Nutrient solution: EC & pH measurement instructions

Jordan Hydroponic Agriculture and Employment Development Project: Experiences 2018 - 2019 no. 2-1

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Why?

You need to measure the EC and pH mainly for the following 3 reasons:

1) To check whether your system is supplying the requested EC and pH. This is called feedback control.
2) To check if the EC & pH in the root environment are in the safe range.
3) To find out if there are trends and relations between the applied EC and plant growth & development. In order to do this you need to record your measurements in excel or other software.

Supply

Why: You will need to measure the EC & pH from a dripper to perform feedback control: does the supplied nutrient solution have the same EC & pH as set in the computer?
How: Measure the EC & pH from the same bucket in which you collect supply water for your supply volume measurement.

Root environment

Why: Roots can excrete anions and cations which will greatly influence the values of the EC and the pH in the root environments. This is why you also need to check the root environment.
How: Use a syringe (figure 1) and place it in the slab under a plant, take a sample from the slab and put it in a container to be measured. Take approximately 5 samples spread over the greenhouse. Put the syringe under the block, facing away from the dripper, and make a hole in the slab to take the sample. You want the pH to be between 5.5 and 6.5 and the desired range of the EC depends on your own preference. Do not mix samples as the pH of mixes is no longer reliable. If you encounter an extreme value or weird pattern, try to find out the reason by taking more samples and closely observing the plants on the slabs with these extreme values.

Figure 1: Taking a sample from the root environment

Drain

Why: Plants take up relatively more water than nutrients which means that the drain water is more concentrated with nutrients than the supply. If it is lower, it means your plants did not received enough nutrients.
How: Measure the EC & pH from the same bucket in which you collect drain water for your drain volume measurement.

Sensors

EC and pH have to be measured with special sensors (figure 2). Make sure to check whether they are working properly and calibrate them every 3 months. Make sure the tip of the pH meter is stored moist at all times using a mist dot of cotton wool or similar.

Figure 2: pH & EC sensor.

Definitions

pH: pH is a scale used to specify how acidic or basic the nutrient solution is. Most nutrients are available at a pH range between 5.5 and 6.5. This means that the pH determines the availability of elements (figure 4). Too high or low pH will quickly harm your plants.

Electronic Conductivity (EC): EC indicates the salt concentration of your nutrient solution. EC is expressed in milliSiemens per centimeter (mS/cm). The higher the total salts concentration, the higher the EC. Salts that are not taken up by the plant, can accumulate in the slabs. This is why a drain percentage is needed to flush out these salts.

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Nutrient solution : EC & pH interpretation

Jordan Hydroponic Agriculture and Employment Development Project: Experiences 2018 - 2019 no. 2-2

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EC

- The ideal EC is specific for each crop and dependent on environmental conditions, they generally range from 1.5 to 2.5 $mS \cdot cm^{-1}$. Higher EC hinders nutrient uptake by increasing osmotic pressure, whereas lower EC may severely affect plant health and yield by nutrient uptake deficiencies.

- Blossom End Rot (BER) (figure 3) is a result of calcium deficiency but it is often caused by too high salt levels. At high salt levels other nutrients, mainly Potassium (K) compete with calcium (Ca) reducing it's availability. This results in low calcium levels in the fruit. It is also increasing with hot weather, high levels of ammonium and potassium. If your plants suffer from BER, do not remove the affected fruits. This will cause calcium deficiency to move up to higher trusses. Analyse your nutrient solution in the lab and quickly adjust the nutrient recipe accordingly.

Figure 3: Blossom end rot

- Maintaining a proper drain is an important part of EC management. Too low drain (<20%) causes salts to accumulate whereas a too high drain (>30%) causes nutrients to flush out and costs extra money.

pH

- If the pH in your slabs is too high or too low it can quickly harm your plants; high pH hinders nutrient uptake of P, Ca, Fe, Mn, Zn, Cu, and low pH values cause burning of your plant roots.

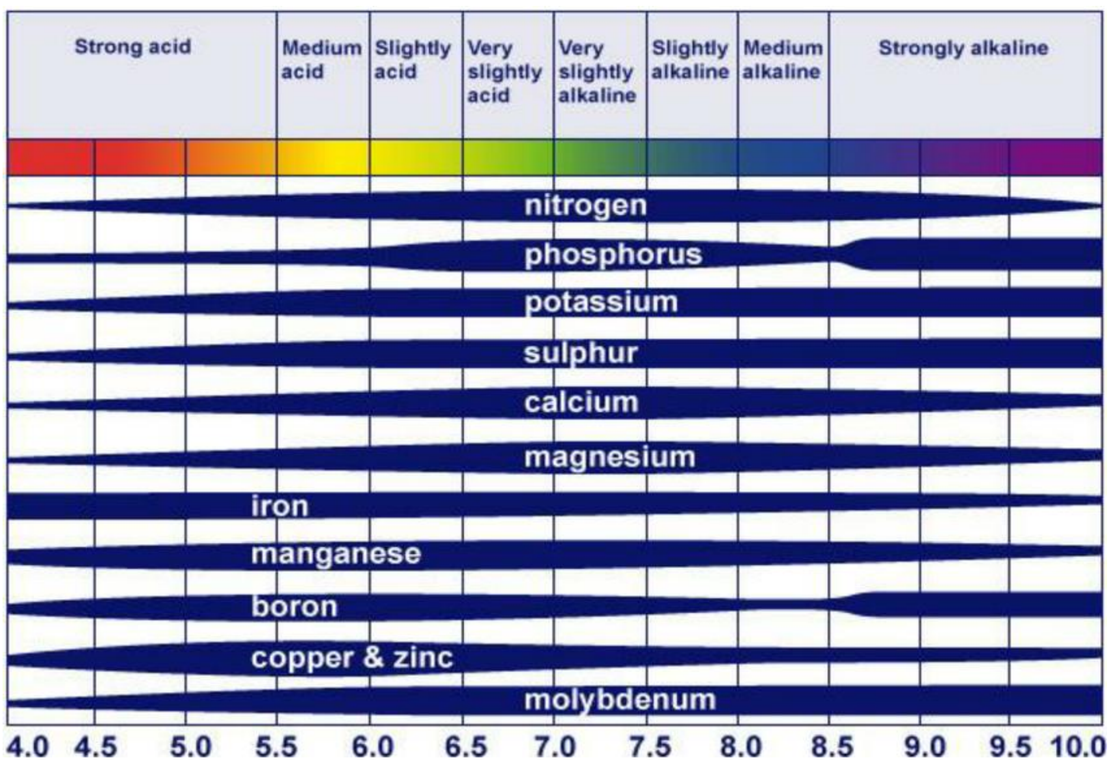

Figure 4: Availability of nutrients at different pH values

- Uptake of anions results in excretion of OH^- increasing the pH and uptake of cations results in excretion of H^+ decreasing the pH. NO_3^- and NH_4^+ are both sources of nitrogen, but NO_3^- is a anion and NH_4^+ is a cation. Uptake of NO_3^- results in excretion of 1 OH^- whereas uptake of NH_4^+ results in excretion of 2 H^+. You can use your nitrogen source to balance the pH. In substrate growing, NH_4^+ always needs to be low as it quickly acidifies your substrate! The ratio of moles from ammonium should be 7% or less of the total moles of Nitrogen.

Important

EC and pH measurements only give you a general idea of what is happening in the slabs. Regularly send samples of the supply, slab and drain solution to a lab for component analysis. During propagation preferably weekly and later in the growing season monthly. The effects of nutrient deficiencies and excess are often not noted until it is too late. Performing analysis regularly will therefore certainly be worth its costs.

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