PROFILE DISTRIBUTION OF AVAILABLE POTASSIUM IN DES MOINES LOBE SOILS

John Kovar and Doug Karlen
USDA Agricultural Research Service
National Laboratory for Agriculture and the Environment
Ames, Iowa

Abstract

Plant potassium (K) concentrations and soil fertility evaluations to predict available K have received renewed attention during the past few years due to increasing interest in harvesting crop residues as feedstock for production of bioenergy and other bio-products [e.g., button mushroom (*Agaricus Bisiporus*) compost]. Interest in K crop nutrition has also increased as more producers adopt reduced or no-tillage production practices. This latter situation is not new, because the potential for K deficiencies under reduced tillage corn (*Zea may*s L.) production systems is a well-documented soil fertility problem, attributed primarily to stratification of plant-available K in surface horizons. Generally, the amounts of plant-available K in subsurface horizons have been ignored because the amount of active plant roots in those zones was considered to be relatively small and because it would be very difficult to fertilize subsoil. However, recent research has shown that the root systems of more drought tolerant corn hybrids tend to grow deeper into the profile when surface water becomes limiting. Due to more erratic weather patterns during the past decade, water stress has become more common in central Iowa. Corn plants accumulate most of their K during the exponential growth phase. Therefore, if a substantial portion of the soil water being taken up during that time is coming from the subsoil, it is possible that the plants are not getting sufficient K for optimum growth and development. This hypothesis is based on several years of plant tissue analysis at both the V6 and R2 growth stages that have indicated low K levels even though fertilization rates and surface soil-test values were within an optimum range.

To test this hypothesis, we quantified the amount of exchangeable K to a depth of 1.0 to 1.2 m in 1116 samples of Des Moines Lobe soil collected during an eight-year period (2005-2012) from research sites being used for corn and soybean [*Glycine max* (L.) Merr.] studies at four locations in central Iowa. Three sites were located in Boone County and one site was in Palo Alto County. At each location, samples were collected in 0 to 15-, 15 to 30-, 30 to 60-, 60 to 90-, and 90 to 120-cm increments. Samples were air dried, crushed to pass a 2-mm sieve, and extracted with either 1.0 N ammonium acetate at pH 7.0 or Mehlich III extracting solution. The concentration of K in the extracts was determined, using inductively coupled plasma (ICP) emission spectroscopy.

Our preliminary analysis showed that in surface (0-15 cm) soil, mean exchangeable K varied from 119 to 164 mg kg^{-1}. Based on Iowa State University recommendations, only the site with the highest K level would be rated as having an optimum level (161-200 mg kg^{-1}) for crop production. The other sites were rated as having low K availability. At deeper soil increments, exchangeable K concentrations tended to decrease even further, ranging from 86 to 129 mg kg^{-1}

at the four locations. These results suggest that roots growing into the subsoil will not encounter an abundant supply of plant-available K. Because both the soil parent material and crop production practices at the four locations were similar, exchangeable K concentrations in the subsoil did not vary among the sites. Furthermore, soil pH values below the 15-cm depth were generally above 7.0, and exchangeable calcium (Ca) and magnesium (Mg) concentrations were very high. These initial results support our hypothesis that K acquisition by plant roots, especially those in subsurface soil, may also be hindered by excessive soil solution concentrations of Ca and Mg relative to K. We conclude that for successful crop production on Des Moines Lobe or similar soils, more attention must be given to K management and that this essential nutrient should no longer be neglected.

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PROGRAM CHAIR:
James L Camberato
Purdue University
915 W State St.
West Lafayette, IN 47907
(765) 496-9338
jcambera@purdue.edu

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International Plant Nutrition Institute
2301 Research Park Way, Suite 126
Brookings, SD 57006
(605) 692-6280
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