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Influence of Organic Matter on Some Characteristics of Aquatic Soils

by

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Influence of Organic Matter on Some Characteristics of Aquatic Soils*

by

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Soil organic matter has long been of interest in studies of terrestrial and aquatic fertility. Agricultural workers have used soil organic matter to estimate certain fertility parameters. Quantities of nitrogen (JACKSON, 1958) and reserve or organic sulfur (BARDSLEY & LANCASTER, 1960) can be calculated with considerable accuracy from soil organic matter values. The cation exchange capacity (C.E.C.) of soils increases with increasing soil organic matter.

Organic matter-soil fertility relationships for agricultural soils are probably directly applicable to studies of natural terrestrial soils. Aquatic soils develop under considerably different conditions than terrestrial soils and the chemical characteristics of the organic matter may not be the same as those for terrestrial soils. The present study was initiated to determine if certain organic matter-soil characteristic relationships in pond soils were similar to relationships reported for agricultural soils.

MATERIALS AND METHODS

Soil samples were collected from 29 state owned public fishing lakes during the spring of 1968. At least one impoundment was located on each of the major physiographic regions of Alabama (HODGKINS, 1965). Lakes varied in size from 4 to 100 hectares and exhibited an array of morphometries. The impoundments ranged

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in age from 3 to 30 years. All lakes had a history of inorganic fertilization according to rates recommended by SWINGLE (1947). Several lakes had been drained and refilled one or more times.

Soil cores (5 to 10 cm deep) were taken from 10 to 12 locations within each lake. Cores were combined to constitute a sample. Soils were air dried and pulverized in a mortar and pestle to pass a 20 mesh screen. Samples for organic matter analysis were further pulverized to pass a 60 mesh screen.

Organic matter was estimated by the Walkley – Black method (ALLISON, 1965). Kjeldahl nitrogen, C.E.C. and exchangeable calcium, magnesium, and potassium and dilute acid extractable phosphorus were determined by techniques outlined by JACKSON (1958). Reserve sulfur (total sulfur minus sulfate sulfur) analyses were made according to BARDSLEY & LANCASTER (1960). Analyses were generally performed in duplicate. Only 15 samples were selected for C.E.C. and exchangeable cation determinations.

RESULTS AND DISCUSSION

Relationships between organic matter and nitrogen, reserve sulfur and C.E.C. are presented in Fig. 1. Organic matter levels were rather low (range 0.37 to 6.42 %), but the values were higher than organic matter contents of most Alabama agricultural soils (MILLAR, 1955). Since the lakes had received fertilization and were very productive, higher organic matter levels were expected. Even samples taken from a series of experimental ponds on the Alabama Agricultural Experiment Station which had received high rates of fertilization or supplemental feeding for 15 to 20 years contained only 2 to 6 % organic matter. Additions of nitrogen and phosphorus over the years apparently accelerated microbial activity and little organic matter accumulated. In fact, fertilization of old ponds on previous soils in southern Alabama resulted in mineralization of accumulated organic matter that had served to seal the basins and the ponds drained by permeation (H. S. SWINGLE, personal communications).

Correlation coefficients between organic matter and nitrogen, reserve sulfur and C.E.C. were highly significant. Organic matter x 0.05 has been widely used to estimate organic nitrogen (JACKSON, 1958). This factor was equally valid for samples in the present study. The relationship between organic matter and sulfur content for the pond soils was similar to that reported for terrestrial soils (WALKER, 1955). A high degree of correlation was reported between organic nitrogen and sulfur, the ratio nitrogen/sulfur usually being between

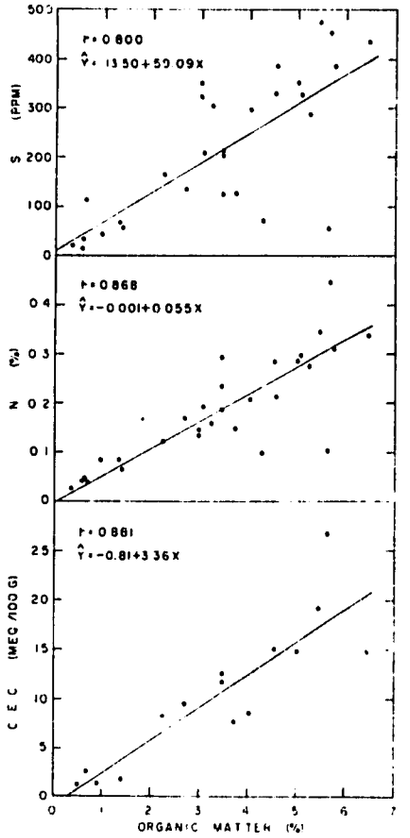

Fig. 1. Relationships between soil organic matter and organic sulfur, Kjeldahl nitrogen, and cation exchange capacity in hydrosoils.

7 and 11 (BARDSLEY & LANCASTER, 1960). Results for samples from Alabama impoundments were in close agreement (Fig. 2).

C.E.C. values for soil associations on which the lakes are located range from 1.8 to 4.9 meq./100 g dry soil (MILLAR, 1955). Organic matter can be assumed to have a C.E.C. of 200 meq./100 g and the exchange capacity of a soil increases by about 2 meq./100 g for each 1% increase in organic matter (BUCKMAN & BRADY, 1960). This generalization appeared to be fairly valid for samples in the present study (Fig. 1). The cation exchange of most soils will not approach zero when organic matter contents are very low since the soils will contain clay colloids that also contribute to the C.E.C. The lake soils with low organic matter values were composed almost entirely of sand, so the entire exchange capacity was due to organic matter.

Lake soils containing above 2% organic matter usually had C.E.C. levels from 2 to 6 meq./100 g above the values attributable to organic matter. This difference is of about the same magnitude as the C.E.C. of low organic content agricultural soils in Alabama and is related to the clay content.

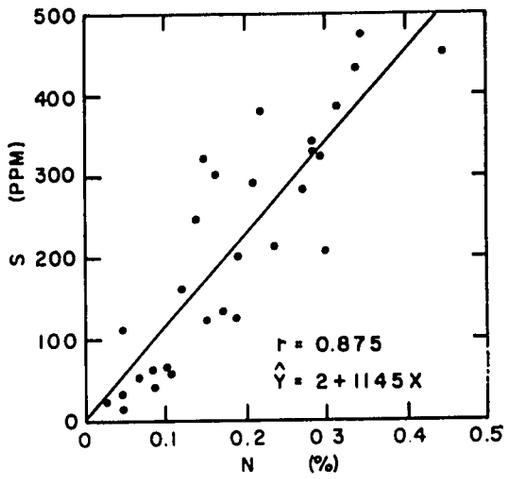

Fig. 2. Relationship between Kjeldahl nitrogen and organic sulfur in hydrosoils.

Correlation coefficients between organic matter and calcium and potassium were significant (r = 0.524 and 0.733, respectively). Magnesium content (r = 0.372) and dilute acid extractable phosphorus levels (r = 0.200) were not correlated with organic matter values.

These findings revealed that some of the relationships between organic matter and other soil properties for agricultural soils are equally valid for hydrosoils of Alabama impoundments. The results are from a narrow range of relatively low organic matter levels and should be used with caution for hydrosoils of higher organic content. More extensive data from other physiographic regions would be helpful.

Summary

Analyses of hydrosoils from 29 Alabama impoundments revealed that relationships between soil organic matter and organic nitrogen, organic sulfur and cation exchange capacity were similar to those for agricultural soils. Therefore, much of the data for agricultural soil organic matter should be applicable to studies of hydrosoils.

Zusammenfassung

Die Analyse aquatischer Erde von 29 künstlichen Teichen in Alabama zeigt, daß zwischen organischen Erdstoffen und organischem Nitrogen, organischem Sulfur und Cation-Austausch-Inhalt eine Verwandtschaft herrscht, ähnlich wie in der Agrikulturerde. Aus diesem Grunde können Angaben für organische Stoffe in der Agrikulturerde auch für Studien der aquatischen Erde verwendet werden.

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