Geoderma, 29 (1983) 77—80
Elsevier Scientific Publishing Company, Amsterdam — Printed in The Netherlands

Short Communication

ORGANIC NITROGEN IN POTASSIUM CHLORIDE EXTRACTS OF HISTOSOLS IN THE PHILIPPINES

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(Received February 9, 1982; accepted after revision June 17, 1982)

ABSTRACT

Sahrawat, K.L., 1983. Organic nitrogen in potassium chloride extracts of Histosols in the Philippines. Geoderma, 29:77—80.

Analyses of 2M KCl extracts of four Histosols (Tropohemists) in aerobic and anaerobic states showed that they contained significant amounts of organic N (21—102 mg N/kg of soil) but that the amounts were higher in anaerobic samples (following 4 weeks incubation under waterlogged conditions). It is suggested that the amounts of organic N extracted by KCl and other salt solutions should be taken into account along with mineral N estimation to avoid error in measuring potentially mineralizable N in Histosols of tropical lowlands.

INTRODUCTION

Nitrogen-supplying capacity of wetland rice soils plays a key role in N nutrition of rice even in well fertilized paddies because about 50 to 75% of the total N used by a rice crop comes from the soil mineral N pool (Broadbent, 1978). The N-supplying capacity of wetland rice soils is usually assessed by measuring NH_4^+ produced in soils under waterlogged conditions during short periods ranging from 6 to 14 days (Chang, 1978, Sahrawat, 1982). The measurement of NH_4^+ in flooded soils is thus an important component of such research programs.

Exchangeable NH_4^+ in soils is usually measured by extracting the samples with 2*M* KCl using a soil to KCl ratio of 1:10. The NH_4^+ in the filtered extracts is determined by distilling a suitable aliquot with MgO (Bremner, 1965b). In an earlier study, we found that direct distillation of samples of aerobic and anaerobic soils used for rice in the Philippines with MgO gave inflated values for exchangeable NH_4^+ due to hydrolysis of organic N at high pH's (9.9—10.7) due to the boiling of the MgO suspensions (Sahrawat and Ponnamperuma, 1978). Our preliminary observation also indicated that KCl extracts of some organic soils contained alkali-labile N.

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0016-7061/83/0000—0000/$03.00

The objective of work reported here was to estimate the contents of organic N in KCl extracts of 4 organic soils in aerobic and anaerobic states in the Philippines.

Apart from a report by Broadbent and Thenabadu (1967) who found that KCl and HCl extracts of humic acid preparations from some soils in California contained alkali-labile organic N, little information is available about the amounts of organic N extracted by salt solutions usually employed for extracting NH_4^+. However, this is important because organic N extracted by salt solutions can cause serious errors in estimation of potentially mineralizable N in soils.

MATERIALS AND METHODS

The soil samples were obtained from layers to a depth of 15 cm in Tropohemists at four locations in the province of Laguna, Philippines (Sahrawat, 1981). Some of their characteristics are given in Table I. Samples were air-dried and crushed to pass through a 2-mm sieve before use.

TABLE I

Some characteristics of the Histosols (Tropohemists)

Soil		pH (1:2 H_2O)	Organic matter (%)	Total N (%)
No.	Location			
1	Morong	5.65	22.0	0.65
2	Calauan	6.25	36.7	1.48
3	Lam Aw	6.10	39.0	1.20
4	Pangil	5.95	42.0	1.40

For the analyses reported in Table I, pH was measured by a glass electrode using a soil:water ratio of 1:2, organic C and total N determinations were made as described by Walkley and Black (1934), and Bremner (1965a), respectively.

2*M* KCl extracts of aerobic and anaerobic soil samples (after 4 weeks incubation of 10-g samples under waterlogged conditions with 25 ml water at 30°C) were prepared by shaking a 10-g sample with 2*M* KCl for 1 h in a wrist-action shaker, keeping a soil-to-solution ratio of 1:10. The suspension was filtered and the extract was analysed for contents of mineral and total N.

For the mineral N ($NH_4^+ + NO_3^-$) determination, a 20-ml aliquot from the extract was distilled with MgO and Devarda's alloy. The ammonia distilled was absorbed in a boric acid-indicator mixture and titrated with 0.04*M* H_2SO_4 (Bremner, 1965b). Total N in the extract was determined by transferring a 50 ml aliquot to a 800-ml kjeldahl flask and digesting with concen-

trated H_2SO_4 at low temperature initially to reduce the volume. The digestion was then carried out at high temperature after adding a K_2SO_4 and catalyst mixture (Bremner, 1965a). All analyses and experiments reported were done in duplicate.

RESULTS AND DISCUSSION

It was found that KCl extracts of the 4 Histosols samples in an aerobic state contained amounts of organic N varying from 21 to 85 mg/kg of soil (Table II). KCl-extractable organic N increased in the anaerobic soil samples following their incubation under waterlogged conditions for 4 weeks at 30°C. Organic N content in the anaerobic soil samples ranged from 29 to 102 mg/kg of soil. The mineral N (mainly NH_4^+) content of the aerobic soil samples ranged from 58 to 203 mg/kg of sample and it increased manyfold (221—483 mg N/kg) in anaerobic soil samples following waterlogged incubation (Table II). These results showed that in general KCl-extractable organic N content tended to increase following waterlogged incubation. This may be due to the fact that when soils are flooded low molecular weight, organic N compounds are synthesized (Ponnamperuma, 1972), which are probably extracted by KCl and are reflected in higher contents of organic N in the extracts prepared from anaerobic soil samples.

TABLE II

Amounts (mg/kg of soil sample) of mineral N, total N and organic N extracted by 2*M* KCl from samples of four Histosols in the aerobic and anaerobic states

Soil no.	Aerobic			Anaerobic		
	mineral N	total N	organic N*	mineral N	total N	organic N
1	58	79	21	221	250	29
2	108	152	44	483	538	55
3	183	238	55	273	339	66
4	203	288	85	472	574	102

*Organic N = Total N—mineral N ($NH_4^+ + NO_3^-$).

A recent report by Smith et al. (1980) has indicated that significant amounts of organic N were removed with the mineral
soils were incubated under aerobic conditions and the mineral N was periodically leached with 0.01*M* $CaCl_2$. These authors concluded that the common methods for aerobic N mineralization resulted in leaching and removal of significant amounts of organic N (13—163% of total mineralized N) and suggested that the amounts of organic N leached should be considered in order to avoid serious errors in the determination of N-mineralization potentials and mineralization rate constants for aerobically incubated samples. The

results of the present study provide further evidence that significant amounts of organic N are extracted by 2*M* KCl from samples of aerobic and anaerobic Histosols, the amounts being higher in samples from anaerobic soils. It is recommended that amounts of organic N extracted by KCl should be taken into account along with mineral N measurements to avoid errors in measuring potentially mineralizable N in Histosols of tropical lowlands.

ACKNOWLEDGEMENTS

I thank the International Rice Research Institute (IRRI), Los Baños, Laguna, Philippines for financial support and Dr. F.N. Ponnamperuma, Principal Soil Chemist, for his interest in the work.

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