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K-STATE Research and Extension

SOIL TALKS

SWREC CROPS & SOIL

What is Soil Cation Exchange Capacity?

By: Dr. AJ Foster

Cation exchange capacity (CEC) is a measure of the capacity of a soil to hold exchangeable cations.

A soil is negatively charged and cations are positively charged. The cation exchange capacity is the amount of negative charge per unit quantity of soil that can be neutralized by exchangeable cations. Another way to look at CEC is to think of the soil as a battery. The CEC would be the amount of charge that the battery can hold.

Material	CEC (meq/100g)
Soil Texture	
Sand	1-5
Fine Sandy Loam	5-10
Loam	5-15
Clay loam	15-30
Clay	>30
Clay Types	
Kaolinite	3-15
Illite	15-40
Montmorrillonite	80-100
Organic Matter	200-400

Table 1. Cation exchange capacity of different soil texture, clay type, and organic matter.

The CEC of a soil is determined by the relative amount and type of clay and the amount and state of decomposition of organic matter that make up that soil. For example, sandy soils generally have low amounts of clay and organic matter and have low CECs compared to silt loam and clay loam soils. Very high CEC is often associated with organic matter compared to inorganic clay (Table 1). Organic matter can have 4 to 50 times higher CEC per given weight than clay. Soil CEC is also dependent on soil pH. For example, a soil with the same amount of clay and organic matter at pH 7 will have a higher CEC than a soil with a lower pH (pH 5.5). The quickest and easiest way to increase CEC is to raise soil pH.

CEC is expressed in terms of moles of positive charge adsorbed per unit mass. However, for convenience of reporting CEC in whole numbers centimoles of positive charge per kilogram of soil ($cmol_c/kg$) or milli-equivalents per 100 grams of soil (meq/100g) are used [Both expressions are numerically identical (10 $cmol_c$/ kg = 10 meq/100 g). For example, if a soil has a CEC of 10 $cmol_c/kg$, this implies that 1 kg of this soil can adsorb 10 $cmol_c$ of H^+ ion and can exchange 10 $cmol_c$ of any other cation.

Management implications

1) Low CEC soils (low reservoir of nutrients) —fertilize with small quantity of fertilizer more frequently.

2) High CEC soil (large reservoir of nutrients) —fertilize amount removed each season as it will require a large amount of fertilizer to fix a deficiency problem. Knowing your soil charge and supplying capacity is the key to management.