrate accumulation while in the Tejgaon series soil acid-adapted strains of autotrophic nitrifiers and/or heterotrophic nitrifiers are responsible.

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