SOFTENED WATER MAY RUIN YOUR CROP

Betty B. Messier
Graduate Student

There has been concern, and rightly so, about the use of water softened in home systems for greenhouse irrigation. Hard water is due to a high content of calcium and magnesium. When concentrations are high enough to precipitate soap to an undersirable extent, softening is undertaken to correct the situation.

Cation exchange water softeners operate by replacing the calcium (Ca^{++}) and magnesium (Mg^{++}) ions with sodium ions (Na^{+}). When salts of metals such as these are dissolved in water they dissociate into cations (+) and anions (-). The principal anions found in water are bicarbonate (HCO_3^{-}), sulfate (SO_4^{--}) and chloride (Cl^{-}). These 3 positive and 3 negative ions in 9 possible combinations account for almost all the dissolved salts in hard water. For example:

$$Ca(HCO_3)_2 \xrightarrow{H_2O} Ca^{++} + 2HCO_3^{-}$$

calcium bicarbonate — calcium ion — bicarbonate ion

$$MgSO_4 \xrightarrow{H_2O} Mg^{++} + SO_4^{--}$$

magnesium sulfate — magnesium ion — sulfate ion

$$NaCl \xrightarrow{H_2O} Na^{+} + Cl^{-}$$

sodium chloride — sodium ion — chloride ion

Cation exchange softening occurs when negatively charged resin beads, holding positively charged sodium ions, release the sodium ions and absorb calcium or magnesium ions when hard water is passed over the beads:

$$2\ \text{resin}^{-}\text{Na}^{+} + \underset{\substack{\text{calcium}\\\text{bicarbonate}}}{\text{Ca(HCO}_3)_2} \text{ ------ resin}_2^{--}\text{Ca}^{++} + \underset{\substack{\text{sodium}\\\text{bicarbonate}}}{2\text{NaHCO}_3}$$

In the same fashion, for instance, magnesium chloride would be replaced by sodium chloride.

The softened water contains soluble sodium salts instead of soluble calcium and magnesium salts. Sodium does not react with soap to form a greasy curd as do calcium and magnesium. The result is water that is suitable for laundry but not for irrigation of plants.

When all the negative charges on the resin beads occupied by sodium ions are replaced by calcium and/or magnesium ions, the system must be recharged. A solution of common salt (Na^+Cl^-) and water is passed through the resin beads until all the negative sites are again taken by the sodium ion (Na^+). The calcium, magnesium and chloride ions (from the NaCl) are flushed out in the waste water.

Sodium of course is not generally considered an essential nutrient, although it plays a role in the nutrition of some plants. If greenhouse soil is irrigated with sodium-rich water, sodium will tend to replace calcium and magnesium on the soil colloids and in the soil solution. The situation is aggravated when the sodium salt is a

bicarbonate rather than a sulfate or chloride since both calcium and magnesium are more likely to leach in the bicarbonate form.

When sodium ions are present in high concentration, uptake of other cations is depressed. The plant will take up the sodium ions to the detriment of potassium, calcium and magnesium. The end result may possibly be multiple deficiency symptoms. Furthermore, sodium has a detrimental effect on soil structure. Dispersion of the soil particles may interfere with proper drainage and oxygen exchange.

References

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