The Residual Effects of Phosphates Used on Long-Time Field Experiments

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Crops grown on low-phosphate soils in the humid region ordinarily show immediate response to applications of phosphate fertilizers. Fertilizer recommendations for field crops on these soils usually call for an application of phosphate fertilizers once in each rotation, the phosphate being applied to the crop which shows greatest response. Subsequent crops in the rotation receive their phosphorus from what is left after the first crop has been grown. As more phosphates are applied in succeeding rotations, the phosphorus content of the soil will build up somewhat. If fairly liberal amounts are applied, yields may not build up significantly after the first or second rotation.

If after several rotations the use of phosphate fertilizers is discontinued, crop yields and the phosphorus content of the crops will begin to decline, slowly at first, but steadily until they approach those of the untreated soil. The rate of decline is dependent on the soil, the amount of fertilizer used, the cropping system, and the general fertilizer and soil management practices of the farmer.

It is the purpose of this investigation to determine how residual phosphorus builds up and behaves in soil and how readily it may be used by succeeding crops.

FIELD EXPERIMENTS

There are five long-established experiment fields in Kentucky. Three of these, at Berea, Greenville, and Mayfield, were started in 1913. The Fariston field was started in 1916, and the Campbellsville field in 1919. The soils of these fields, low in total and available phosphorus, show a strong response to applications of phosphate fertilizers and a further strong response to lime and manure. Data from these fields have been reported from time to time, most recently in bulletins 397 and 485 (1, 2).

These fields are fairly representative of extensive areas of low-phosphate soils in the state. The soil of the Berea field has been given the field name of Tyler silt loam. It is derived from the calcareous shales of the Waverly formation. The Mayfield field is a Grenada silt loam derived from the loessial deposits along the Mississippi river.

A 4-year rotation was used on all fields, one at Campbellsville, where a 3-year rotation has been used on certain plots of all the fields. There have been slight changes in rotations from time to time, but at present they consist essentially of 1 year, wheat 1 year, mixed grass and legumes 1 year, and hay 1 year at Campbellsville).

Lime, manure, and phosphate and potash fertilizers have been used on certain plots of all the fields, as well as on plots where phosphate fertilizers were discontinued on other plots. At the same time at Campbellsville, for the purposes of the phosphate experiment, the use of phosphate fertilizers was discontinued on several plots. Table 1 shows the amount of phosphorus in pounds per acre on these plots and half plots from the time they were started.

It will be noted that at the Berea, Greenville, and Mayfield fields nearly twice as much phosphate has been used on those plots that have continued the rotation beginning in 1931. At Campbellsville, on the other hand, some over 30% more phosphate has been used on plots where phosphate fertilizers were discontinued than on those where it was continued. This is due to the higher rates used in the early work at this field. All fields have gone through 8 to 10 rotations.

Table 2 gives a general idea of the composition of the soils at the different fields. All are strongly acid and low in total and available phosphorus. The pH of limed plots at the different fields will average about 6.0 at the present time.