# Influence of Pine Bark Particle Size and pH on Cation Exchange Capacity

Cation exchange capacity (CEC) describes the maximum quantity of cations a soil or substrate can hold while being exchangeable with the soil solution. This is often associated with a substrate's ability to hold added mineral nutrients, and which can be altered by pH and particle size. With relatively little documented work on factors that affect CEC of pine bark substrates, the objective of this research was to determine the variability of CEC in different batches of pine bark and determine the influence of particle size, substrate pH, and peat amendment on pine bark CEC.

Four batches of nursery-grade pine bark were collected from two nurseries. These four samples were separated in to several particle size classes (Table 1), and along with a single source of sphagnum moss were measured for CEC. For pH and CEC evaluations a batch of bark sample was amended with 1 or 2 lb/yd$^3$ elemental sulfur, or with 4, 8, or 16 lb/yd$^3$ pulverized dolomitic line. The non-amended bark served as the control.

The CEC varied with pine bark batch. Part of this variation is attributed to differences in particle size of the bark batches. Pine bark and peatmoss CEC increased with decreasing particle size, although the change in CEC from coarse to fine particles was greater with pine bark than peatmoss (Figure 1). Substrate pH from 4.02 to 6.37 had no effect on pine bark CEC (Table 2). The pine bark batch with the highest CEC had similar CEC to sphagnum peat.

Growers wishing to improve nutrient retention and pH stability are advised to have their substrates and parent components analyzed for CEC so that more informed decisions can be made for amendment needs and rates.

Table 1. Particle size distribution of four pine bark batches used in container nursery production (n = 3).

| Class[z] | Sieve (mm)[y] | Particle size distribution (%) Batch 1 | Batch 2 | Batch 3 | Batch 4 | $LSD_{0.05}$[x] |
|---|---|---|---|---|---|---|
| Fine | 0.00 | 1.0 | 0.5 | 3.8 | 1.6 | 0.4 |
| | 0.11 | 1.7 | 0.8 | 4.5 | 1.8 | 0.2 |
| | 0.18 | 2.0 | 1.0 | 3.6 | 1.5 | 0.2 |
| | 0.25 | 4.0 | 2.1 | 5.2 | 2.0 | 0.4 |
| | 0.35 | 4.7 | 2.9 | 5.1 | 2.2 | 0.6 |
| | ∑[w] | 13.4 | 7.3 | 22.2 | 9.1 | 1.4 |
| Medium | 0.50 | 7.0 | 5.8 | 6.8 | 3.3 | 1.1 |
| | 0.71 | 6.9 | 7.2 | 6.8 | 4.0 | 1.1 |
| | 1.00 | 6.7 | 8.7 | 7.0 | 4.6 | 0.6 |
| | 1.40 | 8.8 | 12.5 | 9.0 | 8.2 | 0.9 |
| | ∑ | 29.5 | 34.2 | 29.5 | 20.1 | 3.3 |
| Coarse | 2.00 | 9.5 | 11.6 | 9.5 | 10.8 | 0.9 |
| | 2.80 | 13.1 | 13.5 | 12.0 | 17.5 | 1.1 |
| | 4.00 | 19.9 | 16.3 | 15.0 | 23.2 | 3.1 |
| | 6.30 | 14.5 | 14.6 | 11.7 | 18.7 | 4.2 |
| | 12.50 | 0.0 | 2.4 | 0.0 | 0.6 | 1.1 |
| | ∑ | 57.1 | 58.5 | 48.3 | 70.8 | 4.4 |

[z]The class category represents three arbitrary and relative groupings of pine bark particle size.
[y]1 mm = 0.0394 inch.
[x]Fisher's least significant difference, when $\alpha = 0.05$.
[w]∑ = the sum of values within a batch and class.

Figure 1. The relationship between particle size and cation exchange capacity (CEC) of four bark batches.

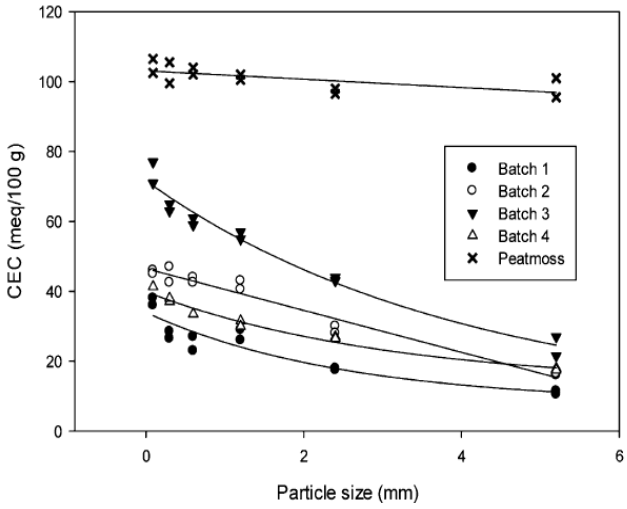


Table 2. The effect of sulfur and pelletized dolomitic lime additions to pine bark on substrate pH, EC (EC), and cation exchange capacity (CEC).

| Amendment | Rate (lb/yard$^3$)[z] | EC (mS·cm$^{-1}$)[z] | pH | CEC (meq/100 g)[z] |
|---|---|---|---|---|
| Sulfur | 1 | 0.26 | 4.08 | 51.3 |
| Sulfur | 2 | 0.31 | 4.02 | 50.0 |
| None | 0 | 0.22 | 4.10 | 58.6 |
| Dolomitic lime | 4 | 0.20 | 4.71 | 56.4 |
| Dolomitic lime | 8 | 0.24 | 5.78 | 58.3 |
| Dolomitic lime | 16 | 0.27 | 6.37 | 58.9 |
| Rate response: Sulfur[y] | | L** | L* | NS |
| Rate response: Lime | | L* | L*** | NS |
| $LSD_{0.05}$[x] | | 0.062 | 0.063 | NS |

[z]1 lb/yd$^3$ = 0.5933 kg·m$^{-3}$, 1 mS·cm$^{-1}$ = 1 mmho/cm, 1 meq/100 g = 1 cmol·kg$^{-1}$.
[y]NS or L represent nonsignificant or linear rate response in the measured parameter, with * and ** representing a significant response with $P < 0.05$ and 0.01, respectively.
[x]Fisher's least significant difference, when $\alpha = 0.05$.

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