



# Maine Vegetable and Small Fruit Growers Association

Winter 2022

## Maine Agricultural Trade Show January 10 – 14<sup>th</sup>

The Maine Agricultural Trade Show which was going to be live has now been moved to online due to the Covid 19 surge here in Maine.

To get a show schedule the best way I have found is to do a google search for “Maine Agricultural Trade Show”. The link is

[https://www.maine.gov/dacf/ard/market\\_promotion/ag\\_trade\\_show.shtml](https://www.maine.gov/dacf/ard/market_promotion/ag_trade_show.shtml)

The page that will come up has a “Enter the 2022 Trade Show” button just under the “Real Maine’ logo.

[https://www.maine.gov/dacf/ard/market\\_promotion/2022-agtradesshow.shtm](https://www.maine.gov/dacf/ard/market_promotion/2022-agtradesshow.shtm)

On the next page is a list of topics such as business directories where you can talk to certain vendors, and at the bottom of the page is “Conference Sessions” which will give you the schedule of the various programs.

[https://www.maine.gov/dacf/ard/market\\_promotion/ats-conferences.shtml](https://www.maine.gov/dacf/ard/market_promotion/ats-conferences.shtml)

If you want to know what sessions have credit opportunities, you can find out on the Board of Pesticides training page. The link is

[https://www.maine.gov/dacf/php/pesticides/credit\\_calendar.shtml#training](https://www.maine.gov/dacf/php/pesticides/credit_calendar.shtml#training)

The “Conference Sessions” page has directions on how to use the page. Some programs have a fee which will have a \$ in front of the program. Preregistration is required for most of the programs and will be needed if you desire to get Pesticide Recertification Credits. Also, Zoom and WHOA will be used to view these sessions. These are free apps and links are available on that page. At the bottom of the page are two sessions for Maine Vegetable and Small Fruit Growers which will be on January 19<sup>th</sup> and 26<sup>th</sup>.

## **Why Is MVSFGA Important to You?**

Maine Vegetable and Small Fruit Growers Association has a number of activities that affect members of the group. Some of the activities are listed below.

### **Agcom Representation**

This is a meeting of the various agricultural groups in Maine such as Maine Dairy Producers, Maine Apple Growers, Maine Potato Growers, etc. This group discusses issues that affect the agricultural industry in Maine, often regarding legislation and the affect of various sections of Maine agriculture. This is an important group particularly regarding proposed legislation.

### **Board of Agricultural Representaion**

This group provides advise to the Chancellors Office at the University of Maine. The Maine Cooperative Extension is under this office. The group provides input as to how the Cooperative Extension and the university as whole can better serve the agricultural community.

### **Twilight Meetings**

The MVSFGA helps the cooperative extension plan this event and gives input to the evening program. Some of business members have also provided funding for the program.

### **Ag Day at the Legislature**

This is an informational event for the State Legislature. Typically a display is set up in the Hall of Flags room for the legislative members to come through and learn about various aspects of agriculture and talk to farmers. The MVSFGA has provided strawberry shortcake thanks to board members in the past who have provided the ingredients.

### **Legislative Testimony**

This is something that has become more important in recent years. Maine Agriculture is being hit in a number of areas from pesticide use to labor related issues. The testimony from MVSFGA is very important in both the work sessions and in legislative hearings. Typically some of the hearing are done on very short notice and input from various members in the group has had a great impact along with other agricultural groups.

### **Newsletter**

The Maine Vegetable and Small Fruit Growers put out a newsletter several times a year to members with articles that are important to the growers in Maine.

### **Website**

A web site is maintained by the organization and contains various resources for both members and the public. If you have not visited it, you should.

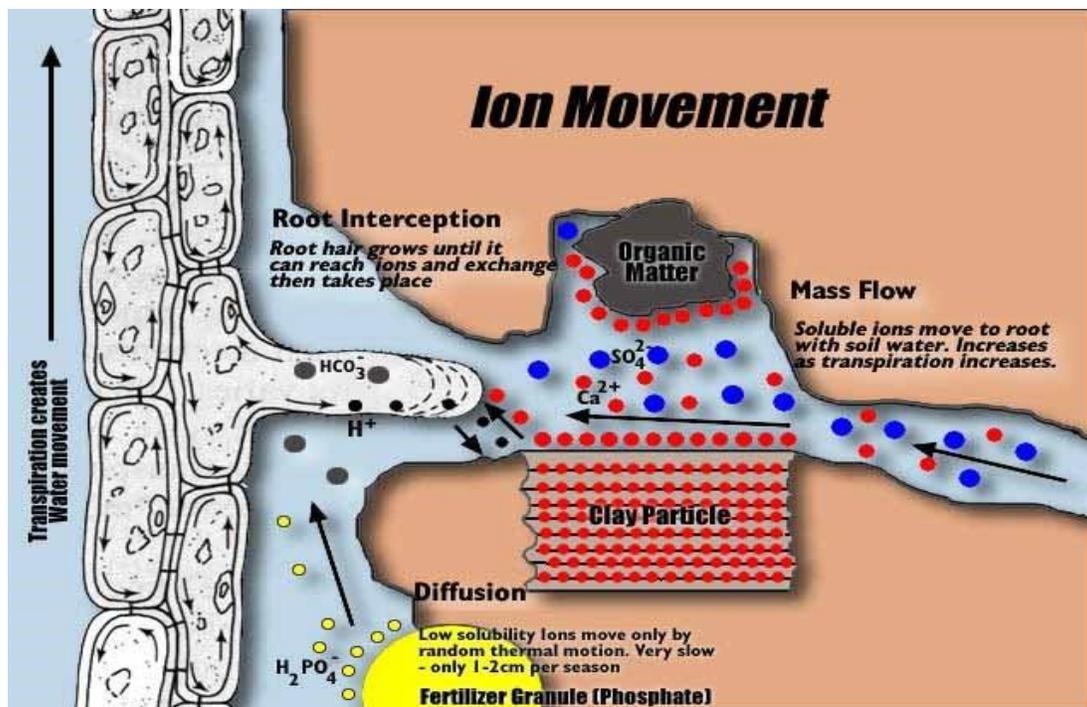
### **Crop Production Guides**

The cost of the New England Small Fruit Guide and the New England Vegetable Guide are included in the dues. These are published every two years so one or the other is received each year.

# A Detailed Exploration of Cation Exchange Capacity (CEC) By Bruce Hoskins, University of Maine Soil Testing Laboratory

## Concept, Terms, and Definitions

Cation exchange capacity can be a confusing term in soil testing, in no small part because it can be defined or estimated in different ways. **In the simplest terms, cation exchange capacity is the total negative charge of soil particles.** This negative charge is concentrated on the smallest particles of mineral material (clays) and finely broken down organic matter (humus), since these small particles have a high surface area relative to their size. The surfaces of clay particles carry a permanent negative (-) electrical charge. The surface charge of organic particles can vary, as will be explained later.



Almost all nutrient uptake by plants is through the soil water. Nutrients dissolved in the soil water have either a plus (+) charge and are called **cations** or a negative (-) charge and are called **anions**. Essential nutrients with a plus charge (cations) include calcium ( $\text{Ca}^{+2}$ ), magnesium ( $\text{Mg}^{+2}$ ), potassium ( $\text{K}^{+1}$ ), and ammonium ( $\text{NH}_4^{+1}$ ), among others. Other non-nutrient ions also carry a plus charge, including sodium ( $\text{Na}^{+1}$ ), aluminum ( $\text{Al}^{+3}$ ), and hydrogen ( $\text{H}^{+1}$ ). Essential nutrients with a negative charge (anions) include nitrate ( $\text{NO}_3^{-1}$ ), phosphate ( $\text{PO}_4^{-3}$ ), and sulfate ( $\text{SO}_4^{-2}$ ). Anions are held in the soil by other means and will not be covered in this article. Calcium, magnesium, potassium, and sodium are dominant in higher pH soils. These are often referred to as **base cations**. Aluminum, iron, and manganese are dominant in lower pH soils. Because opposite charges attract, cations are attracted to and held by the negative surface charges of the soil particles. Cations on particle surfaces are always in equilibrium with those dissolved in soil water and may be exchanged between a surface and soil water. For example, as

the soil water level of potassium (K) is depleted by plant uptake, it is replenished by release of K held on a negative charge site, in exchange for some other cation in the soil water. This phenomenon is why negative surface sites are referred to as **exchange sites**. The total *active* negative surface charge in the soil is called **Cation Exchange Capacity**. It is a gauge of the ability of the soil to hold and supply nutrient cations and carry them through one or more growing seasons. CEC is also sometimes referred to as the soil's **nutrient holding capacity**, even though this doesn't apply to *all* nutrients. Because this is a measurement of particle surface charge, the units are in terms of quantity of charge per weight of dry soil: milliequivalents per 100 grams (meq/100g) or centimoles charge per kilogram (cmolc/kg). The 2 units are numerically identical.

Since most surface charge in soil resides on clay or humus particles, CEC is higher in soils with greater clay content and higher in soils with more organic matter content. Clay content of soil does not change significantly over time. So one of the easiest ways to increase CEC or nutrient holding capacity is by adding more organic matter.

The second, and more significant way, CEC increases with pH is by the creation of additional exchange sites on organic matter particles. As pH increases,  $H^+$  ions are released from organic molecules. This creates many new (-) charge cation exchange sites where  $H^+$  was tightly bound at lower pH. The higher the pH, the more new exchange sites are created. This variable charge on organic matter is called **pH-dependent Cation Exchange Capacity**.

The third factor determining CEC (and often the most confusing), is soil pH. CEC increases as soil acidity is neutralized with a lime application and pH increases. The 2 cations that are responsible for most of the active acidity in our soils are hydrogen ( $H^+$ ) and aluminum ( $Al^{+3}$ ). Soil acidity, by definition, is the concentration of  $H^+$  in the soil water. However, in most of our soils Al is the predominant acid-forming ion, as it is in most geologically young soils. Aluminum forms acidity ( $H^+$ ) by splitting  $H_2O$  water molecules into  $H^+$  and  $OH^-$  ions. Al forms very strong bonds with the  $OH^-$  ions, creating  $Al(OH)_3$  and is neutralized. The 3  $H^+$  ions remaining create acidity. This process is called **aluminum hydrolysis**. Because of the +3 charge on Al bound to exchange sites, it can effectively block some of those sites for active exchange. By raising pH, Al is removed from some of these sites, which are opened up for occupation by nutrient cations. This is one way active CEC increases with pH.

So to summarize, CEC is higher in soils with greater clay content, higher organic matter, and higher soil pH. CEC is lower in sandier soils, soils low in organic matter, or soils with low pH.

### **Buffering Capacity**

A high CEC soil holds a large pool of available nutrients, relative to crop plant requirements, so each nutrient will be depleted by plant uptake more slowly over time. This is an example of the concept of **buffering capacity**. Higher CEC soils are said to have a greater buffering capacity. Nutrients are depleted more slowly, but more nutrients are needed to replenish the supply once they are depleted. Lower CEC soils are more poorly buffered. They are depleted more rapidly, but require less nutrient input to be replenished.

Buffering also applies to soil acidity. A higher CEC soil requires more lime to neutralize a low pH, because of the relatively large amount of acidity. Those same soils will maintain ideal pH range longer and need lime less often than soils with low CEC.

### **Exchange Site Selectivity**

Different soils hold and supply essential nutrient cations with varying degrees of efficiency. Not all exchange sites are equal in how well they hold K, Ca, Mg and other cations. The relative makeup of clay-based vs organic-based exchange sites is called the **exchange complex**. Organic-based sites have a high affinity for divalent cations, like  $\text{Ca}^{+2}$  and  $\text{Mg}^{+2}$ , and a relatively low affinity for monovalent cations, like  $\text{K}^{+1}$  and  $\text{NH}_4^{+1}$  (Evangelou and Blevins, 1985). Clay-based exchange sites have a higher affinity for K. Sandy soils, with little clay content, tend to hold less K on exchange sites and release more to the soil water. This makes K more susceptible to depletion and is part of the reason why it is so difficult to build K levels in sandy soils. Soils with higher clay content hold more K on exchange sites and release it more gradually over time. This is another part of the definition of **buffering capacity** in soils. Sandy soils, with a higher proportion of organic-based exchange sites, are well-buffered with respect to Ca and Mg and poorly buffered with respect to K, compared to soils with higher clay content.

### **Measuring or Estimating CEC**

Cation exchange capacity can be directly measured in the lab by “direct displacement”. The soil is flooded with a single exchangeable cation (usually ammonium  $\text{NH}_4^+$ ) at a specific pH (usually pH 7), forcing a mass exchange of all cations and saturating all exchange sites (active at the pH of the solution) with  $\text{NH}_4^+$  ions. The  $\text{NH}_4^+$  is removed by a second “displacing” cation into an extracting solution, where it can be measured. Because of the labor and time involved, this is an expensive procedure.

Most soil testing labs, including Maine, estimate active CEC by calculation. Nutrient extraction methods are measuring most or all exchangeable cations. Adding together Ca, K, Mg, and acidity according to their amount of (+) charge (milliequivalents), provides a ballpark estimate of CEC. This is called **summation CEC**. In practice, non-nutrient cations like sodium are often ignored in the summation, since they are present at very low levels in most soils.

Because of the pH-dependent nature of CEC, the acidity factor used or assumed in the summation can vary considerably from lab to lab. This leads to discrepancies between labs when comparing CEC values. Many labs estimate CEC at pH 7.0, by adding the amount of acidity to be neutralized to reach pH 7.0. Some labs use no acidity factor at all and are estimating CEC at current soil pH. In Maine, we are able to estimate acidity at several different target pH levels. These acidity factors are in turn used to calculate the lime application to reach each target pH. The target pH assumption used to calculate CEC is explicitly stated on each of our reports. This is not a common practice among most labs.

When estimating CEC at current soil pH, exchangeable acidity should be factored in at lower soil pH levels. Low pH soils have an abundance of aluminum, some of which is readily or easily exchangeable. This **readily exchangeable acidity** diminishes to near zero as soil pH approaches 5.8 – 6.0 range. However at lower soil pH levels, readily exchangeable acidity can comprise a large portion of active exchange sites. CEC at current soil pH is also known as **effective cation exchange capacity (ECEC)**.

A common bias in the summation estimate of CEC occurs in situations of high pH, near or above 7, when unreacted lime (calcium/magnesium carbonate) is present. Since almost all commercial and University labs use an acidified extracting solution (Morgan, modified Morgan, Mehlich III), some of the Ca (and Mg) extracted may be from dissolved carbonates and not from exchange sites. This leads to a significant, sometimes major, overestimation of CEC. Labs compensate for this in different ways. Some just place an upper limit on CEC, corresponding to the upper limit of unlimed soils they typically run. CEC can be roughly estimated with soil pH and organic matter content (2 of the 3 factors determining CEC). This is the system used at Maine, where the summation CEC is adjusted if it exceeds 130 % of the alternative estimate based on pH and organic matter.

Another less common bias in summation CEC is in cases of extremely high fertility, where nutrient content exceeds nutrient holding capacity. If a significant portion of the cations exist as free salts (not held on exchange sites) in the soil water, the summation estimate will be biased high. This occurs occasionally in high tunnel production, in cases of very high soluble salt content (measured by electrical conductivity). Fertility management in these cases can be achieved by monitoring cation levels in the soil water.

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## MVSFGA

MVSFGA is an association of vegetable and small fruit growers dedicated to the promotion and advocacy of the vegetable and small fruit industry in Maine. MVSFGA supports research education, and promotion and political advocacy. The association has provided important testimony at legislative hearings on such issues as pesticide regulation, labor, IPM, farmland preservation and technology transfer.

MVSFGA members receive the annual New England Vegetable Production Guide, and the New England Small Fruit Production Guide. Members also receive the association newsletter. To become a member of the MVSFGA please write to: William Jordan Jr. Treasurer, 21 Wells Road, Cape Elizabeth, Maine 04107, email: [whjir30@aol.com](mailto:whjir30@aol.com)

MVSFGA Directors are: Lisa Turner (President), Bill Bamford (Vice-President), William Jordan (Treasurer), Tomi Chipman (Secretary), Tom Stevenson, Justin Gray, Paul Peters, Mathew Matson, Pete Karonis, and Harold Grams.