PHOSPHORUS FIXATION AND THE ASSIMILATION OF FIXED PHOSPHATES
FRANK MOSER

Annual applications of phosphate fertilizer to lateritic soils have not appreciably affected the available phosphorus content, but each soil tends to approach a constant level of available phosphorus. Fixation is evident as the phosphorus removal by the increased crop growth does not account for the difference between the fertilizer additions and the available supply in the soil. Recent (11) studies on several soil types used for cotton fertilizer experiments in South Carolina corroborate the fact that the available phosphorus content, determined by the Truog and rapid test methods, remains approximately at the same level where normal fertilizer applications have been used annually.

Fixation of phosphorus by soil is the conversion of the soluble phosphate to a less soluble form. The process is influenced largely by the pH of the soil and by active cations predominating in the colloidal complex, while the mass-law equilibrium reaction is undoubtedly responsible for maintaining a constant level of available phosphorus.

Numerous methods have been proposed for studying phosphorus fixation in soil. Chemical methods have been employed by such workers as Fraps (4), Ford (5), Heck (7), Scarseth and Tidmore (13), and Hibbard (8), while electrodialysis has been suggested by McGeorge (9), Harper (6), and Dean (3). Inasmuch as all of the methods are rather empirical and no method has been definitely accepted, this study was begun to obtain further information on electrodialysis as a means of determining the nature of the phosphorus complex of soils through the release of phosphorus and accompanying cations.

Plant and fungi cultures were grown and analyzed for total phosphorus assimilated during their growth period to determine the available plant phosphorus supply of the soil.

PROCEDURE

Surface soil samples of Lloyd clay loam, Cecil sandy loam, and Orangeburg fine sandy loam, used for cotton fertilizer experiments at Greer, Gaffney, and Florence, South Carolina, which had received 0, 60, and 160 pounds of P₂O₅, respectively, were passed through a 60-mesh sieve for the soil cultures. Fifty grams of soil were electrodialyzed in a field three-compartment cell for a period of 120 hours, while a portion was passed through a 20-mesh sieve for the plant and fungi cultures. The fungi cultures were determined by the soil plaque method, as proposed by Mehlich (10). Available phosphorus of the soils was determined by the Myer (15) method, and phosphorus fixation by the method proposed by Heck (7).

Calcium, magnesium, potassium, iron, and aluminum were determined in each of the composited cathode diffusates by the official methods (1), while phosphorus was determined in the anode diffusates by the Deniges' colorimetric method. Volumetric methods were used for calcium and magnesium, while potassium was estimated by the sodium-cobalt nitrite method. Iron and aluminum were precipitated with NH₄OH and weighed as mixed oxides. Iron was determined volumetrically and then the aluminum calculated by difference.

The soil cultures were prepared in duplicate by adding 250 grams of soil in 250 ml containers. Twenty sorghum seedlings were grown in each culture for a period of 30 days. The entire plants were harvested by gently washing the roots from the roots. The plant material was oven-dried and ashed with magnesium nitrate after which total phosphorus was determined by the official method. Analysis of several lots of sorghum seeds were made and proper correction applied for this source of phosphorus in order to obtain the exact amount supplied by the fertilizer.

PHOSPHORUS FIXATION AS INDICATED BY ELECTRODIALYSIS

The results of the electrodialysis of soil samples with phosphate fertilizers have been applied and are shown in Table 1. The data include the M.E. of phosphorus released during the first forty-eight-hour period, and for a second period, 48-120 hours. All data are also expressed as M.E./100 grams of soil.

A more complete study of the behavior of phosphorus fixation is possible as these periods of electrodialysis vary, since phosphorus fixation is possible as these periods of electrodialysis vary, since phosphorus fixation occurs throughout the period of electrodialysis.