Effects of Sampling Time and Extraction Method on Soil-Test and Nonexchangeable Potassium in Iowa Soils

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ABSTRACT

More research is needed to better understand K cycling and high short-term temporal soil-test K (STK) variation. The objective of this research was to study soil-test K and nonexchangeable K pools across Iowa soils managed with corn-soybean rotations as affected by K application rates, soil properties, parent materials, and time of sampling. Three-year field trials that included a control and several broadcast K fertilizer rates were conducted at 35 Iowa sites. Soil samples (6-inch depth) were taken at harvest, late fall before soils froze, and in the spring before planting crops. Soil was analyzed for STK with the ammonium-acetate method using dry and field-moist sampling handling procedures and for nonexchangeable K by the Na tetraphenyl-boron method (TPBK). The sites were summarized into four groups with contrasting soil parent material and internal drainage. The groups were Northern (poor drainage formed in glacial till), Western (moderate to well drained formed in loess), Southern (moderate to poor drainage formed in loess), and Northeast (well drained and formed in silty or loamy till sediments on underlying loess). Soils were naturally low in K except for those in the Western group. Results for time of soil sampling showed inconsistent differences in K pools across sampling dates and site groups, although K measured by the dry STK method tended to show higher temporal variation than for moist STK and TPBK methods. The dry/moist STK ratio was largest for low-testing soils and decreased towards a 1:1 ratio with STK values higher than the boundary between the high (H) and very high (VH) Iowa STK categories for the dry method (240 ppm). The dry/moist STK ratio was higher for the Northern group, ranging from 2.9:1 for the very low and low (VL-L) categories (<160 ppm) to 1.3:1 for the H-VH category (>200 ppm), than for the other groups, which on average ranged from 1.8:1 for VL-L to 1.0:1 for H-VH. The TPBK/dry STK ratios decreased as the dry STK increased for most site groups (on average 3.0:1 for VL-L to 2.4:1 for H-VH) but for the Northern group the ratio slightly increased (2.1:1 for VL-L to 2.4:1 for H-VH). The additional STK measured by the dry method compared with the moist method was much larger for the Northern group, which suggests that drying releases proportionally more nonexchangeable K than for other groups. The TPBK/moist STK ratio decreased with increasing STK for all groups but was more noticeably for the Northeast group (4.6:1 for VL to 1.8:1 for VH) than for other groups (5.8:1 for VL-L to 2.9:1 for H-VH). Therefore, in these well drained soils, K fertilization and removal over time has resulted in a relatively greater increase of the exchangeable K pool. We conclude that soil sample drying interacting mainly with soil drainage and parent material can greatly affect the dynamics between soil K pools. Previous Iowa research showed that the moist K test provides better estimates of K sufficiency for crops than the dry method, especially in highly productive soils with moderate to poor drainage.