e-GRO Alert

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Volume 7 Number # 33 Month 2018

Dealing with salty irrigation water

A number of growers have reported problems this spring related to irrigation water quality, particularly issues with high concentrations of sodium and chloride salts. For example, Figure 1 shows container-grown *Alchemilla* (Lady's Mantle) at a perennial operation, where the margins of the older leaves appear "burned" (necrotic, brown and crispy) and the younger leaves are still green and healthy. The grower sent samples of the irrigation water to a commercial testing laboratory, which indicated a high chloride concentration at 240ppm. Figures 2 and 3 show a similar scenario, except with a cut flower operation where the concentration of sodium in the irrigation water was high at 90ppm. Both operations were near a highway, and it appeared that salt used to de-ice roads during winter (usually sodium chloride) had contaminated groundwater used for irrigation, resulting in plant burning.

This e-GRO Alert discusses the importance of water quality, sources of salt contamination and their effects on plant growth, and strategies to mitigate risks associated with "salty" irrigation water.

Figure 1. Lower leaf necrosis and burn resulting from chloride toxicity in *Alchemilla*.

Figure 2. Lower leaf burn and necrosis in snapdragon cut flowers resulting from sodium toxicity.

Water quality and dissolved salts

Dissolved salts are a major aspect of irrigation water quality. Dissolved salts can be plant nutrients, such as calcium and magnesium, or non-essential and potentially harmful elements such as sodium and chloride. Sources of irrigation water often contain naturally dissolved salts, where the type and concentration depends on the water source and location. For example, water from deep artesian wells often contain calcium, magnesium, and carbonate ions that dissolve in varying concentrations as a result of the natural mineralogy of the aquifer system. Surface water sources (ponds, lakes, rivers) typically are relatively low in salts, and rainwater is usually one of the purest sources of water with the least amount of salts.

We often measure soluble salts in irrigation water and soil solutions as electrical conductivity (EC), where high EC values equate to higher dissolved salt concentrations. Water-soluble fertilizers and mineral acids are also salts, and contribute to EC when dissolved into the irrigation water. Poor water quality is typically characterized by high concentrations of total dissolved salts (high EC values) or having high concentrations of individual elements that can be toxic, such as sodium, chlorine, and boron.

Potential issues when irrigating with “salty” water include (a) plant stress caused by salt accumulation in the growing substrate and (b) toxicity of harmful elements such as sodium and chloride.

Figure 3. Stunting and lower leaf necrosis resulting from sodium toxicity in snapdragon. Symptoms occurred in a location where the soil was dry from poor uniformity of the irrigation system.

High salts supplied by the irrigation water can build up in the growing media and cause high substrate-EC and salt stress. This can appear as dark foliage, stunted growth, wilting, and burning of leaves. Roots take up non-essential elements such as sodium and chloride, but these elements are not essential for plant growth and can accumulate to toxic levels in the older and more mature leaves. In addition, sodium and chloride compete for uptake with other essential plant nutrients, such as potassium and chloride, and can increase the risk of deficiency symptoms.

Salt contamination of groundwater is a major problem in certain regions. For example, aquifers near the seacoast are more susceptible to seawater intrusion, resulting in higher sodium and chloride concentrations. In Northern regions, salt used to de-ice roads during winter can seep into groundwater, spiking salt concentrations for growers during spring production. In areas of intense agricultural production, fertilizer nutrients can leach and accumulate to harmful concentrations in groundwater over time, particularly with trace elements such as boron.

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Both grower operations in our example were located in the north and near a highway, where road salt contaminated the groundwater with sodium at 90ppm and chloride at 240ppm. For both growers, irrigation water EC was higher than normal from the extra salt, which accumulated and raised substrate EC above their target ranges. Sodium in snapdragon leaf tissue had accumulated to over 40,000ppm (4%), similar to the recommended amount of nitrogen. Although seemingly high, to our knowledge, however, there is little information on tissue toxicity thresholds for sodium or chloride in floriculture species.

In general, there is a greater risk of toxicity when chloride reaches 110ppm and sodium reaches 40ppm in the irrigation water. However, these thresholds are likely influenced by other factors, including the plant species, leaching fraction, and presence of other nutrients such as calcium and magnesium. For the growers in our example, sufficient snowmelt and rainfall later in spring replenished the aquifers and dropped sodium and chloride concentrations to acceptable values.

The growers were able to solve the problem and salvage portions of the crop by leaching heavily to flush out the accumulated sodium and chloride. Leaching approximately 1.5 container capacities (CCs) of water will adequately flush the substrate and replace with new solution. For example, if a container holds 1 quart of water, leaching 1.5 CCs means applying enough water so that 1.5 quarts leach from each container. You can leach with fertilizer solution or clear irrigation water. Leaching with clear water will likely deplete nutrients and lower substrate EC, especially if fertilizer is normally applied only through irrigation, in which growers should reapply fertilizer solution to replenish nutrients around the roots.

If possible, the best option for dealing with poor quality irrigation water is usually to switch to a better water source. However, in some cases this may not be practical. There is no guarantee a new, or even deeper well, will always result in better quality water. In addition, municipal water sources and water purifying technology such as reverse osmosis and de-ionization can be expensive or not available.

Another option is to increase the leaching fraction (volume of water leached ÷ volume of water applied × 100%) to more than the recommended 20% at each irrigation, which helps prevent accumulation of harmful salts. Since leaching also washes away nutrients, leaching more may require that you increase the applied fertilizer rate. It is also important to note that flood floor and sub-irrigation benches are essentially no-leach irrigation systems, and are therefore more sensitive to salt accumulation in the growing substrate.

A good practice is to conduct periodic monitoring of irrigation water quality. You can measure irrigation water EC and pH in-house using portable meters, and changes in these values may indicate changes in water quality. We recommend sending water samples to a reputable commercial testing laboratory at least twice per year for a complete analysis of pH, EC, alkalinity, all plant essential nutrients, and potential contaminants such sodium (Na), chloride (Cl), and fluoride (F). We also recommend using a laboratory that specifically analyzes water for horticulture and not just drinking water, since the analytical methods may differ. Setting up a monitoring program can help you identify water quality problems, allowing you to take preventative and early corrective action to reduce crop loss.

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