Citrus and salinity

By Mongi Zekri

Salts are a common component of soils that originate from mineral weathering, fertilizers, irrigation waters and soil amendments. The addition of most soluble fertilizer materials will increase soil salinity. However, it is only when salts are present in relatively high concentration that crops are damaged or adversely affected.

Salinity is of increasing concern in Florida because of saltwater intrusion into groundwater in areas where citrus is grown. The ions in soil solutions, which contribute significantly to salinity problems, are principally sodium, chloride, calcium, magnesium, sulfate, potassium, bicarbonate, carbonate, nitrate and borate ions.

All stages of citrus tree development, such as root and vegetative growth, are adversely affected by salinity. Salinity can also depress flowering, fruit yield and fruit quality. Citrus is generally classified as a salt-sensitive crop because growth and yield reductions can occur at relatively low salinity levels.

Salinity of irrigation water is determined by measuring the electrical conductivity (EC) of the water. Soil salinity is determined by measuring EC of the solution extracted from a water-saturated soil paste with an EC meter. Salinity is expressed in units of deciSiemens per meter (dS/m) or millimhos per centimeter (mmho/cm). Both are equivalent units of measurement. The total dissolved salts or solids (TDS) in parts per million can be estimated by multiplying EC in dS/m or mmho/cm by 700.

Leaf burn caused by salinity

SALT DAMAGE

Salt damage is caused by a decrease in the water potential of the soil solution or by the toxicity of specific ions. Some researchers attribute most of the salt damage to osmotic stress, while others believe that salt damage is due to toxic effects of specific ions. Water is osmotically more difficult to extract from saline solutions. Salt addition is analogous to soil drying since both result in reduced water uptake.

Ion toxic effect is attributed to excess accumulation of certain ions in plant tissues and to nutritional imbalances caused by such ions. High concentrations of chloride and sodium in citrus leaves shorten the lifespan of leaves by increasing chlorosis and by promoting senescence and abscission. Accumulation of ions in large amounts in leaves can cause leaf burn and inhibit certain metabolic processes.

Depending on climatic conditions, visible sodium toxicity symptoms may appear when leaf sodium levels reach 0.2 to 0.5% of leaf dry weight. Chloride toxicity symptoms usually appear when leaf chloride levels reach 0.5 to 0.7%. For salt concentration in the soil, the threshold salinity is an electrical conductivity of the soil saturation extract of 1.8 dS/m. Above this threshold, yield can be reduced at a rate of 16% per dS/m.

Relatively few studies have been conducted to investigate the effects of a combination of water table and salinity on citrus, even though this condition is prevalent in Florida and many parts of the world. The severity of defoliation and twig dieback due to salinity is greatly accelerated by a frequently fluctuating water table.

IRRIGATION AND NUTRIENT MANAGEMENT

Good irrigation management should consider the salinity factor in the irrigation water and in the root zone. As soil dries, salts become concentrated in the soil solution, increasing water stress. Therefore, salt problems are more severe under hot, dry conditions than under cool, humid conditions. Increasing irrigation frequency and applying water in excess of plant demand may be required during hot, dry periods to minimize salinity stress.

Prior to implementing irrigation management, the water source should be tested for quality. The results of the test will determine if the water is suitable for citrus irrigation. The primary requisite for managing soil salinity is adequate drainage. When saline irrigation water is a potential problem, fertigation should be managed properly. A fertilizer program using frequent applications of relatively low fertilizer rates is recommended over a program using infrequent applications of high fertilizer (salt) concentrations. Selecting nutrient sources that have a relatively low salt index can reduce salinity problems.

Avoiding the addition of chloride from the application of muriate of potash (potassium chloride) and the addition of sodium from sodium nitrate are also good strategies. It is recommended to routinely monitor the TDS of irrigation waters to keep poor-quality water off the leaves, especially under dry weather conditions, and to keep the soil moist so as to not further increase its salt concentration.

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