

## MODULE 1. - Essential knowledge

### 6. Salinity management

Salinity is a major issue for irrigated horticulture, especially in covered structures where rainfall cannot assist leaching of soil salts. There is some salt in nearly all water supplies. Every time growers irrigate they add some salt to the greenhouse soil. If this is not managed properly the soil can be damaged and cause problems with the health of plants. This fact sheet looks at salinity and the issues it causes, and strategies for measuring and managing excessive salinity in greenhouse soils.

#### WHAT IS SALINITY?

Salt is a natural component of soils and water. Some salts, eg fertilisers, are useful but too much salt of any kind is detrimental to plants and beneficial organisms in the soil. Salinity is a problem in horticulture that is typically defined by the level of common salt (sodium chloride of Na Cl) in soil and water. Soil and water also contain other salts including trace elements such as calcium, magnesium, potassium.



Extreme salinity – toxic to plant roots

**Excess sodium** (sodicity); High levels of SODIUM in soil will make a soil SODIC. Sodic soils have a horrible dispersive, hard-setting and easily-compacted structure. Well-structured soils have plenty of exchangeable Calcium. Poorly structured, dispersive, “sodic” soils contain high levels of exchangeable Sodium that will displace calcium from the surface of soil particles. Calcium is required to hold soil particles together, ensuring stability, root penetration, water infiltration and aeration. Sodium ions have only half the charge as Calcium ions, so therefore holds particles weakly....which means the bonds between soil particles fall apart, leading to compaction, poor aeration, poor infiltration and root penetration.

This is a common problem in irrigated horticulture because sodium (+ve charge) is not as easy to leach out of soils as its ionic partner chloride (-ve charge), so it stays behind and accumulates. As sodium builds up it can have major detrimental effects on soil structure which stresses plant roots due to poor water penetration and drainage and suffocation.

Sodium leaching is assisted by the use of gypsum, calcium, and some proprietary detergents. Compost assists by opening up the soil for improved drainage.

**Excess chloride.** Chloride can build up in the soil due to issues that make leaching difficult and poor water quality. However, depending on soil type and water tables it can normally be leached out easily.

### Measuring salinity

Salinity levels can be measured in a number of ways, including with an EC meter and a soil sample analysis. High salinity in greenhouses is readily visible as salt rings around the dripper wetting pattern. A common symptom in capsicum plants is ‘burning’ of small fruit during hot spells.

Sodicity (Na excess) can be detected using a 1:5 soil salinity field test and as part of an expert soil test report.

### **THE IMPACT OF SALINITY ON PLANTS, FRUIT AND SOILS**

An increase in soil salinity from saline irrigation water can occur over time. All irrigation water contains some dissolved salts. When the plants use the water, the salts are left behind in the soil and begin to accumulate.

Salinity in soils and irrigation water poses a major challenge for managing soil and plant health and harvest quantity and quality. Plant yield is directly affected by salinity levels. Fruit quality is also affected by salinity stress. High salt levels may cause plant fruits to express stronger flavours in some cases, but may decrease shelf life mainly because of nutrient imbalances in the plant and fruit.

Plants growing in saline soils are unable to extract sufficient water from the soil because of osmotic effects associated with too much soluble salt in the root zone, which creates a ‘**chemically induced drought**’ which leads to reduced plant growth and yield and will tend to lower fruit quality. Reduced water uptake can lead to reduced calcium uptake which will increase the risk of blossom end rot.



Blossom end rot. Salinity can be a factor.

Salt toxicity causes direct damage to plant tissues and can cause plant nutrient imbalance as specific solutes reach critical levels. For example excessive chloride tends to cause burning of leaf tips and margins and if excessive sodium is taken up, because of low potassium levels, it will cause weakening of plant tissues making them more vulnerable to wilting and collapse.

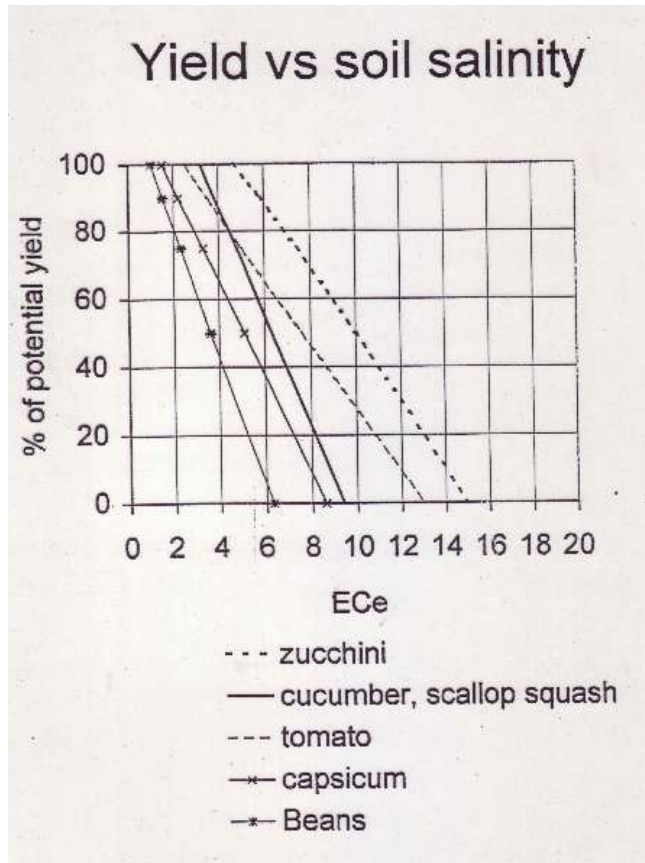
**Nutrient uptake is affected for two reasons.** 1) Reduced ease of water uptake makes it harder for plant to take in dissolved nutrients. 2) High levels of sodium lock out calcium and other trace elements. If Chlorides also build up because the soils are hard to leach they will be taken up by plants and cause leaf burning and other tissue damage.

**Salt favours soil diseases** like pythium, sclerotinia etc, and nematodes that can survive or even thrive in salty degraded soils and overwhelm beneficial soil biology. If we repair the soil physically, chemically and biologically the improved conditions favour beneficial organisms once again so the pests become much less common. If we destroy the soil again with high salt



Moderate salinity

from irrigation water, excessive fertilizers etc. and neglect caring for soil structure, drainage, organic matter etc. the diseases come back!



Most important of all increasing salinity has an overall effect on yields levels. See table opposite.

### SOURCES AND ACCUMULATION OF SALT

Soils have varying levels of naturally occurring salts. Irrigation water varies in its quality in terms of dissolved salts depending on its source (rainwater, mains, bore, reclaimed etc.). Fertilisers can be a source of additional salts. Organic amendments can also vary widely in their salt content (manures, grape-mark, poorly made composts etc.) Salinity, regardless of the various sources can become problematic in the root zone depending on soil type (heavy or light), water quality (salt content), irrigation practices that can contribute to a build up of salts in the root zone, and the overall soil management program that should assist leaching of accumulated salts.

### MANAGING SALINITY

Managing salinity is about:

- Minimizing salt input in water, fertilizers and various soil amendments including cheap 'composts'
- Reducing salt build-up in the root zone during a cropping cycle

Managing salt levels is much easier and less expensive than always battling to control disease, nutrient deficiencies and blossom end rot etc. Because salinity is so damaging to plants and soil,

managing salinity is a key part of preventing and fixing damaged soil.



Very low salinity

*Every aspect of farming is based on having a good understanding of your soil and health status in terms of soil type (texture), salinity, structure, organic matter, biology etc.*

Soil type is primarily determined by soil texture. Soil type (ranging from sand to heavy clay) has a big impact on salt accumulation and management. Soil type is determined by texturing your soil profile, and provides vital information for working out your irrigation program because it enables you to calculate how much water it takes to refill your soil profile. You can avoid under and over watering and fine tune applications to minimise salinity around plant roots and apply effective leaching irrigations.

**NOTE:**

*In sandy soils salt is more mobile and can be leached out more readily. In heavier clay soils, because of reduced drainage, leaching is harder to achieve. Soils with a shallow impervious layer, or worse still a shallow water table underneath are even harder to manage.*

The case study grower has an advantage in his water quality over many other growers. His bore water has an EC of about 700-800 which is pretty good, making it easier to leach salt out. The reclaimed water used by most Virginia growers is closer to 1300EC when tested on farm most of the time, so it adds more salt when irrigating and is not as good for leaching. The best option for such growers is to harvest rainwater in a dam and use this for leaching - a very important investment in water and soil quality! Phuong also has a deep soil profile because of excellent long term soil management and no underlying shallow water table which is also very helpful when leaching.

Key management practices

There are several stages in the crop cycle where salinity levels can be reduced or managed to improve crop health including:

- Improving water quality: Most growers have limited options in terms of changing to mains water or obtaining a bore with lower salinity readings. However all protected cropping growers can capture their rain water in a lined dam providing them with a very low salt water fraction to ‘shandy’ with more saline water supplies/to use for leaching in between crops
- Soil testing: soils must be tested to identify salinity levels to address, and soil characteristics (like sand vs clay etc.) that need to be borne in mind when planning a salt management strategy. Soil testing tools and on-farm options include the following:
  - Simple on-farm physical and chemical soil tests (see fact sheet in Resource Index)
  - EC water/soil tester (around \$150.00)
  - Advanced sampling with various sampling probes at different depths to identify changes in salt levels in response to management actions
- Ripping to improve drainage (ripping) and leaching of salts prior to planting: Leaching of salts is easier in sand than clay because clay does not drain as freely. The amount of water needed should be calculated as a ‘leaching



Ripping helps to improve drainage and leaching

fraction' that is sufficient without being excessive and is different for sand and clay. The more saline the leaching water the larger the required leaching fraction.

- Careful planting to minimise salinity for young plants: After the major pre-plant leaching planting should be preceded by a final leaching through the dripper to further reduce salt in the seedling root zone
- Good irrigation practice should combine optimum water supply (not too much or too little) with salinity management to minimise salt in the root zone.
- Compost is an aid to salinity management: Compost helps to build good soil structure which helps to improve drainage and leaching.

### **Costs and Benefits Related to Managing Salinity**

Salinity issues (physical, chemical and biological) can severely reduce yields and quality. Ensuring the lowest possible salinity from planting to the end of the crop was critical to Phuong achieving improved yields and central to his overall soil health management program. You can track Phuong's changes, what they cost and his estimated benefits and create your own Cost-Benefit estimate for making changes by clicking here for [Module 4. Cost Benefit fact sheet and 'Capsicum Calculator'](#).

### **Additional Fact Sheets And Videos**

A lot more information supporting the topics in this fact sheet is available in the Resource Index under [6. Salinity management](#).



Horticulture Australia

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