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Predicting soil nitrogen mineralization in humid environment of Eastern Canada

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Accurate estimate of growing season soil nitrogen supply (SNS) in humid regions greatly relay on a precise prediction of soil nitrogen (N) mineralization. Soil N mineralization varies in response to crop management, amendment history, biotic and abiotic soil characteristics and environmental factors. Due to the complex controls on this process, mineralization is difficult to predict on an individual field basis, and commercial applications of soil N mineralization based tests are currently limited. A comprehensive research project on prediction of SNS was initiated in 2005 across Canada with focus on humid environments. Factors controlling variation in N mineralization potential was examined in this study. A series of laboratory-based measures of soil N mineralization were evaluated. These measures were evaluated as predictors of field-based indices of soil N supply within potato production systems in eastern Canada. Potentially mineralizable N (N0) was determined by aerobic incubation at 25°C and periodic leaching for 24 and 44wk for soils with or without history of organic amendment application, respectively. Three different pools of mineralizable N were recognized: [Pool-I] The flush in mineral N which occurs in the first 2 wk period following rewetting. This pool represents the mineralization of a labile organic N pool. [Pool-II] Cumulative N mineralizaed between 2 and 24 or 44wk and is representative of the release of an intermediate pool of organic N. [Pool-III] The amount of N which was predicted to be potentially mineralizable based on curve fitting but did not mineralize during the incubation period. The values for N0 ranged from 54 to 197 mg N kg-1 in non-amended soils and from 100 to 354 mg N kg-1 in historically amended soils with compost and/or beef manure under potato and forage in eastern Canada and northeast USA. A trend towards increasing values of N0 in no-till management systems was measured. Pool I and II were significantly higher in no-till compared with conventional tillage at three of four tested sites. The N0 and pool-II values were significantly higher in historically amended soils compared with non-amended soils, where higher amendment application rates resulted in proportionally higher values of these parameters. Crop rotation (i.e. non-legume based vs. legume based and mono- or bi-cropping vs. multiple-cropping) had significant positive effect on N0 and potentially mineralizable N pools in the long-term. Higher values of N0 were measured in heavy- compared with light-textured soils and in soils with high inherent soil organic C content than soils with low inherent soil organic C content. Soil properties, climatic conditions and history of organic amendment application had a greater influence on soil N mineralization potential than crop rotation or tillage practices. Mineral N fertilizer application did not affect soil mineralizable N. Our findings also suggested the possibility of a finite capacity of soils to retain organic N similar to organic C. Pool I combined with soil mineral N (0-15 cm) at planting represented the best predictor of SNS for potato and forage crops in eastern Canada. This test is in the process of modification for use in soil research laboratory and validation in the field. The potentially mineralizable N pools and laboratory-based measures of SNS, used alone and in the absence of additional environmental information, have limited potential as predictors of field-based indices of SNS. A further improvement in predictive potential is under investigation by consideration of environmental conditions such as soil water content and temperature.