The Influence of Temperature and Moisture Variation in Storage Upon Soil Test Values for Potassium[1]

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Abstract

Ten cycles of rewetting and drying two soils once each 72 hours significantly (1 per cent level) reduced soil test values for available potassium as compared with continuous air-dry storage at the same temperature (approximately 21° Centigrade) and for the same time. The reduction was 21.7 per cent for Ragsdale silty clay loam and 11.5 per cent Crosby silt loam. Storing rewetted Ragsdale soil at either 2° or at —23° Centigrade for 36 hours followed by storage at 21° Centigrade for 36 hours for 10 cycles of rewetting and drying further significantly reduced (1 per cent level) available potassium values.

Introduction

In studying soils in drying and rewetting cycles, Agarawal, Singh, and Kanehiro (1) showed that temperature of soil was important in nitrogen (N) and carbon (C) mineralization and therefore in microbial activity. Burns and Barber (3) stated that the higher the temperature in soils, the greater was the release of nonexchangeable potassium (K) to the exchangeable form. Khanna and Datta (6) found that wetting soil samples increased the amount of easily exchangeable K in most cases, and on drying these wet samples, this increase was further enhanced. In growth experiments Walsh and Collman (7) found that K was temporarily fixed by alternate wetting and drying. However, in their pot experiments with mustard, they found that in the second crop this temporarily fixed K was liberated resulting in greater growth. In other greenhouse experiments, Barber *et al.* (2) found that drying soil before it was used to grow millet caused an increase in the availability of K. The millet growing in field-moist soil had a greater response to K fertilizer than that growing in air-dry soil. However, in selected soil samples from Indiana, Hanway *et al.* (4, 5) found that this difference between moist and air-dry soil in the surface horizon was small.

The purpose of this experiment was to determine the influence of different cycles involving moisture and temperature variations upon the available K test of soil samples. It was thought that freezing would increase the available K test values.

Methods and Procedure

Previously mixed, air-dried, and screened 450 g samples of a Ragsdale silty clay loam (Typic Argiaquoll) and a Crosby silt loam (Aeric Ochraqualf) were subjected to 10 consecutive cycles of 4 different treatments, the first part of which varied as follows: 1) storage for 36 hours in a greenhouse at approximately 21°C; 2) rewetting to saturation and storage for 36 hours in a greenhouse at approximately 21°C; 3) re-

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wetting to saturation and storage for 36 hours in a walk-in refrigerator at 2°C; and 4) rewetting to saturation and storage for 36 hours in a walk-in freezer at —23°C. The rewetting of all cycles was done with Purdue tap water.

The second 36 hours of each cycle was the same for all treatments—storage in the greenhouse at approximately 21°C during which thawing and/or drying of soil occurred.

To prepare the soils for testing, all samples were air-dried in a greenhouse at approximately 21°C, ground to pass a 2 mm screen, and tested for available K by the Purdue Soil and Plant Analysis Laboratory. A 1:3 ratio of soil to neutral normal ammonium acetate was used and the mixture was shaken 2 min and filtered. Two ml of filtrate were then diluted with 8 ml of neutral normal ammonium acetate and read on an atomic absorption spectrophotometer.

TABLE 1. *Influence of temperature and moisture treatments of stored soils upon Purdue soil test values for available potassium.*

	Lbs/Acre of avail. K and K test level	
Treatments[1]	Ragsdale silty clay loam	Crosby silt loam
21° drying in greenhouse, then 21°C drying in greenhouse	249 (High)	278 (High)
21°C rewetted, stored in greenhouse, then 21°C drying in greenhouse	195 (Medium)	246 (High)
2°C rewetted, stored in refrigerator, then 21°C drying in greenhouse	177 (Medium)	238 (High)
—23°C rewetted, freezing in deep freeze, then 21°C drying in greenhouse	177 (Medium)	229 (High)
Average of all treatments	206 (Medium)	248 (High)
Least Significant Difference .05	12	11
Least Significant Difference .01	16	15

[1]One cycle of each treatment took approximately 72 hours which was approximately evenly divided between the first and the second part of each treatment.

Results and Discussion

As compared to the continuous air-dry treatment in a greenhouse at 21°C, rewetting the soil once each 72 hours and storage at approximately 21°C for 10 cycles of rewetting and drying resulted in a 21.7% lower available K value with Ragsdale soil and a 11.5% lower available K value with Crosby soil (Table 1). Rewetting and storing the Ragsdale soil at either 2°C or at —23°C for 36 hours followed by storage at 21°C for 36 hours for 10 cycles of rewetting, freezing and/or drying resulted in a significant (1% level) reduction in available K. This reduction was equal to 9.2% of the amount of available K of the 21°C rewetting and drying cycle. Rewetting and storing (and freezing) the Crosby soil at —23°C for 36 hours followed by storage at 21°C for 36 hours for 10 cycles of rewetting, freezing and drying also resulted in a significant (1% level) reduction in available K. This reduction was equal to 6.9% of the total amount of available K of the 21°C wetting and drying cycle. These results tend to support the research of Walsh and Collman (7) in that available K was fixed (at least temporarily) by alternate wetting and drying.

As compared to air drying, the wetting and drying cycles changed the K soil test level of the Ragsdale soil from high to medium. However, in the Purdue Soil and Plant Analysis Laboratory soil samples are not routinely dried as much as those which were continuously air-dried in this experiment. Furthermore, soil samples never become this dry in cultivated fields in Indiana. This experiment does show, however, that available K test values of certain soils can be changed by continuous air-drying as compared with wetting and drying at room temperature (21°C), as in long-time storage.

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