KANSAS STATE UNIVERSITY RESEARCH

Editors' Note: This is the final article in a seven-part series on Extension, teaching and research programs being performed at Kansas State University.

Organic Fertilizers for Container Production

WITH INCREASED CONSUMER INTEREST IN SUSTAINABLY PRODUCED CROPS, MORE GROWERS ARE INVESTIGATING THE FEASIBILITY OF USING ORGANIC NUTRIENT SOURCES.

By Kimberly A. Williams

In the past, organic fertilizer options consisted of single sources of plant and animal by-products like bone and blood meals, composted manures and alfalfa meal (as examples) that varied in quality, nutrient analysis and nutrient release from batch to batch and source to source. But today, manufacturers are providing an increasing array of organic and semi-organic fertilizer products that are more uniform from batch to batch, both in nutrient analysis as well as release. This consistency is being accomplished by tightening the specifications of raw materials used to manufacture the fertilizers and by developing and following consistent, repeatable manufacturing or composting processes and formulation specifications. Several of the organic products now available are composites of several different organic materials, which, because of the diversity and homogeneity of their raw materials, help provide more balanced nutrient analyses and may contribute to a more diverse microbial population in the root medium. Examples are provided in the sidebar on the next page.

Figure 1. Impatiens grown with feather meal 13-1.4-0.2 (center) and blood meal 14.4-1.4-0.2 (right), both also with bone meal 6.3-33-1.4 and KMS (potassium magnesium sulfate), incorporated to provide the same amount of N, P and K as Osmocote 14-14-14 (left, rate of 7.7 g per liter mix). All were leached twice with a 20 percent leaching fraction before plug transplant.

Challenges

Despite these advances, fertility management is still arguably more challenging with organic nutrient sources compared to conventional fertilizers. There are several reasons for this, starting with the fact that organic fertilizers release nutrients differently than conventional fertilizers: Many nutrients like nitrogen are bound in complex molecules in organic nutrient sources that are not available for plant uptake until they are broken down. Much of the nutrient load must be released through microbial activity and, as a result, may be prone to reduced leaching. Because nutrient release is microbe-mediated, most factors that impact the activity of microbial populations will influence organic fertilizer breakdown into plant-available nutrient forms. For example, cool temperatures will slow conversion of ammonium to nitrate because the bacteria that accomplish this process are "moving" more slowly. This is in stark contrast to constant liquid fertilization with soluble ammonium-N and nitrate-N that are immediately available for absorption by plant roots.

A second reason organic fertilizers are more challenging to use is that their formulations — or amount of nitrogen, phosphate as P_2O_5, and potassium as K_2O — are not typically provided in ratios that are traditionally considered to be in correct proportions to each other. The historical "rules of thumb" are that because nitrogen and

Several consistent organic nutrient sources are available on the market today. Here is a small sampling of some of the ways that manufacturers are increasing consistency of their products from batch to batch.

Nature's Source oilseed extract. Fertilizer is derived from the extract byproducts from manufacturers that mill oilseeds, and a narrow range of nutrient content specifications ensures product consistency. Filtering during manufacturing helps eliminate large particles that would clog irrigation lines. (www.naturessourceplantfood.com)

Suståne turkey litter compost. A 26-week aerobic, thermophilic composting process is used to convert turkey litter, or softwood pine shavings on which turkeys are bedded that collect droppings and spilled feed, into stabilized high-humus organic matter. (www.sustane.com)

Verdanta line of bio-organic and organo-mineral fertilizers. Uniform fertilizer granules are created with high-quality secondary raw materials of both plant and animal origins in ultrafine powdered form that are formulated into fine, dense composite granules. The production process and engineered formulas result in products with homogenous composition and nutrient release characteristics from granule to granule. (www.bioworksinc.com/products/fertilizers.php)

Worm Power vermicompost. Highly standardized and consistent dairy cattle manure source and vermicomposting process are used to generate the product. (www.wormpower.net)

potassium are both about 4 percent of the makeup of plant tissue, we should provide about the same amount of both in our fertilizers. Phosphate should be no more than about half of the amount of nitrogen, and in the past decade, we have become more comfortable with even lower proportions of phosphate. For these reasons, we are accustomed to soluble liquid fertilizers such as 20-10-20 and 13-2-13 that can be easily formulated into these desired ratios by blending inorganic fertilizer salts. Organic nutrient sources, on the other hand, are not so easily blended and are therefore often available in less-desirable proportions, such as a liquid fish hydrolysate of 2-5-0.2 or solid feather meal source of 13-1.4-0.2. In fact, high levels of phosphorus in organic fertilizers are fairly common.

What we have observed, though, is that these ratios are not set in stone; some organic nutrient sources will often result in plant growth comparable to conventional fertilizers even with nutrient ratios that would traditionally be considered "out of whack." One example is an oilseed extract with a formulation of 3-1-1, or the combination organic and conventional version of 10-4-3 in which the amount of nitrogen and potassium are not comparable; however, potassium deficiency does not typically develop. Part of the reason we can use organic nutrient sources with formulation ratios that do not meet the rule of thumb may relate to length of the production cycle: with short-turn crops like vegetable transplants that may only need to be grown for four weeks, deficiencies or toxicities may not occur. For longer-turn potted crops such as geraniums or mums that may be in production 10 to 12 weeks, the altered nutrient formulations may result in nutrient imbalances within the plant. Using only slower-release organic fertilizers on crops with a high fertility requirement may also result in nutrient imbalances or deficiencies.

A third reason organic fertilizers are more challenging to use than conventional fertilizers is that some contribute high salt levels that can lower seed germination early in the crop or damage root systems at any time during crop production. Part of the problem is that we often add nutrients based on parts per million nitrogen to apply, but because organic fertilizers tend to contain lower percentages of nitrogen compared to conventional soluble fertilizers (such as 2 percent in organic compared to 20 percent nitrogen in conventional, for example), we end up with high salts and organic acids from other constituents of the fertilizers just to get the amount of nitrogen we desire. We can (and should!) estimate salt levels by measuring electrical conductivity (EC) but the results of our measurements are not as useful compared to monitoring nutrient availability with EC from conventional fertilizers. This is because while nearly all of the EC from conventional fertilizers are from plant essential nutrients — nitrogen and potassium, for example — some organic nutrient sources contribute excessive plant-essential nutrients, such as phosphorus, or unneeded elements, such as sodium.

EC 1 week after potting (dS/m):
• Sustane (8-4-4): ~2 (8 lbs fertilizer pre-plant + 8 lbs top-dress at day 45)

EC 1 week after potting (dS/m):
• Verdanta GM2 (7-6-12): ~3.5 (9 lbs fertilizer pre-plant + 9 lbs top-dress at day 45)

Figure 2. Top-dress at mid-crop to reduce initial EC and sustain nutrient release for the duration of a four-month crop

Figure 3. Poinsettias on the left were fertilized with 175-ppm nitrogen from 20-10-20 at each irrigation. Growth was matched when Verdanta EcoVita was incorporated pre-plant at a rate of 17 pounds fertilizer per cubic yard and 100-ppm nitrogen from either 13-2-13 (top right) or 20-10-20 (bottom right) were supplied beginning on the fifth week of the production cycle.

Switching to Organic? Now What?

So what does this all mean for growers who are interested in making the switch to organic fertilizers? Be prepared to more intensively manage the fertilization program over the course of the production cycle. Here are a few issues to consider to help growers mitigate or navigate the challenges with organic nutrient sources.

First, consider the length of your crop's production cycle. Pre-plant incorporation of organic nutrient sources is more likely to meet all of the crops' needs for short-turn crops like vegetable transplants. You should plan to supplement nutrients for longer-term crops like potted geraniums or fall mums with soluble feed or top-dressing.

Second, get a handle on the amount of soluble (and thus plant-available) nutrients that will be quickly available from pre-plant nutrient sources. This includes knowing the EC that the amended mix will generate after watering in. If the initial EC is too high, a grower can leach before transplant. Consider these results from some of our research at Kansas State University: a normal pre-plant EC range as measured from a saturated medium extract is 2.0 to 3.0 dS/m, but when feather meal and blood meal were incorporated into a peat-based substrate at rates to meet nutrient needs for the entire production cycle, EC levels rose to about 4.5 and 4.0 dS/m, respectively, during the first week of production. These high initial salt levels damaged young impatiens plugs. But when the same mix was prepared and leached with two irrigation events at a 20 percent leaching fraction prior to transplanting the impatiens plugs, EC at transplant fell to within the 2.0 dS/m range and the plants produced matched the growth of those grown with Osmocote 14-14-14 and Peter's 20-10-20 constant liquid feed with no additional fertilizer additions (Figure 1).

Third, mix and match nutrient applications to meet plant needs within your production system. This might be accomplished by top-dressing half of the organic fertilizer dose about four weeks into the production cycle. This reduces EC at transplant but provides a boost of nutrients as the pre-plant source is dwindling. When this was done with Sustâne 8-4-4 and Verdanta GM-2 7-6-12 fertilizers, EC was within the normal range of 2 to 3.5 units a week into a poinsettia production cycle and finished plant growth was of marketable quality (Figure 2). Consider two organic-based fertilizers for pre-plant incorporation in the Verdanta line. EcoVita 7-5-10, a true bio-organic fertilizer, has a lower soluble fraction than GM-2 7-6-12, an organo-mineral fertilizer, so nutrients will be released more slowly from EcoVita early in the production cycle. This makes it a better choice for pre-plant incorporation with salt-sensitive crops. On the other hand, the GM-2 with its higher soluble nutrient fraction offers quicker nutrient release without waiting on microbial breakdown, which is suitable for pre-plant incorporation for rapidly germinating seedlings in cool conditions or for mid-production top-dressing on longer-term crops.

Fourth, mix and match fertilizers and formulations to meet plant needs within your production system. This may mean integrating pre-plant solid and supplemental liquid nutrient sources, or mixing a couple of fertilizer formulations to balance the essential nutrient needs of the crop. For example, pre-plant incorporation of an organic fertilizer with conventional soluble feed provided beginning at week 4 of a poinsettia production cycle resulted in growth comparable to the constant liquid feed control (Figure 3).

Regardless of your fertilizer choices, your nutrient management program should always include routine monitoring of pH, EC, shoot growth and quality, and root development so you can track and respond to how your fertilizers are providing nutrients to your crops if needed. g

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