

**LOSS OF ADDED NITRATE NITROGEN DURING WATER LOGGED
INCUBATION IN THREE SOILS OF BANGLADESH**

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The nitrogen economy of soils is dependent on how best the nitrogenous compounds - indigenous or added - are utilized. Of the many ways of N losses from soils, denitrification occupies an important position, especially under poorly drained and low aeration conditions. These conditions are obvious in our rice fields. The nitrate reduction is due primarily to microbial action, though some chemical reactions occur (1). In flooded soils losses by denitrification may often be as high as 60-70% of the applied N fertilizers (2).

The present study was done to evaluate the loss of added $\text{NO}_3\text{-N}$ in three different soils of Bangladesh after 3 and 6 weeks incubation under water logged condition. The soils used represent three soil series, viz., Fatki clay loam (texture CL, pH 7.6, organic carbon 0.55%, total N 0.081%); Jamuna alluvium (texture L, pH 7.4, organic carbon 0.56%, total N 0.076%); and Tejgaon silty clay loam (texture SiCL, pH 5.2, organic carbon 0.56%, total N 0.069%). The soils are designated in the text as F, J and T soils respectively. Soil samples were collected from the top 25 cm over several acres.

Processed soils were mixed with 2% w/w finely ground straw. KNO_3 was added to give a 500 ppm N. 2 ml water was added to 2 g portions of this treated soils to produce a water-logged condition and these were incubated in 50 ml Kjeldahl flasks. The flasks were closed with corks and incubated at 30°C for 3 and 6 weeks. All experiments were done in triplicates. Initially and after each incubation period residual nitrate was reduced to ammonium by boiling with iron and 2N H_2SO_4 . The whole of the mixture was then subjected to Kjeldahl digestion to convert all organic N compounds to ammonium. The ammonium was collected over 2% boric acid after alkali distillation and was estimated by titration.

Results on total N initially and after 3 and 6 weeks of incubation and loss of nitrate after 3 and 6 weeks are presented in Tables 1 (a) and 1(b) respectively.

By 3 weeks of incubation the F and J soils showed considerable loss of nitrate than T soil. During the following 3 weeks further losses of $\text{NO}_3\text{-N}$ in F and J soils were relatively smaller while that in T soil it was considerable. By 6 weeks loss of NO_3 was similar in all three soils.

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The extent of loss of the added nitrate through denitrification during 6 weeks incubation under water logged condition was 85.4, 84.0 and 90.2 per cent for F, J and T soils respectively.

Table 1. Denitrification during waterlogged incubation of soils treated with 2% straw and 500 ppm $\text{NO}_3\text{-N}$ (a) N before and after incubation; (b) loss of $\text{NO}_3\text{-N}$ after incubation.

(a)				
Soil	Total N (ppm)		Total N (ppm)	
	Initial		after 3 weeks	after 6 weeks
F	1505		1115	1078
J	1474		1078	1054
T	1428		1311	977

L. S. D. ($P \leq 0.05$) = 53

(b)				
Soil	I	II	III	IV
F	390	427	78.0	85.4
J	396	420	79.2	84.0
T	117	457	23.4	90.2

I = $\text{NO}_3\text{-N}$ loss after 3 weeks incubation (ppm); II = $\text{NO}_3\text{-N}$ loss after 6 weeks incubation (ppm); III = % of added $\text{NO}_3\text{-N}$ loss after 3 weeks incubation; IV = % of added $\text{NO}_3\text{-N}$ loss after 6 weeks incubation.

The T soil is an upland and well-drained soil. So, it is very likely that the activities of denitrifiers are initially low and which could be a possible reason for not getting much denitrification loss during the earlier periods of incubation. However, during the latter 3 weeks the organisms might have been activated due to pH rise, which is common under submergence, so that by 6 weeks denitrification from T soil was almost at par with F and J soils. Bacterial denitrification under acid condition is low (3), but chemical denitrification can occur by reaction of nitrite (produced by reduction of nitrate) with ammonium followed by decomposition of ammonium nitrite to nitrogen and water (1). In addition, spontaneous decomposition of nitrite to nitric oxide can occur especially under acid conditions (1).

The fact that there was not complete denitrification of added nitrate from any of the soils by 6 weeks suggests that some of the nitrate might have been immobilized by the microorganisms decomposing straw and was locked up in microbial tissue. Further studies are being carried out with other soils under various conditions of water status to see the effect on denitrification loss of added nitrogen.

LOSS OF ADDED NITRATE

References

1. Brady, N. C. (1984). Nitrogen and Sulfur Economy of Soils. In: *Nature and Properties of Soils*, (9th edition), Macmillan Publishing Co. Inc. USA. pp. 283-326.
2. Partrick, W. H. Jr. and Reddy, K. R. (1977). Fertilizer nitrogen reactions in flooded soils. In: *SEFMIA, Proceedings of the International Seminar on Soil Environment and Fertility Management in Intensive Agriculture (Tokyo: The Society of the Science of Soil and Manure)*. pp. 275-281.
3. Alexander, M. (1976). *Introduction to Soil Microbiology* (2nd ed.) Wiley Eastern Ltd. New Delhi. pp. 467.

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