EFFECT OF CERTAIN SOIL TREATMENTS ON THE CATION EXCHANGE PROPERTIES AND ORGANIC MATTER CONTENT OF DUNMORE SILT LOAM

C. I. Rich and S. S. Obenshain

The Virginia Agricultural Experiment Station at Blacksburg has conducted an uninterrupted field experiment since 1914 to determine the effect of various soil treatments on crop yields. Progress reports (8, 9, and 38) on this work have been published. In addition, Elson (4) has recently studied soil aggregation on these same field plots.

The purpose of this study was to determine the effects of manure and certain fertilizer treatments on the pH, organic matter content, and cation exchange properties of the soil of these 26-year old rotation and continuously cropped plots.

MATERIAL AND METHOD OF PROCEDURE

DESCRIPTION OF PLOTS

In 1909, 14 plots were laid out on the Virginia Agricultural Experiment Station Farm at Blacksburg. Thirteen of these plots (plots 2 to 14) consist of four ½-acre subplots which accommodate a 4-year rotation consisting of corn, wheat, clover hay, and timothy and red top hay. The four subplots of plot 1, which are also ½-acre in size, accommodate the following crops which are grown continuously on the same land: (a) Corn; (b) wheat; (c) timothy and red top hay, reseeded every second year; (d) continuous grass.

The treatments which these plots have received are given in Table 1. However, these treatments have not always been the same, so the changes made in fertilizer treatment during the progress of this experiment will be described briefly.

On plots 4 and 11, no fertilizer was applied until 1914, at which time the four subplots of each plot were divided in half. The south half received the fertilizer treatment indicated in Table 1 from 1914 to the present, while the north half continued to receive no fertilizer. Between 1909 and 1914 all plots except Nos. 4 and 11 received the fertilizer treatment indicated in Table 1, except that the same quantity of fertilizer now applied only on the south half of each subplot was then applied to the whole subplot.

Since 1914, the experiment has continued without interruption, except that in 1933 ammonium nitrate replaced dried blood as a source of nitrogen. With the exception of plots 4 and 11, one-half of each subplot has received no fertilizer for 26 years, while the other half has received fertilizer for 31 years. The same conditions occur on plots 4 and 11, except that one-half of each subplot has not been fertilized since the beginning of the experiment in 1909. Ground limestone was applied at the rate of 2 tons per acre on the whole experimental area every 4 years, the last application having been made in the spring of 1940.

These plots are located on Dunmore silt loam, a soil which has developed from material weathered from dolomitic lime-

METHOD OF ANALYSIS

The pH and organic matter determinations were made by Mr. Elson. Soil reaction was determined with a glass electrode, using a 1:2 soil-water ratio. Organic carbon was calculated from the total carbon determinations, found by wet oxidation from chromic acid, according to Tuin (33).

A modification of Parker’s method (20) for exchangeable hydrogen was used, in which 250 cc of normal, neutral ammonium acetate was leached through 10 grams of soil containing 0.05 N sodium hydroxide. Exchangeable hydrogen was calculated from the difference in titration value.

The cation exchange capacity was calculated as the quantity of barium absorbed by the soil in the exchange hydrogen determination according to a modification of the method of Prince and Toth (22). Instead of determining barium gravimetrically as the sulfate, a volumetric procedure was followed. After removal of iron and aluminum, barium was precipitated as barium chromate and determined gravimetrically according to Scott (30, pages 65 to 66).

Exchangeable calcium, magnesium, and potassium were removed from the soil by leaching with neutral ammonium acetate. The advantages of ammonium base exchange work have been pointed out by Schollenberger and Dreibelbis (29). In the cases of exchangeable calcium and magnesium, 10 grams of soil were leached with 500 cc of the ammonium acetate solution. The leachates were evaporated to dryness and treated with hydrogen as outlined by Volk and Truog (34). In the case of exchangeable potassium, 500 cc of the ammonium acetate solution. The leachates were evaporated and potassium was precipitated as potassium permanganate solution to Hillebrand and Lundell (6, pages 501 to 509). Ammonium salts were removed from the filtrate remaining in the leachate for the potassium determinations, ammonia was precipitated as magnesium ammonium phosphate and then precipitated as magnesium ammonium phosphate determined volumetrically as outlined by Wright and Dreibelbis (35).

Potassium was precipitated as potassium silver nitrate and determined by titration with potassium silver nitrate according to the method outlined by Wilson.

The data reported here are averages for the four plots of each of which represents the duplicate determinations.

SOIL SAMPLING

tember, 1940, by means of a core sampler 3 inches in diameter to a depth of 6 inches from three locations on each subplot. The soil from the three locations was air-dried and analyzed for analysis according to the method outlined by Wilson (26).