LESSONS LEARNED FROM ON-FARM TRIALS WITH ORGANIC MIXES – ALKALINITY AND pH

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In spring 2012, our team worked with 14 local growers on this project looking at substrates and fertilizers for organic transplant production. This article is the second of two on lessons learned. This one is related to water alkalinity and media pH.

Water Alkalinity and media pH

Oh my, you'll have to dig way back in the recesses of your mind to high school chemistry class for this one! Just kidding, it's not that hard.

We're all familiar with how important pH is for plants. Plant nutrients (nitrate, calcium, phosphorus, etc) change forms at different pH values, and the best pH for most of the nutrients to be in a plant available form is somewhere around pH 6.0-6.5 (down to 5.5 in potting mixes). This is why we lime our soils—to raise the pH up to somewhere near this ideal point, so plants can make use of the nutrients supplied by the soil.

When transplants are grown in potting media, pH is critical, and it can change quickly—much more quickly than outside soil pH changes. This is because our potting mixes don't have nearly as much "buffering capacity" as soil. In the field soil world, less lime is needed to change a sandy (lighter) soil's pH than to change pH on a heavy clay. You can think of potting media as a super sandy soil.

Why all this lecturing on potting soil pH? We have found in our trials that pH of organic potting soils increased substantially over time, to the point where some potting soils were seeing pH values over 8. Plants growing in these media didn't look so good. They were hungry because the nutrients that were still present in the media were not in a form that they could pick up.

You're not liming your transplants, so why is the pH of the media going up? It turns out that we're often unintentionally liming transplants every time they get watered. The reason is water alkalinity—the calcium and magnesium carbonates that are naturally present in many NY water sources.

Many water sources (municipal and well) in NY are alkaline or "hard," having calcium and magnesium deposits in them. It's a great irony, how our soils can be naturally acidic yet our water high in "lime." We can thank the geological past for our underground limestone deposits. You know you have a lot of water alkalinity when the inside of your tea kettle accumulates white crusty scuz (the 'technical' term for calcium carbonate and magnesium carbonate deposits).

When we grow transplants in potting soil, the potting soil pH starts out somewhere around 6.5, or just about ideal for nutrients to be available to the seedlings. With each watering, alkaline water adds calcium and magnesium carbonates, effectively adding liquid limestone. The more alkaline (harder) your water is, the faster the pH creeps up.

Water pH is not an indicator of alkalinity, surprisingly. Dissolved calcium carbonate doesn't necessarily make for a high pH water, so you won't know if your water has high alkalinity by measuring its pH.

Carbonate combines with H to form water and carbon dioxide, thereby taking H out of commission. $H^+ + HCO_3^- \rightarrow H_2O + CO_2$ Less H^+ means a higher pH.

We definitely saw pH get higher in the potting mixes in our on-farm media trials.

One of our trial farms grew onions in 8 different potting mixes. Onions were in open flats, we measured media pH 3 weeks after seeding, and again 5 weeks after seeding. This farm has alkaline water, about 150 ppm CaCO3. Our waters generally range from 50-500 ppm CaCO3, so while this farm's number isn't extremely high, it's high enough to cause the pH of the media to increase over time.

All the mixes had increased pH after 3 weeks of growing, an average increase of 0.5 pH units from their beginning pH values. After 5 weeks of growing, the increase was over 1 pH unit. This means that if the media started out near that ideal range of 6.5 pH, it was up around 7.5 after 5 weeks. A couple of the mixes that started out high were in the 8's by then. When plants were ranked in order of appearance, media with pH's 7.5 or above definitely looked worse—they looked hungry, as you might expect if nutrients were getting tied up. In plants that are particularly sensitive to low iron (like peppers), one distinctive symptom of high pH is "interveinal chlorosis"—leaves with green veins and yellowing between the veins.

This high pH problem isn't unique to organic mixes—conventional growers face the same problem. In greenhouse operations, it's common to add sulfuric acid to the water to compensate for high alkalinity. Organic growers can use citric or acetic acids that meet national organic standards, but they are weaker acids than sulfuric acid so greater quantities must be used to have the same effect, and there are not great dosage guidelines available. Another pH management technique is to choose fertilizers that acidify soil media—those that contain more ammonium or urea forms of nitrogen instead of simply nitrate. Organic nitrogen sources are not that simple.

The media that did the best in our trials seemed to be the ones that started out at pretty low pH, 5.1-5.9. The pH could creep up over time and still not be limiting by the time the plants were put out in the field. Peat, a common media component, is acidic, and lime is commonly added to bring media pH up to acceptable levels for peat-based mixes, so one strategy could be to reduce the amount of lime added to the mix if you're making your own. When we tested composts that went into farm-made mixes, they tended to have a high pH, somewhere around 8.

When measuring the pH or nutrient level of a media, it's important to wet it and let it sit (warm, like you would grow plants) for 1-2 weeks before taking your measurement. Media that is currently being used to grow plants will already have passed this test.

So go ahead, check the pH of your transplants, and see if it has gotten too high for their comfort.