Preventing salinization of soilless substrates

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Salinization is an excessive accumulation of water-soluble salts including various compounds of sodium, potassium, calcium, magnesium, sulfates, chlorides, carbohydrates, and bicarbonates.

Salinity becomes a problem when enough salts accumulate in the root zone to negatively affect plant growth. Excess salts in the root zone hinder plant roots from withdrawing water from surrounding substrate. This lowers the amount of water available to the plant, regardless of the amount of water physically in the root zone.

Growing in soilless media is challenging in regards to salinity since the volume of the substrate is relatively limited. This means that the root system cannot grow towards more comfortable conditions, as happens in earth-grown plants, but necessarily remains in the conditions of the space within its container, even if they're sub-optimal. For this reason, it's important to create and maintain optimal growing conditions in the growing media (or, in the root zone) at all times. One method is Proportional Fertigation, where every irrigation event supplies a full spectrum of nutrients to ensure their constant availability.

The small volume of the growing media also reduces its buffering capacity and hence limits our margin of error. For this reason, precise fertigation and well-timed, uniform water distribution are highly important to the prevention of substrate salinization.

Table 1: A limited volume of growing media = a limited buffer of available water and nutrients

Substrate	Root volume (l)	Water content (%)	Available water (l)	N g/l
Soil	500	30	150	52
Peat moss (organic)	25	50	12	3.4
Rockwool (mineral)	15	60	10	2.1

Table 1 shows the relationship between substrate volume and availability of water and nutrients, and consequently, the buffering capacity of the solution. The smaller the growing substrate volume, the more sensitive the plants are to imbalances. As excess salinity is a detrimental factor for plant growth, successful cultivation in soilless media depends on maintaining a good balance of water and nutrients in the root zone.

Start at the source

A high-quality water source with a low EC is an essential starting point for creating a well-balanced nutrient formula. It's important to know the water's EC and pH levels, as well as the ratios of its elements, as stable EC and pH levels enable to precise irrigation. Carry out water analysis to know your initial situation.

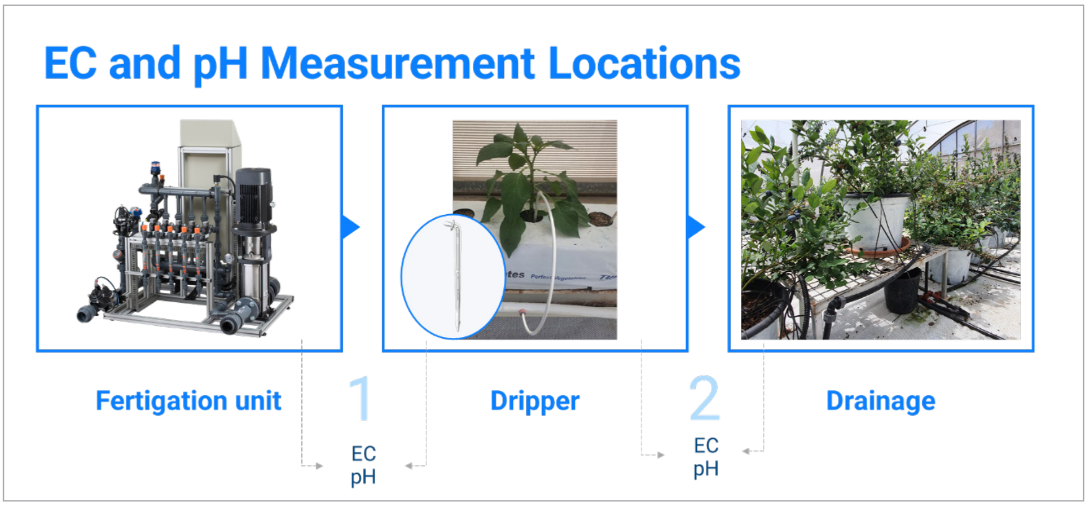
Use of high-grade fertilizer with low sodium and chlorine content is also important in achieving this goal. Sodium are not only salts themselves, but they compete with calcium, potassium and magnesium which are important to the plant.

Salinization results from accumulation of high concentrations of salts. This can occur when irrigation is insufficient to flush them out of the substrate or when uneven water distribution enables their accumulation in dry areas.

Monitoring

As a rule of thumb, 30% drainage should keep the EC at a correct level most of the time. However, constant monitoring is required to keep track of the situation in the root zone and make corrections in real time.

Water volume, EC and pH are monitored in the irrigation solution as well as the drainage. To prevent salinization, we must keep track of the changes in the drainage with time and take care it remains within the required range.



If the measurement shows an accumulation of salts beyond a predetermined limit (usually 0.5mS), a rapid response is necessary to prevent damage to the crop. Action is needed when EC levels in irrigation solution and drainage differ, as indicated in Table 2.

Table 2: Comparison of EC levels between irrigation and drainage indicates when corrective measures must be taken.

EC measurement results			Action
Dripper EC level	=	Drainage EC level	None required
Dripper EC level	>	Drainage EC level	Inspection and appropriate action
Dripper EC level	<	Drainage EC level	Immediate action required

If there's a difference which is smaller than 0.5mS/cm, follow to ensure that the gap does not increase.

When dripper EC is higher than drainage EC, it is often because the plants consumed nutrients. In this case, increase fertilizer in the irrigation solution. Another situation which can cause a lower EC in drainage than in irrigation solution is unintended washing. This will usually be accompanied by a high drainage volume, i.e., above 40%.

When dripper EC is lower than drainage EC, it's usually due to a smaller than necessary irrigation volume. In this case, increase irrigation time. In some cases, a flushing process may be necessary. Flushing is done with a relatively high volume of water, with the required pH but without fertilizer (salts), until the drainage EC target is reached.

Rapid response irrigation system

In order to prevent salinization and to minimize damage once salinity has been detected, a hydraulic system which can provide the necessary response must be in place. The hydraulic system must be designed a priori to supply not only the day-to day water needs of the crop, but also the exceptional demands for in case EC drainage monitoring show unwanted values:
A relatively high flow, pressure compensated, non-leakage dripper (PCJ CNL for example) enables keeping the system (including the main and submains) pressurized at all times, to get the required flow immediately and simultaneously.

To summarize

Remember that when you fertigate in soilless media, you give your plants the best chance to fulfill their potential, but at the same time, you decrease your margin of error. Being aware, monitoring, and making adjustments is the key to success.