ION-SELECTIVE ELECTRODES FOR SIMULTANEOUS REAL-TIME ANALYSIS OF SOIL MACRONURIENTS

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ABSTRACT

Automated sensing of soil macronutrients (i.e., N, P, and K) would allow more efficient mapping of soil nutrient variability for variable-rate nutrient management. This study reports on the development of a sensor array consisting of three different ion-selective electrodes (ISEs) for simultaneous determination of soil macronutrients. The sensitivity and selectivity of PVC membrane-based ISEs with tetradodecylammonium nitrate (TDDA) and valinomycin for sensing nitrate and potassium, respectively, and of cobalt rod-based phosphate ISEs were satisfactory for measuring N, P, and K ions over typical ranges of soil concentrations. The nitrate ISEs, when used in conjunction with the Kelowna extractant (0.25M CH_3COOH + 0.015M NH_4F), provided soil NO_3-N values similar to those obtained with standard methods (i.e., automated ion analyzer and 1M KCl extractant). However, the soil K values obtained with the K ISEs and Kelowna extractant were about 50% lower than those obtained with an ICP spectrometer and Mehlich III extractant due to decreased K extraction by the Kelowna solution. The ISE-P values for soil were about 63% lower than ICP-P values (ICP and Mehlich III) due to both decreased P estimates in soil extracts by cobalt electrodes and reduced P extraction by the Kelowna solution. Nevertheless, strong linear relationships ($r^2 > 0.78$**) existing between the two methods would make it possible to use the K and P ISEs for soil K and P sensing.