

RELATIONSHIP IN SOILS OF TOTAL NITROGEN, TOTAL REPLACEABLE BASES AND PRODUCTIVITY

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A critical study of the productivity of soils in relation to total nitrogen content must necessarily involve a consideration of a number of other soil factors. Total nitrogen in soils is very closely related to total organic carbon, which in turn is proportionately related to total organic matter, and organic matter in soils is related to physical condition, water-holding capacity, color and other soil conditions, all of which are closely associated in soils and may influence productivity.

Soil reaction, that is acidity or alkalinity, is always considered in connection with productivity and is closely related to the active bases in soils, which in this region are composed mainly of calcium and magnesium.

Generally speaking, those mineral soils which have a relatively high nitrogen content are among the more productive soils. Productivity is usually found to be in almost direct proportion to the amount of total nitrogen in the surface layer. W. McLean¹ has suggested that either total nitrogen or total organic carbon be used as an index of fertility for soils of the same general region.

The following study was conducted in order to determine the relationship that might exist between total nitrogen, total replaceable bases ($\text{Ca} + \text{Mg}$) and the productivity of soils on 12 widely distributed Illinois experiment fields. The soils upon which these fields are located represent considerable variation in soil type, and soil maturity, and some small climatic variation. The soils used in these chemical analyses represent the untreated check plots which contain only the native fertility, and the corn and wheat yields were averaged from the same untreated plots.

The reaction of these soils ranged from pH 4.7 to pH 8.0 and the total nitrogen varied from approximately 1,000 pounds up to 5,000 pounds an acre. The replaceable total bases varied from approximately 700 pounds up to 3,300 pounds an acre. The long-time average corn yields

varied from 10 bushels an acre up to 58 bushels an acre. The wheat yields varied from approximately 3 bushels up to 20 bushels an acre. The chemical composition of the soils as well as of the crop yields represent values of rather extreme variation; however, the low crop yields were on soils with low nitrogen and low base content, and the high crop yields were on soils with relatively high nitrogen and high base content, as shown graphically in Fig. 1.

On soils with a relatively low total nitrogen content the crop yields apparently correlated more closely with the replaceable base content of the soils, as illustrated by the results plotted in Fig. 1.

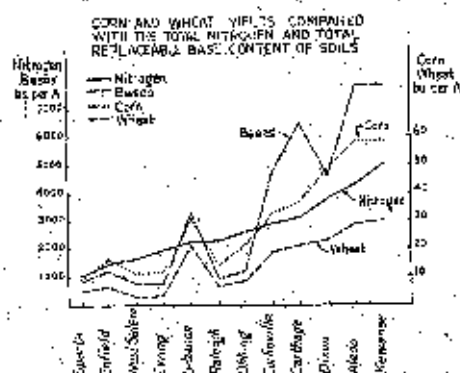


Fig. 1. Relationship between total nitrogen and total bases in soils and the production of corn and wheat on twelve experimental fields.

from the Sparta, Enfield, West Salem, Ewing, Lebanon, Raleigh, and Orling fields. On this group of fields the total nitrogen ranged from approximately 1,000 pounds at Sparta to 2,600 pounds an acre on the Orling field, and the base content varied from approximately 700 pounds up to 3,200 pounds an acre. On the remaining fields, Carlinville, Carthage, Dixon, Alledo, and Kewanee the total nitrogen ranged from 2,800 pounds at Carlinville to approximately 5,000 pounds an acre on the Kewanee field and the total base con-

¹ The carbon-nitrogen ratio of soil organic matter. Jour. Agr. Sci. 30: 237, 1930.

tent varied from approximately 4,500 pounds up to 7,200 pounds an acre. On this latter group of fields with a relatively high nitrogen content the corn and wheat yields followed rather closely the upward trend of the nitrogen curve and apparently were not greatly affected by fluctuations in the amounts of total bases in the soil as illustrated by the curves.

SUMMARY

It is apparent from these results that the total nitrogen content of soils when

considered alone may not always be a reliable gauge to their fertility and finally to their productivity. Soils which are relatively low in total nitrogen and total bases are apparently influenced in the production of corn and wheat by the total base content as well as by the nitrogen content. Soils which are relatively high in total nitrogen and total bases produce corn and wheat in yields per acre which are somewhat closely related to the total nitrogen content of the surface layer of soil.
