The Release of Artificially Fixed Potassium from a Kaolinitic and a Montmorillonitic Soil

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Adequate proof of the existence of the phenomenon of potassium fixation has been well established by a number of workers, among whom are Wood and DeTurk (10), Bray and DeTurk (1), Hoagland and Martin (4), Volk (9), Page and Baver (6), Truog and Jones (8), and Hoover (4), but quantitative data are lacking on the subsequent release of artificially fixed potassium in southern soils of known clay mineral type.

It is the object of this paper to present quantitative data on the release of fixed potassium in two soils whose fine clay mineral fraction are known to be predominately montmorillonitic and kaolinitic, respectively.

EXPERIMENTAL PROCEDURE

SOILS STUDIED

Soil samples were taken from the C horizon of Susquehanna and Orangeburg profiles, respectively. These two soils were used because it is known from previous work by Coleman (3) that the fine clay fraction is predominately montmorillonite for the former and kaolinite for the latter.

CHEMICAL METHODS

Artificial fixation.—Each soil was air dried and screened through a 20-mesh sieve, after which potassium was added as KCl to the montmorillonitic soil at rates of 2,160 ppm and 9,960.7 ppm, respectively, and to the kaolinitic soil at rates of 400 ppm and 1,589.4 ppm, respectively. The higher addition for each soil represented one symmetry. After potassium additions, the moisture content of the soils was raised to field capacity and the samples were stored at room temperature for 1 month. After this 1 month period of storage, three samples from each treatment were air dried and three were leached directly to determine the effect of air drying on fixation. Samples of these same two soils studied by Hoover (5) which had been treated with varying amounts of KCl and K$_2$HPO$_4$, and stored at room temperature for approximately 4 years, were also used in these potassium release studies.

The leaching reagent was neutral normal ammonium acetate. The potassium thus removed from soil to which no potassium had been added was designated as native exchangeable potassium, and it was assumed that this native exchangeable potassium was included in all ammonium acetate extractions of potassium from soils to which potassium had been added.

For the sake of clarity in this paper, artificially fixed potassium may be represented by the following formula:

\[ \text{Artificially Fixed K} = A - (b - c) \]

where \( A \) = potassium added, \( b \) = potassium available potassium, and \( c \) = exchangeable potassium (ppm) removed from untreated soil. Artificially fixed potassium may be represented by the following formula:

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DISCUSSION OF RESULTS

ARTIFICIAL FIXATION

Large amounts of potassium were fixed by the montmorillonitic soil even though they were added for only one month.

Fifty-seven per cent of the 2,160 ppm and 70 per cent of the 9,960.7 ppm added potassium was fixed by samples which were air dried after the period of moist storage; whereas, only 23 per cent of the 2,160 ppm was fixed when the samples were air dried before leaching, 56 per cent of the 9,960.7 ppm was fixed when the samples were air dried before leaching, 56 per cent of the 9,960.7 ppm was fixed when the samples were stored moist after the period of moist storage. For the soils treated and held moist at room temperature for approximately 4 years, the samples were then ready to be stored until the next leaching time.

Thirty-four per cent of the 9,960.7 ppm added potassium was fixed by samples which were stored moist after the period of moist storage; whereas, 26 per cent of the original content was fixed when the soil was air dried before leaching, 56 per cent of the original content was fixed when the soil was air dried before leaching, 56 per cent of the original content was fixed when the soil was air dried before leaching, and 26 per cent of the original content was fixed when the soil was air dried before leaching.