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NEWS FROM THE WONDERFUL WORLD OF SOIL AND PLANTS

By John Ferguson

Subject: Cation Exchange Capacity (CEC) Epson Salts

A question I often get is "What is CEC?" CEC stands for Cation Exchange Capacity and is a measurement of how many nutrients the soil can hold and release.

CEC is for elements with a positive electrical charge like magnesium (Mg^{+2}), calcium (Ca^{+2}), or potassium (K^{+1}). This measurement is called "cation" exchange since it measures the ability of negatively charged soil particles (sand, silt, clay, organic matter, etc.) to bind up and then release positively charged elements like those above.

There is a similar measurement for negatively charged elements (sometimes called ions) called Anion Exchange Capacity (AEC). An ion may be a compound with a negative electrical charge like nitrate (NO^{-3}) which is a molecule composed of oxygen and nitrogen. A few other negatively charged ions we experience in our soils are sulfate (SO_4^{-2}) or chloride (Cl^{-1}).

Note: Both CEC and AEC values are dependent of the acidity or alkalinity (pH) of the soil at time of measurement.

Most of us remember our grade school science where we were shown that the positive side of a magnet attracts the negative side. Conversely the negative side repels another negative side. Similarly in electricity, positive and negative charges attract each other and two of the same charge (negative or positive) repel each other.

This property affects the leaching potential in our soils and explains why artificial fertilizers cause so much pollution. For example, anions like nitrate (NO^{-3}) are repelled rather than attracted to soil surfaces with high cation exchange capacity since they are negatively charged which causes the nitrate to leach and pollute our streams and bays eventually creating dead zones in the ocean.

The next question one might ask is, "How are these nutrients (elements) in their ion form exchanged?"

Now biology comes into play. Root exudates from plants and soil microbes give off or produce positively charged hydrogen ions (H^{+1}). If two hydrogen ions get close to a calcium ion on a soil particle, they kick it off and then they take its place on the soil particle. This allows the microbe or plant to easily absorb the calcium atom. The actual chemistry is a little more complex but this gives you an idea of what happens for plants to get needed nutrients.

A great Christmas present for gardeners is the following book:

Teaming with Microbes, A Gardener's Guide to the Soil Food Web, 2nd Edition, by Jeff Lowenfels & Wayne Lewis, Timber Press, 2006, ISBN-13:978-0-88192-777-1

This is the most complete book on the market about biological or organic methods in horticulture. It is written in a very easy to understand, non-technical format with lots of pictures illustrating the latest research is soil science. It is written for the average gardener and landscaper as an introduction that explains why organic methods work so well and how they help a person save time and money.

The book is written in two parts. The first part is a easy to understand very basic presentation on the science of soil biology. The second part take the ideas and concepts on the Soil Food Web that were introduced in part one and applies them to solving problems in our yards and gardens.

Subjects covered range from taking care of our soil, to compost and mulch choices. Also included is information on compost teas to natural weed control.

Each plant group from lawns and turfgrass, to annuals and vegetables, to shrubs perennials and trees are covered.

This book is ***Highly Recommended for*** *all gardeners, landscapers or anyone taking care of a lawn or garden or anyone whom makes compost for use in a landscaping project.*

A related issue I often hear from gardeners is, "my leaves were yellowing so I applied Epson salts but things are worse than before."

In general, the application of calcium (Ca) loosens a soil and helps it be crumblier (better soil structure) and magnesium (Mg) tightens it and may create hardpan.

Research from the University of Missouri found that when a soil's CEC was saturated to 65 percent calcium (Ca) and 15 percent magnesium (Mg) and the rest being potassium and all the other minor and micronutrients, it produced excellent structure and grew high quality plants. Thus, the ratio of calcium to magnesium should be around 4-5:1.

If one has a soil with lots of clay, the Ca:Mg ratio may need to be 7:1 or more in extreme cases.

Epsom salt is also known as magnesium sulfate. It is a chemical compound is made up of magnesium, sulfur, and oxygen ($MgSO_4 \cdot 7H_2O$) that easily dissolves in water. When one applies Epson salts and the magnesium is not needed, then too much magnesium ends up in the soil and makes it tighter. This means less water and air can move through the soil which then hurts a plant growth and health. It also may create conditions that favor the growth of pathogens, as many diseases grow best in low aeration (oxygen) soils.

Often nutrients (elements) in excess cause more problems than a mild shortage.