SOLUBLE SALTS

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While there is no replacement for a complete soil test, testing pH and EC (electrical conductivity or the salts level) can help monitor the progress of a crop. The results of soluble salts tests answer many grower questions about crop performance often before symptoms show. The importance of an EC or soluble salts measurement is associated with the fertilization program. Take pH and EC readings on a regular basis in the greenhouse by using meters that are available to you.

What are soluble salts?

Soluble salts are a measure of total soluble salts in the media. While from this definition it may seem that the greater the number, the more fertilizer available, the better plant grown, this isn't always the case.

Salts, or fertilizers, are taken up by the roots when the concentration of salts is higher in the root cells than in the surrounding media. Salts are taken up in solution with water. If the salt concentration in the medium is higher than the concentration in the root cells, water can no longer move into the roots and therefore the plant. This means that if a grower applies too much fertilizer the plant will be unable to take up the fertilizer. After a plant loses water through transpiration, the plant begins to dry out if the medium salts level is too high.

Excess salt in the growing medium can harm a plant. First signs that salt levels may be high in a medium is wilting of a plant, even though the plant has been recently watered. This is due to the dieback of the root tips and water moving from the roots to the media. The most dieback occurs in drier portions of the media. Leaves begin to show necrosis along leaf margins following root tip dieback. Further damage shows up as necrotic spots on the leaves. Eventually the plant shows nutrient deficiency symptoms since the roots are unable to take up nutrients after the dieback.

Fertilizers are not the only source of soluble salts in a growing medium. Growers may have high salts levels in their irrigation water. This is especially true for growers in northwestern Minnesota and eastern North Dakota. Some growers can work with this water, using the naturally present minerals to help provide fertilization for their crops. Other growers may have to consider drilling a new well that provides a deeper, and hopefully a cleaner, water source. Still other growers have to look for water treatment, such as reverse osmosis, to provide usable water for their crops.

Different fertilizers provide different amounts of salts to plants. The various fertilizers used may also provide salts that plants use rapidly or salts that are used in minimal quantities in the plant and only contribute to the soluble salt level. Table 1

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Table 1. *Relative salt index for several fertilizers. (From Rader, White and Whittaker, 1943.)*

Fertilizer	Salt Index
Sodium nitrate (nitrate of soda)[1]	100
Potassium chloride (muriate of potash—60% K_2O)	116
Ammonium nitrate	105
Urea	75
Potassium nitrate	74
Ammonium sulfate	69
Calcium nitrate	53
Potassium sulfate	46
Magnesium sulfate	44
Diammonium phosphate	34
Monoammonium phosphate	30
Concentrated superphosphate	10
48% superphosphate	10
20% superphosphate	8
Gypsum	8
Limestone	5

[1] Sodium nitrate was arbitrarily set at 100. The lower the index value the smaller the contribution which the fertilizer makes to the soluble salt level of the root medium.

gives the relative salt index of several fertilizers. The higher the number, the greater the potential for increasing soluble salts. You can see that the first two fertilizers listed are two that are not commonly used in the greenhouse, sodium nitrate and potassium chloride. These materials are not commonly used because in the case of sodium nitrate, the nitrate is quickly used by the plant, but the sodium is just a source of raising soluble salts in the media. The same is true with potassium chloride, where the potassium is readily used, but the chloride stays in the media raising the soluble salts levels. This is just a reminder to select the fertilizers that you use carefully and be aware of how plants will use all portions of the fertilizer.

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Measuring EC

EC is simply the electrical conductivity of a solution. Electricity is conducted through a solution increasingly more easily as the amount of salt in solution increases. To measure the EC of a growing medium mix the medium with distilled water in varying ratios. Some meters recommend using a saturated paste where the medium is mixed with only enough water to saturate it. Another method is a 1:2 dilution test were 2 volumes of distilled water are added to 1 volume of growing medium. The soil testing lab at the U of M uses a 1:5 dilution test for testing EC, were 5 volumes of distilled water are added to 1 volume of growing medium. Allow these mixtures to sit for at least 30 minutes to permit all of the salts to leach out of the medium and dissolve into the solution. Place the EC probe in the solution to measure the conductivity of the solution.

Conductivity is measured in mho/cm. A mho is the opposite of an ohm of electrical resistance. Because the conductivity is very low, saturated paste tests are measured in millimhos or thousandths of a mho (mho/cm x 10^{-3}). In the case of the 1:2 or the 1:5 dilutions tests, the measurement is hundred-thousandths of a mho or micromhos (mho/cm x 10^{-5}). Table 2 gives some broad guidelines for interpretation of EC readings.

What to do about soluble salts?

Once you have the readings of soluble salts levels from your crop, you can make some informed decisions. Generally the readings will be within the acceptable limits that you are trying to achieve. If the readings are either high, or low, consider a complete soil test to determine what nutrient is causing a problem. If the soluble salts reading is low, addition of potassium nitrate will not help the plant if it is actually the calcium and magnesium levels that are low. In contrast, leaching may not be the right way to go if a high soluble salt reading is due to high sodium in the water source.

Remember that 'on site' measurements of soluble salts are intended to give you a guideline of what is happening in the growing medium, not to answer all the nutritional questions you may have. Complete soil tests are still needed to insure that you can keep track of the fertilization and growth

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Table 2. *Interpretation of soluble salts levels. (From Nelson, 1985).*

Dilution[1] 1:2		1:5	Saturated[2] Paste Extract,	
Soil	Soiless	Soil	Soil and Soilless	Interpretation
0-25	0-?	1-10	0-1	Insufficient nutrition
26-50	?-100	11-25	1-2	Low fertility unless applied with every watering
100		50	3-5	Maximum for planting seedlings or rooted cuttings
51-125	100-175	26-60	2-4	Good for most crops
126-175	176-225	61-80	4-8	Good for established crops
176-200	225-350	81-100	8-16	Danger area
Over 200	Over 350	Over 100	Over 16	Usually injurious

1 mho x 10^{-5}/cm.
2 millimho/cm.

patterns of your plants. When you send in your next complete soil test, take a soluble salts test of your own. This is an excellent way of testing to see if your readings are in line with the readings from the professional labs.

However you feel is the best way of charting the progress of your plants, frequent complete tests from the soil labs or less frequent complete tests and on site tests that you perform, make sure that you record results for future reference.

When you send in your next complete soil test, take a soluble salts test of your own.