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Understanding Plant Nutrition: Low Media-EC

In the fourth article of this 12-part series, Fisher and Argo pore over the details to systematically identify and correct common nutritional problems found in the greenhouse.

by ***PAUL FISHER, PH.D.*** *and* ***BILL ARGO, PH.D.***

WHEN growers talk about "lack of feed" or "hungry plants" (Figure 1), the issue is usually insufficient supply of fertilizer nutrients. The easiest way to measure fertilizer level in the root media is with an electrical conductivity, or "EC," meter.

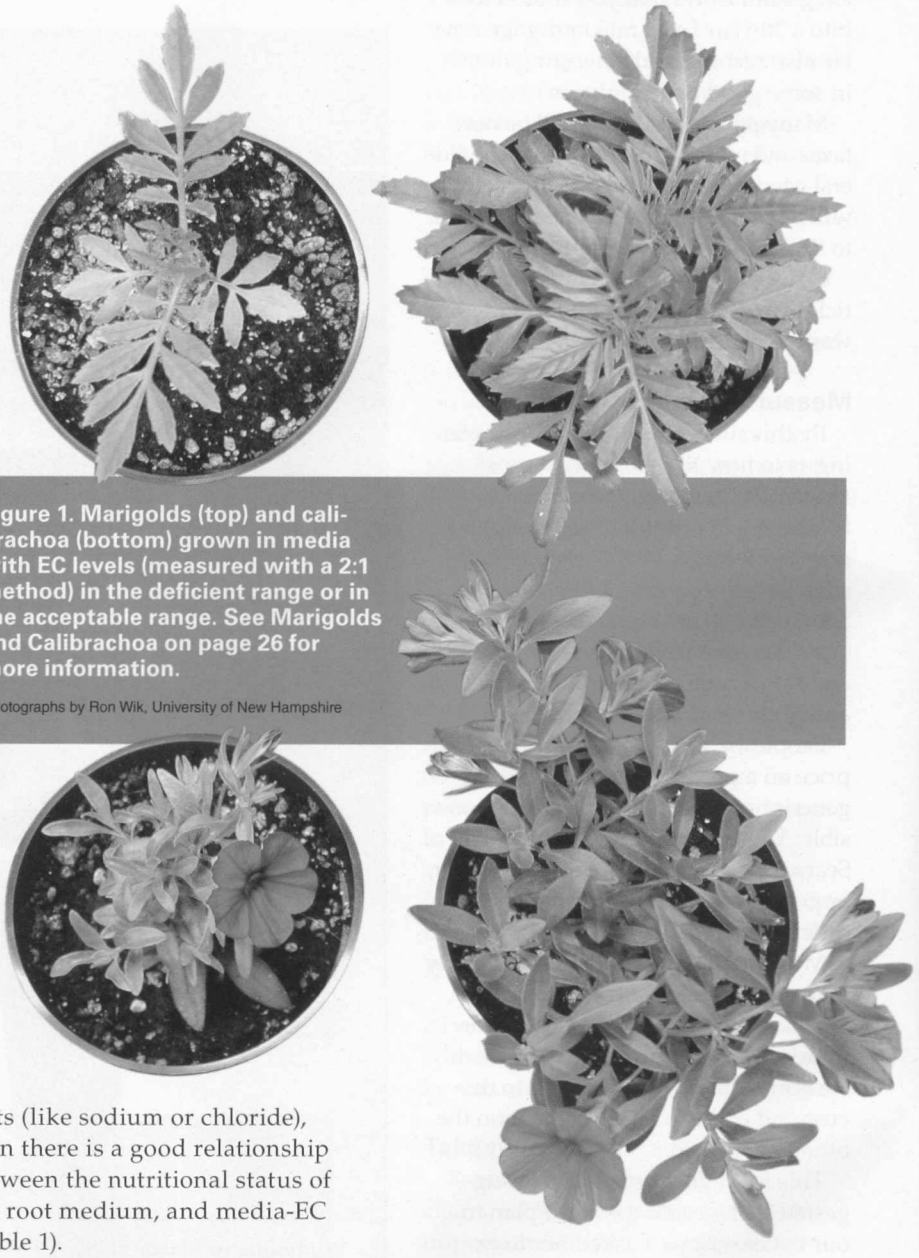

Figure 1. Marigolds (top) and calibrachoa (bottom) grown in media with EC levels (measured with a 2:1 method) in the deficient range or in the acceptable range. See Marigolds and Calibrachoa on page 26 for more information.

Photographs by Ron Wik, University of New Hampshire

What is Media-EC?

Electrical conductivity (also know as conductivity, EC or soluble salts) is a term used to measure the total concentration of "salts" in a solution. When salts are dissolved in water, they break apart into their individual constituents, called ions. For example, sodium chloride or table salt, when dissolved in water, breaks apart into sodium ions and chloride ions. Since pure water has no electrical conductivity (EC = 0), increasing EC means more salt is dissolved in the solution.

In greenhouse and nursery production, you can quantify the nutrient status of the growing medium with a soil test. As long as your irrigation water source has nutrient levels within an acceptable range and you are using a balanced fertilizer that doesn't contain a lot of useless salts (like sodium or chloride), then there is a good relationship between the nutritional status of the root medium, and media-EC (Table 1).

EC is a measure of the total salt

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Table 1. Interpretation of media electrical conductivity (EC) or soluble salt levels. For salt-sensitive crops, like orchids, the low fertility level range would be a good starting point. Values are reported in mS/cm.

	1:2 Method	Saturated media extract method	Pour-through method	Plug squeeze method
Low fertility	0 to 0.5	0 to 1.0	0 to 2.4	0 to 2.4
Acceptable range	0.6 to 1.5	1.1 to 3.0	2.5 to 5.0	2.5 to 4.0
High fertility	>1.5	>3.0	>5.0	>4.0

Values are reported in milliSiemens per centimeter (mS/cm). The units of measure for EC can be mmho/cm, dS/m, mS/cm, µM/cm or mmho x 10-5/cm. The relationship is 1 mmho/cm=1 dS/m=1 mS/cm=1000 µS/cm=100 mmho x 10-5/cm.

concentration in the extracted solution, but EC does not give an indication of the concentration of any individual plant nutrient. The only way to determine exactly which ions make up the EC is to use a more extensive commercial laboratory analysis that will not only measure the EC, but also the concentration of each of the nutrients (ions).

Because of differences between batches of growing media, even from commercially blended products, it is important to not only know what your starting nutrient intensity is (as measured by EC), but also the composition and balance of the nutrients making up the EC (as measured with a complete soil test at a laboratory).

What Causes Low Media-EC?

The initial concentration of nutrients in a container media is provided by the pre-plant nutrient charge, which may include lime (providing calcium and magnesium), and other fertilizers such as superphosphate, gypsum or urea-formaldehyde. Part of the initial nutrient source is immediately soluble and therefore affects the initial media-EC. Other nutrient sources are bound to the soil particles or are in a slow-release form (e.g. limestone, resin-coated fertilizers), and only affect EC as nutrients dissolve into the soil solution.

Most media components, such as peat, bark or perlite supply a small amount of nutrients, whereas compost can supply significant nutrients as it decomposes and releases nutrients.

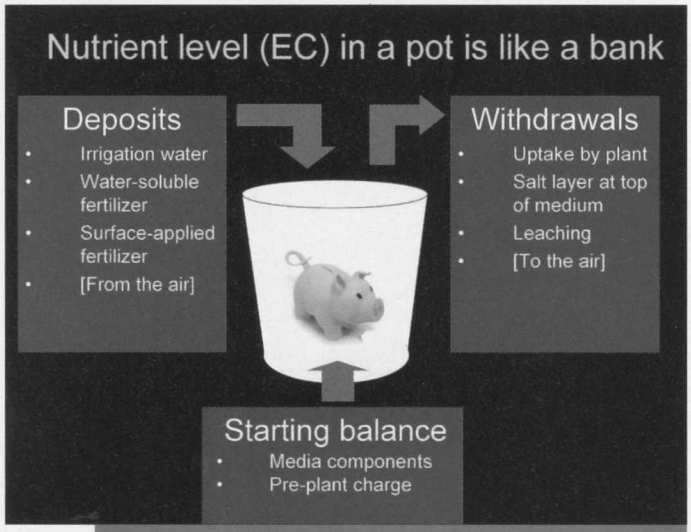

Figure 2. Nutrient level is a balance of factors.

After planting, the goal is to balance deposits and withdrawals, in order to supply nutrients to the plant within an optimal level so they don't get too high or too low. This is measured during the season by regular on-site EC testing.

You can picture the nutrients available for plant uptake in a pot using the analogy of a bank account (Figure 2).

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We can increase the account balance by making deposits through salts contained in the irrigation water, with water-soluble fertilizer, or by surface-applying nutrients. Certain nutrients (carbon, nitrogen, oxygen and hydrogen) can be fixed from the air and water, but they do not contribute to soil EC unless they are dissolved ions in the soil solution.

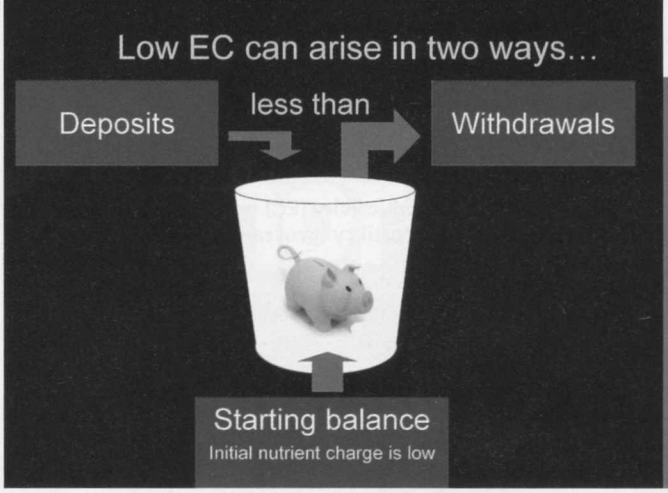
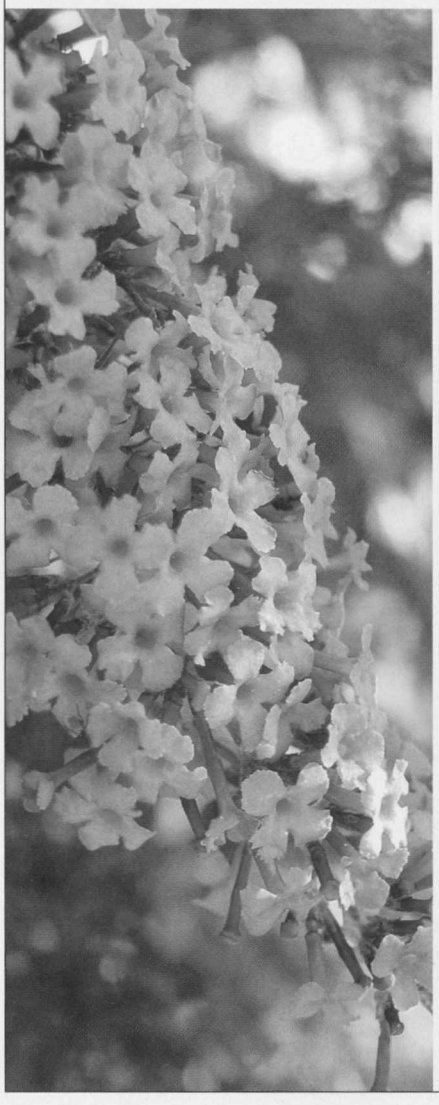


Figure 3. A low EC arises over time if withdrawal of nutrients through leaching or plant uptake is more rapid than deposits of new fertilizer, or when the initial nutrient charge (starting balance) is too low.



Marigold & Calibrachoa

- **Disorder:** insufficient fertilizer
- **Symptoms:** overall yellowing or purple color on all leaves, especially on older leaves.
- **Likely suspects:** All plants, especially fast-growing (high fertilizer-demanding) crops such as petunia.
- **Less likely to show the disorder:** slow-growing plants, or low fertilizer-demanding crops such as New Guinea impatiens (iron-efficient plants)
- **Confirm with:** an EC test, tissue analysis, response to a drench of fertilizer
- **Causes:** injector not working, fertilizer concentration not high enough, excess leaching.
- **Solutions:** Apply a water-soluble fertilizer that contains NPK and micronutrients. Suggested constant water-soluble fertilizer levels (parts per million of nitrogen) to correct low media-EC on plants that show deficiency symptoms are:
  - 150-200 ppm N plugs
  - 200-300 ppm N bedding plant flats
  - 300-400 ppm N larger containers

The account balance is decreased by several types of withdrawal. These include nutrients taken up by roots for plant growth. The faster the crop is growing, the more nutrients are withdrawn from the crop and the more fertilizer needs to be deposited. Plants often require greater amounts of nutrients as growth rate increases during the middle of the crop, and less nutrients both when plants are very small or are mature and flower-

ing. Some growers may increase the fertilizer concentration during this rapid growth phase, but keep the fertilizer concentration lower during the early and later stages of the crop.

Leaching is a very important type of withdrawal, because nutrients leaving the container can enter the environment and it is the one type of withdrawal that is completely controlled by the grower.

Many growers routinely leach, but this is not needed if irrigation water contains few impurities such as sodium and chloride. Leaching washes nutrients from the pot, and leaching with clear water is therefore one way to reduce EC when the nutrient concentration is too high. However, the more a crop is leached on a routine basis, the higher the applied fertilizer concentration that is needed to maintain adequate nutrient levels in the root media. In other words, lower fertilizer concentration with low leaching can have the same effect on the EC account balance, with less cost, compared to a high leach/high concentration approach.

An excessively low EC means the nutrient balance can become "bankrupt" (i.e. there is inadequate nutrient level for healthy growth and plant stress occurs). You then need to deposit additional fertilizer. Figure 3 shows a low EC may occur if the starting balance is low, or if the withdrawals are occurring more rapidly than deposits.

Summary

Overall, the goal of any nutrition program is to supply nutrients at the same rate as needed for plant uptake. This can be achieved with many strategies, including controlled release and water soluble fertilizers. The faster your crop is growing or the more you leach, the greater your fertilizer cost. Regular soil testing helps avoid having deficiency or toxicity symptoms. **GG**

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