A STUDY OF SOIL NITROGEN ORGANIC FRACTIONS AND CORRELATION WITH YIELD RESPONSE OF SUDAN-SORGHUM HYBRID GRASS ON QUEBEC SOILS *

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SUMMARY

Acid-hydrolysable organic nitrogen fractions were determined before and after two crops of Sudan-sorghum hybrid grass grown in a growth chamber on twenty Quebec soils. The relationship between the organic nitrogen fractions and yield response to N fertilizer and N uptake was examined by correlation methods and compared with corresponding relations obtained using incubation and boiling water extraction methods as indices of soil N availability.

Mean contributions to total N lost during growth of the two crops were: hydrolysable NH$_4^+$-N - 19%, amino acid N - 16% and hexosamine N - 2%. The amino acid N, hydrolysable NH$_4^+$-N and total hydrolysable N were significantly correlated with percent yield, log percent yield decrement and N uptake. Better correlations were obtained with the incubation and boiling water extraction methods than with the organic-N fractions.

INTRODUCTION

The large reserve of soil nitrogen is in the organic form and must be mineralized to become 'available' to plants. A measure of the 'available' soil nitrogen is essential for the evaluation of supplemental fertilizers. Several empirical methods are available for measuring the nitrogen supplying capacity of a soil during the growth period of a crop 2. However, the role played by the different hydrolysable organic nitrogen fractions in supplying the 'available' nitrogen is not completely understood.

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Present knowledge on the changes in the different soil organic nitrogen fractions on mineralization has been gathered mainly from two sources,
(I) the study of virgin soils and their long-term cultivated counterparts \(^{12,6}\)
(II) the study of changes that occur under conditions of intense mineralization \(^{7}\) (e.g. incubation for long periods).

No attempt has been made so far to follow the changes in the organic nitrogen fractions under short term crop growth periods. This is probably due to difficulties in detecting small differences in these fractions in short term crop growth experiments. Further, reports are scarce on the relationship among organic nitrogen fractions and laboratory indices of soil nitrogen availability or response of crops to added nitrogen.

The objectives of the study reported here were to determine the relative contributions of acid hydrolyzable organic nitrogen fractions to the growth of Sudan-sorghum grass and to the estimates of 'available' N currently in use \(^2\).

**MATERIALS AND METHODS**

**Soils**

Surface samples (0-15 cm) of twenty cultivated soils of different texture and organic matter content were collected in Quebec (Table 1). The soils were air dried, crushed and sieved to suit the particular analysis or experiment. Sub-samples for N-analysis and incubation studies were stored at 2–5°C prior to use. Organic carbon was determined by the Walkley-Black method \(^1\), total N (on < 100 mesh samples) by the salicylic acid modification of the semimicro-Kjeldahl method \(^3\), pH with a glass electrode in 0.01 M CaCl\(_2\) (soil:solution ratio 1:2), ammonium exchangeable with 2 N KCl and nitrate as extracted by saturated CaSO\(_4\) solution \(^4\). Ammonium and nitrate were determined colorimetrically on a Technicon Autoanalyser, respectively by the alkaline-phenol hypochlorite method \(^{11}\) and a modified Griess-Ilozvay method \(^4\) using hydrazine sulphate to reduce nitrate to nitrite.

**Plant growth experiment**

A growth chamber experiment was conducted to determine the yield and N uptake of Sudan-sorghum hybrid grass from soils with and without nitrogen fertilizer additions.

The experimental design was a split-plot with four replicates, with soils in the main plots and two treatments in the sub-plots, namely:  
A) adequate N, P, and K  
B) adequate P and K