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Soil quality — Determination of potential cation exchange capacity (CEC) and exchangeable cations buffered at pH 7, using a molar ammonium acetate solution

Qualité du sol — Détermination de la capacité d'échange cationique (CEC) potentielle et de la teneur en cations échangeables, à l'aide d'une solution molaire d'acétate d'ammonium tamponnée à pH 7

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Foreword

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Introduction

Cation exchange capacity (CEC) is an intrinsic property of soil defining the concentration of negatively charged sites on soil colloids that can adsorb exchangeable cations. Cation exchange capacity can be a good indicator of soil productivity and is useful for making recommendations of phosphorus (P), potassium (K), and magnesium (Mg) if testing soils of different textures. Cation exchange capacity is also used for regulatory purposes in monitoring land application of biosolids.

Cation exchange capacity is a measure of exchangeable bases and soil acidity at some specific soil pH. The exchangeable bases and acidity neutralize negative charges arising from permanent charges due to isomorphic substitution in clays, or pH-dependent charges from hydroxyl groups on clay and oxides or carboxyl groups on soil organic matter. A common method for determining CEC uses 1 M ammonium acetate at pH 7 (neutral NH_4OAc) and is a standard method used for soil surveys by the Natural Resource Conservation Service.[6],[7] An advantage of CEC measured at a constant pH of 7 is elimination of CEC variability due to differences in soil pH. Thus, comparisons of CEC can occur across varied soil types and lime applications. A disadvantage of the neutral NH_4OAc method is that it may not provide a realistic depiction of the actual CEC at the natural pH of the soil, particularly with soils having considerable pH-dependent charge and a soil pH that is significantly different from 7. An unbuffered salt extract can be used to determine CEC at the natural pH of soil, for example, by using a hexamminecobalt(III)-chloride solution (see ISO 23470, References [6] and [7]).

The method described here determines potential cation exchange capacity (CEC) buffered at pH 7 and exchangeable cations Ca, Mg, K, and Na. Molar ammonium acetate is added to soil to saturate exchange sites with NH_4^+ and release exchangeable cations in a leachate which are measured. The exchanged NH_4^+ is then released either with 1 M KCl or 1 M NaCl and measured to quantify the potential cation exchange capacity at pH 7.

Ammonium acetate, due to its complexing effect, can contribute to the dissolution of part of soil carbonates and other salts present in the soil. Calcium concentrations (or even magnesium) are thus no longer limited to exchangeable quantities. Presence of other soluble salts such as gypsum, sodium chloride or else would also inflate exchangeable cation quantities.