NITROGEN MOVEMENT AND TRANSFORMATION IN SOILS *

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INTRODUCTION

In most soils there is a considerable intake and outgo of nitrogen during the course of a year and these processes are accompanied by many complex transformations. This interlocking succession of reactions, reversible, infinitely recurrent and largely biochemical, constitutes the nitrogen cycle. It has been well established that nitrogen is essential to the metabolism of growing plants. Thus the reserve of plant-available nitrogen as well as the nitrogen supplying power of a soil are factors of singular importance in plant nutrition.

Inorganic nitrogen fertilizers are usually considered to have relatively little residual effect on yields when applied to soils. On the other hand it is an accepted fact that fertilizer N is by no means completely utilized by crops. A certain portion remains in the soil while some may be lost completely. Although the processes which affect the nitrogen not utilized by crops are fairly well understood, investigators have experienced great difficulty in compiling a balance sheet for this N and in estimating its value for future crops.

Jansson in long term pot experiments consistently obtained a 50 per cent recovery of tagged fertilizer N in the first year after addition of the nitrogen. In all subsequent years the per cent N recovery approximated 1 per cent.

Viers found that on a non-calcareous, slightly alkaline soil, nitrogen recovery by crops from various nitrogen fertilizers averaged 81 per cent. On a highly calcareous alkaline soil, however, nitrogen recovery averaged only 26

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per cent. Viers could not explain the wide disparity in nitrogen recovery, but his experimental results led him to conclude that the difference was not due to the kind of nitrogen fertilizer used. Other investigators working on Alberta soils have reported this problem of poor N-recovery from added nitrogen sources.

Little information is available at present on the transformations and distribution of added N in soils. The advent of isotopic tracing techniques involving the use of N\textsuperscript{15} as a tracer has facilitated the differentiation of added N from native soil N. Cheng and Kurtz\textsuperscript{3} employing an N\textsuperscript{15}-tracer technique observed that over 90 per cent of the added N in the soils studied was found in the hydrolytic products of soil organic matter. Stewart \textit{et al.}\textsuperscript{11}, using a similar tracer technique, conducted immobilization-mineralization studies on several organic fractions of soil in an attempt to explain the poor recovery of N fertilizers applied to crop lands.

The objective of the present investigation was to study the movement and transformations of NH\textsubscript{4}\textsuperscript{+}-N added to two Alberta soils by employing an N\textsuperscript{15}-tracer technique with a view to elucidating certain differences in N uptake from the two soils observed in a greenhouse study.

**EXPERIMENTAL METHODS**

The soils used in the experiment were orthic virgin profiles developed on mixed glacial till. The Maleb soil is a Brown soil belonging to the chernozemic order while the Cooking Lake soil is a Grey Wooded in the Podzolic order. Following sampling, the soils were air dried as soon as possible to inhibit nitrification, mixed well and screened through a 2-mm sieve. Mechanical analyses were conducted by the modified Bouyoucos method and nitrogen determinations for total organic and ammoniacal nitrogen were made by Kjeldahl method.

**Greenhouse study**

A greenhouse experiment was conducted on the A- and C-horizons of the two soils with the aim of comparing N-uptake by Gateway barley (\textit{Hordeum vulgare}). A modified Hewitt's nutrient solution\textsuperscript{4} was added to each soil in waxed cardboard containers and the pots were randomly arranged in a 3 × 3 × 3 factorial design for soil from the A horizons with the variables being N and K at 0, 150 and 300 lb./ac. and lime at 0, 5 and 10 tons/ac. The design used for the C horizons was a 3 × 3 factorial, the lime variable being omitted because of the presence of indigenous lime.

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