



Knowledge grows

Yara Analytical Services
Technical Bulletin

Cation Exchange Capacity

Cations (+) - Calcium, Magnesium, Potassium and Sodium

Cation Exchange Capacity

This note explains how Cation Exchange Capacity (CEC) can help assess soil fertility. Yara Analytical Services include analysis of Cation Exchange Capacity as part of our Broad Spectrum Soil Analysis. We believe it provides important additional information for assessing soil fertility.

Cations and Anions

Before explaining CEC, it is useful to provide a general explanation of the behaviour of nutrients in the soil. Plant nutrients exist as particles called ions which carry an electrostatic charge. The positively charged nutrients are known as cations, and those with a negative charge are known as anions.

Exchangeable Cations: The Fraction Available to Plants.

Cations can be bound to the soil in varying degrees. At one extreme, they may be an integral part of the soil, strongly bound to silica and essentially unavailable to growing plants. At the other extreme, they may be fully soluble and not interacting with the soil to any significant event. Between these two extreme are the exchangeable cations, which are weakly bound to soil particles. Soil particles carry negative(-) electrostatic charges as a result of the processes of soil weathering and organic decomposition. These sites of negative charge are most predominant in the humus fraction of the soil and on the edges of clay particles. They are neutralised by the weak bonds that they form with the positive charged cations. The bonds between soil particles and exchangeable cations are not permanent and are continually broken and reformed as the cations move within the water surrounding the soil particles. The bonding of these cations largely prevents their loss by leaching, but is not so strong that plants cannot extract them from the soil.

What is Cation Exchange Capacity?

The cation exchange capacity of a soil is a measurement of its ability to bind or hold exchangeable cations. In other words, it is a measure of the number of negatively charged binding sites in the soil, which can be summed up as the nutrient holding capacity of the soil.

Cation Exchange Capacity helps to characterise soils

The cation exchange capacity helps characterise the soil type under consideration. For example, because organic matter and clay are a major source of negative electrostatic sites there is a strong correlation between CEC values and the amount of clay and organic matter present in the soil.

Typical CEC values:

Rating	CEC (meq/100g)	Comment
Very low	0 - 10	Very low nutrient holding capacity indicating sandy soils with little or no clay or organic matter. Nutrients will be easily leached and foliar applied nutrients are strongly recommended.
Slightly low	11 - 15	Slightly low nutrient holding capacity indicating a more loamy mineral soil. Leaching may still be a problem and therefore foliar applications should be considered.
Normal range	16 - 40	Adequate to high nutrient holding capacity indicating soils with increasing clay content.
High	> 40	Very high level normally found in very heavy soils with a high clay content or soils with a high organic matter level. Nutrients can be bound very tightly to the soil particles and availability can be restricted.