Media pH and EC Effects

Don't disregard testing your media pH and EC; it could save your crop.

By Roger C. Styer

High media pH on petunia. (Photos courtesy of Roger Styer)

Generally, at this time of the spring season, I get a number of phone calls from concerned growers who say their plants are turning yellow, stunted or generally not growing the way they should. After a few questions, it becomes apparent that the problem is related to either media pH or EC. In fact, over 80 percent of nutritional problems are caused by media pH or EC being out of bounds.

When I talk to growers at a seminar or training session, I ask them what the two most important instruments are on the dashboard of their car. After some guesses, the audience decides the speedometer and gas gauge are most important. You look at and depend on the speedometer to tell you when you are going too fast or too slow. Either way, you are looking at a range of speed. That is the same as media pH. Media pH determines the availability of nutrients to the plant. If you go too high or too low, bad things happen.

The gas gauge is important because it tells you if you have enough gas. Media EC is the same as the gas gauge. If too low, plants run out of gas. But if media EC is too high, growth can become excessive or roots may burn. So, to put it bluntly, would you drive a car where the speedometer and gas gauge do not work? Of course not! Then how can you grow plants without measuring the media pH and EC on a regular basis? That is like driving a car by the seat of your pants! It's like you are just waiting for the car to tell you it has a problem, which by that time is when you have crashed, been pulled over by police or run out of gas.

FACTORS AFFECTING MEDIA PH

There are four primary factors affecting media pH in peat-based media: 1) alkalinity of the water; 2) lime in the media; 3) choice of fertilizer; and 4) the plant roots themselves. The alkalinity of the water, not the water pH, is the most important factor affecting media pH, as you water so often. Think of alkalinity as lime in the water, so that every time you water, you are adding lime to the media, which raises the media pH. Alkalinity levels of 60-80 ppm are fine for plugs, whereas 80-120 ppm are fine for bedding plants and larger containers. Anything higher than these ranges will cause an increase in media pH. Too low of alkalinity (less than 50 ppm) can cause wild swings in media pH, generally pushing it down. High levels of alkalinity are usually lowered into the proper range with acid injection, using sulfuric, phosphoric, nitric or organic acids. If using acid injection, test the water weekly for alkalinity levels, not just water pH, to make sure the injectors are working properly. Also, have your main water source tested by a reputable lab every six months.

Lime is added to a peat-based media due to the extremely low pH of the peat moss. In order to get the media into the proper growing range of 5.5-6.5, some lime needs to be added. There are several types of lime that can be used: hydrated lime, calcitic lime or dolomitic lime. Hydrated lime reacts very quickly but does not last long. Calcitic lime is slower to react but lasts longer than hydrated lime. Dolomitic lime also contains magnesium, which is a plant nutrient. Gypsum or calcium sulfate is another form of slow-release calcium added to media, but does not affect pH. The type, amount and particle size of the lime will determine how fast media pH will increase and to what level. Watering frequency will increase the speed of lime activation. For most crops, the media pH should be 5.5-6.0 for the crop cycle, but other crops like 6.0-6.5. As a whole, crops do not like to grow at a low pH of 5.0-5.2.

Your choice of fertilizer will also affect media pH (See figure 1, below). When you use fertilizers high in ammoniacal nitrogen and phosphorus, they will have an acidic reaction in the media. But these fertilizers will also promote fast soft growth of the shoots and leaves. When you use fertilizers high in nitrate nitrogen and calcium, the shoot growth is more toned, root growth is improved and the media pH tends to increase. Choose your fertilizer based on what you want the plants to do, but keep a close eye on the effect on the media pH.

Finally, the plant roots themselves can influence the media pH. Crops ➧

Figure 1. Common commercial fertilizers (list of some commercially available fertilizers used for plugs and bedding plants). Not all formulations are the same from every company. Check the label.

Fertilizer	Ammonium [1] (percent)	Potential Acidity [2]	Potential Basicity [3]	Calcium [4] (percent)	Magnesium [4] (percent)
21-7-7	100	1560	0	—	—
9-45-15	100	940	0	—	—
20-20-20	69	583	0	—	—
20-10-20	40	422	0	—	—
21-5-20 (Excel)	40	418	0	—	—
15-15-15 *	52	261	0	—	—
15-16-17 *	30	165	0	—	—
20-0-20	25	40	0	5	—
17-5-17	24	0	0	3	1
17-0-17	20	0	75	4	2
15-5-15 (Excel)	22	0	141	5	2
13-2-13	11	0	200	6	3
14-0-14	8	0	220	6	3
15-0-15	13	0	420	11	—

[1] *Ammonium (percent) is the total nitrogen percentage that is in the ammonium plus urea forms; the remaining nitrogen is nitrate.*
[2] *Pounds of calcium carbonate limestone required to neutralize the acidity caused by using 1 ton of the specified fertilizer.*
[3] *Application of 1 ton of the specified fertilizer is equivalent to applying this many pounds of calcium carbonate limestone.*
[4] *Only where percent calcium or percent magnesium were 1 percent or greater.*
* *Contains sodium nitrate (nitrate of soda), which adds unwanted sodium to plugs.*

such as geraniums tend to lower the media pH, which causes problems with micronutrient toxicities on the lower leaves. Other crops, such as vinca, tend to raise the media pH over time, causing micronutrients to become deficient. The older the root system, the more likely media pH will change.

FACTORS AFFECTING MEDIA EC

There are a number of factors that affect media EC or soluble salts: water quality, starter charge, media components, fertilizer type and rate, watering technique, environment and age of plant roots. Obviously, if you are using water containing 1.0 µmhos or higher, media EC levels will be quite high, especially after adding any liquid fertilizers. Good quality water should be less than 0.75 µmhos. Most commercial mixes have a starter fertilizer charge added to help with growth during the first week or so after sowing or transplanting. When you take a measurement of media EC out of the bag, you are measuring the starter charge as well as the lime or gypsum. The combination of media components determines cation exchange capacity (CEC), which is the ability of the media to hold onto nutrients. The greater the CEC, the less you need to feed. Fertilizers are a type of salt, so which ones you choose, how much ppm you feed and the frequency of feeding all determine the media EC as you are growing the crop.

How you water the crop will influence EC levels. If you do not leach on a regular basis, you will build up salts towards the bottom of the container, causing damage to roots when they enter that area.

Environment can also affect media EC. Cool temperatures will keep a grower from watering often enough and can build up soluble salts. Low light levels and high humidity will cause the same problems, in addition to causing the plants to stretch and become soft. Finally, the older the root system, the less effect of soluble salts on burning roots and causing root rots.

TESTING MEDIA PH AND EC

All growers should do their own media pH and EC testing every week, at least on key crops. They can then send in periodic samples to a reputable testing lab for complete media (and tissue) analysis to back up their own findings, when they have problems showing up, or when they change something big such as the media or fertilizer program.

Samples should be taken from commercial mixes out of the bag or your own hopper before sowing or planting the crop. To determine the true effect of the lime in the media, I suggest you also take samples after watering the flats or trays for one and two weeks with just your water, no feed. You should be able to see how the lime will affect the media pH within the first two ➧

weeks. Afterwards, I tell growers to monitor key crops, the ones more likely to show problems with media pH or EC. Here are my recommendations:

Dislikes Low pH	Dislikes High pH	Dislikes High EC
Seed and zonal geraniums	Dianthus	Vinca
African marigold	Vinca	Impatiens — any type
Penta	Pansy	Pansy
Lisianthus	Petunia	Primula
NG impatiens	Primula	Penta
Snapdragons		

If you test one or more crops from each list weekly, you can avoid problems on those crops before they show up. All other crops will fall somewhere in between the above crops and do not need to be tested unless problems show up.

I have outlined (right) the two most common methods of testing media: Saturated paste (SME) and 2:1 Extraction. Most commercial labs will use the SME method. You can also use the Squeeze Method for plugs (done right after watering or feeding by pushing the water through the bottom of the cells and collecting it), or the Pour Thru Method for pots (similar to SME without disturbing the media). I prefer the first two methods, as standards have been extensively developed for the results. Whichever method you choose, have the same person do it, and do it the same way every time, including how long to wait before measuring the extract.

Once you have your media pH and EC results, you should graph them for each crop so you can see what is happening over time. Is the general trend for media pH increasing or decreasing? Is media EC fluctuating or going up? Be careful about overreacting to a particular measurement. For instance, EC levels will fluctuate a lot depending on how long after watering or feeding you took the sample each week. You will get a higher EC when sampling two to four hours after feeding than when sampling two days after feeding.

Finally, choose your equipment for measuring media pH and EC based on your needs and how much you want to spend. You can purchase pocket pH and EC meters for about $50, but they do not last as long as other meters and

Top: High media EC damage to roots; Bottom: Low media pH on lisianthus.

are not as exact. Meters can run from $50 to $1,000, depending on how accurate you want to be and whether you want to measure in the greenhouse or in a separate room. I recently had the chance to work with a new EC meter that can quickly measure EC in media without removing the soil. All you do is stick the probe into the soil within one hour of watering or feeding, and get your measurements, whether from a plug tray or poinsettia pot. This new EC meter can be purchased from Spectrum Technologies. Contact your local greenhouse supply company for more information on pH and EC meters. Make sure you carefully calibrate pH meters before every use, and EC meters every other week or so.

ON-SITE MEDIA TESTING PROCEDURES

What Samples to Collect. Collect samples from the inner cells of representative plug trays or from the root zone of containers. With containers, make sure you sample more than one, and sample from the lower ⅔ of the container. With plug trays, use roots zones only, no tops of plants.

When to Collect Samples. It is best to sample fertilized plugs or containers two to four hours after fertilizing. Samples collected more than one day after fertilizing may show much lower EC levels.

EXTRACTION METHOD (SATURATED PASTE OR SME)

1. Collect about ½ cup of media for each sample.
2. Place media sample in a clean container, add distilled water until media sample just glistens on the top, and stir the sample. Let sit for 30 minutes.
3. Calibrate the pH and EC meters while waiting.
4. Pour off the solution through a paper towel filter or fine cheesecloth into a clean container, place the proper electrode into the solution, and record the value after about one minute or until number stabilizes.
5. Rinse electrodes thoroughly with distilled water after each sample.
6. After recording all of the samples, rinse out the containers with water and rinse once with distilled water.

EXTRACTION METHOD (2:1 DILUTION)

1. Collect about ½ cup of media for each sample and air-dry the samples before mixing with distilled water.
2. Place ¼ cup of media plus ½ cup distilled water in a clean container. Stir the sample and let sit for 30 minutes.
3. Follow Steps 3-6 from SME method above.

CORRECTING MEDIA PH AND EC PROBLEMS

Even with all of the above testing on key crops, you still may have some problems show up. The most common problem I see is high media pH, showing up as interveinal chlorosis (yellowing) on younger leaves or tip abortion with lateral branching. The upper yellow leaves are typical of iron deficiency, while the tip abortion is typical of boron deficiency, both caused by high media pH. To correct high media pH, choose from the following:

- Use more acid if already using acid injection. Crank the alkalinity down to 0 or the water pH down to 3.0 for about one week, then adjust back to normal levels.
- Use an acid fertilizer, such as 21-7-7, at about 200-250 ppm one to two times. Be careful controlling excessive growth with this fertilizer.

Low media pH on geranium.

• Use a drench of iron sulfate at 1-2 lbs. per 100 gal. For iron sulfate to be active, it must dissolve in solution and be bluish. If not, then it has oxidized and will not be as active. Make sure to rinse off plants with clear water immediately after drenching.

• For long-term fixes, control alkalinity levels with acid injection, and monitor how much lime is being added to your mix.

Low media pH problems will generally show up on the lower leaves as necrotic spots, stippling of leaves or marginal burn. Sometimes the symptom is a general yellowing and stunting of the plant. The lower leaves show problems with micronutrient toxicities, such as iron, manganese, copper and zinc. If calcium deficiency is involved, severe stunting along with tip abortion and stubbing of root tips will be seen. To correct low media pH, choose from the following:

• Turn off the acid if using acid injection. Let the high alkalinity levels in your water raise the media pH.

• Use a basic fertilizer, such as 13-2-13 or 15-0-15, at about 200-250 ppm one to two times. These fertilizers will not cause excessive top growth.

• Use a drench of liquid lime at 4 qts. per 100 gal., making sure to get enough volume through the pot. Rinse off plants with clear water to avoid build-up on leaves.

• Use a drench of potassium bicarbonate at 2 lbs. per 100 gal., making sure to get enough volume through the pot. Rinse off plants with clear water, and follow up with a calcium-containing fertilizer in the next few days.

• For long-term fixes, add more lime to your mix or readjust acid injection for proper levels of alkalinity.

High media EC problems generally show up as either excessive top growth or damage to root tips and more root rots. If you tend to be a dry grower, you should avoid high media EC levels at all costs. Drying down some plants too far causes the EC levels to build up 3-4 times around the roots. Crops that show problems with high EC include primula, pansy, vinca, any impatiens and penta. To correct high media EC problems, choose from the following:

• Water through the container completely in order to get 10-20 percent run-through. Avoid watering lightly, especially when feeding or using water with high EC levels.

• Use lower levels of fertilizer until plant roots are more developed.

• Avoid using high ammoniacal nitrogen fertilizers when growing temperatures are less than 60° F. This builds up ammonium toxicity, which shows up as salt damage.

• Use more perlite in your mix to improve air porosity (drying) and to reduce CEC.

• Switch to a better source of water, such as city, rainwater or reverse osmosis.

Get yourself some reliable pH and EC meters and use them properly. Otherwise, you are growing plants by the seat of your pants! If you wait for the plants to show you problems, you already have a major crash on your hands and little time to correct. GPN

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