NITROGEN TRANSFORMATIONS IN THE FORMER SUBAQUEOUS SOILS OF POLDERS RECENTLY RECLAIMED FROM LAKE IJSSEL
II. LOSSES OF NITROGEN DUE TO DENITRIFICATION AND LEACHING

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INTRODUCTION

In investigations described in a previous article it was found that, initially, the heavy subaqueous soils of Lake IJssel are very rich in exchangeable ammonium nitrogen to a considerable depth. This nitrogen had been mineralized under water by anaerobic ammonification.

“Kavel” P 72 of the North-East Polder reclaimed from Lake IJssel in 1942 was deep-ploughed to a depth of 1.60 m in December 1959. The 60 cm of hitherto unaerated subsoil brought to the surface by this operation proved to be still very rich in exchangeable ammonium nitrogen. It was found that after nitrification had started about mid-February the mineral nitrogen in this layer decreased gradually. It was concluded that until mid-summer this loss must be ascribed principally to denitrification of nitrate soon after nitrification of the ammonia, since it was improbable that leaching of mineral nitrogen from the uppermost 60-cm layer had occurred by water movement between spring and mid-summer during 1960. Neither could fixation of NH$_4^+$ in crystal lattices be demonstrated.

To test this conclusion topsoil from the bare plot was enriched with ammonium nitrogen by adding (NH$_4$)$_2$SO$_4$ and incubated at different moisture contents. Ammonium, nitrate and total mineral nitrogen were determined at regular intervals.
METHODS

Exchangeable ammonium, nitrate and total mineral nitrogen were determined as described in the previous article (Van Schreven 11).

Two incubation tests were carried out, using small jam jars closed with a lid provided with a small hole, in a chamber having a relative humidity of nearly 100% and a constant temperature of 29°C. The depth of the soil layer in all the jars was 11 cm. The water content of the soils was checked regularly and water was added when necessary. Every two weeks the content of ammonium, nitrate, and total mineral nitrogen in the soil of one jar of each series of jars was determined. In the second incubation test the soil in the jars was more compressed than in the first experiment.

Columns of soil, 1.20 m in length, contained in plastic tubes were incubated at a temperature of 18 to 23°C. Every four weeks the ammonium, nitrate, and total mineral nitrogen contents in the 0–24, 24–48, 48–72, 72–96, and 96–120 cm layers of soil in one tube of each series of tubes were determined. For the final determinations after incubation for 21 weeks three tubes of each series were used.

In a fourth experiment samples of a heavy soil with an initial high content of moisture and extractable ammonium were incubated for several months in plastic tubes 46 cm in length. During the incubation period the soil was allowed to dry out to a certain extent. Every month the amounts of exchangeable ammonium, nitrate, and total mineral nitrogen were determined in the whole of the soil of one tube.

RESULTS

Laboratory experiments

The results for soil taken from the 0–20 cm layer of the bare plot on the deep-ploughed “Kavel” P 72 of the North-East Polder, enriched with ammonium nitrogen and incubated in jars are shown in Fig. 1.

The course of nitrogen mineralization at moisture contents corresponding to 70 and 80 per cent water-holding capacity was very regular and practically the same. Within two weeks all ammonium nitrogen had been transformed to nitrate nitrogen. Even at a moisture content corresponding to 90% W.C. practically all ammonium nitrogen had been transformed to nitrate nitrogen within two weeks. During incubation at this moisture content the amount of mineral nitrogen decreased markedly. Based on the initial content of mineral nitrogen, a 69 per cent loss of nitrogen was recorded after incubation for 20 weeks. In reality the losses were even greater, since during this period a certain amount of nitrogen