The possibility of determining nitrate concentration in soil pastes using mid-infrared attenuated total reflectance (ATR) spectroscopy has been demonstrated by several laboratory studies. If these results, which were obtained under laboratory conditions, could be reproduced under field conditions, such a sensor would be a significant step toward direct determination of nitrate content in the field. A major limitation of the previous studies is that the soil pastes were obtained by adding a pre-determined amount of water to oven-dried soil, so that standardization of the paste moisture content was achieved. While such a procedure is common for laboratory analysis, it is unsuitable for direct field determination. The approach reported in the present work overcomes this difficulty, and shows that the same FTIR/ATR technique can be used to determine both moisture and nitrate content of soil samples without the requirement of additional or special equipment.

Moisture and nitrate content are determined sequentially by FTIR/ATR measurements of two sub-samples. The first measurement involves a paste (of unknown total weight) that is obtained by adding a pre-determined amount of highly concentrated KNO₃ solution (5000 ppm[N]) to 5 grams of directly sampled soil. The water initially present in the sample dilutes the added nitrate. The FTIR/ATR spectrum of the paste is used to estimate its nitrate concentration, which in turn is used to determine the "nitrate dilution factor" and hence the water content of the sample. A second paste is prepared by adding the estimated amount of water required to obtain the desired, standardized, moisture. Analysis of the spectrum of this second sub-sample gives the soil nitrate concentration. Determination errors are less than 3% gravimetric moisture and 10-15 mg[N-NO₃]/kg[dry soil], depending on soil type.

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