KANSAS STATE UNIVERSITY RESEARCH

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

Using Organic Fertilizers in Hydroponics and Recirculating Culture

THINKING ABOUT IMPLEMENTING RECIRCULATING CULTURE TO YOUR PRODUCTION? HERE ARE TWO STRATEGIES TO CONSIDER.

By Kimberly A. Williams, Olivier Francescangeli and Jason Nelson

As more and more greens and herb production occurs in recirculating culture, grower interest in providing crop nutrients from organic sources has increased. Following is our experience at Kansas State University with two different nutrient management strategies to provide nutrients from organic nutrient sources.

Hydroponic Lettuce Production with Soluble Organic Fertilizer

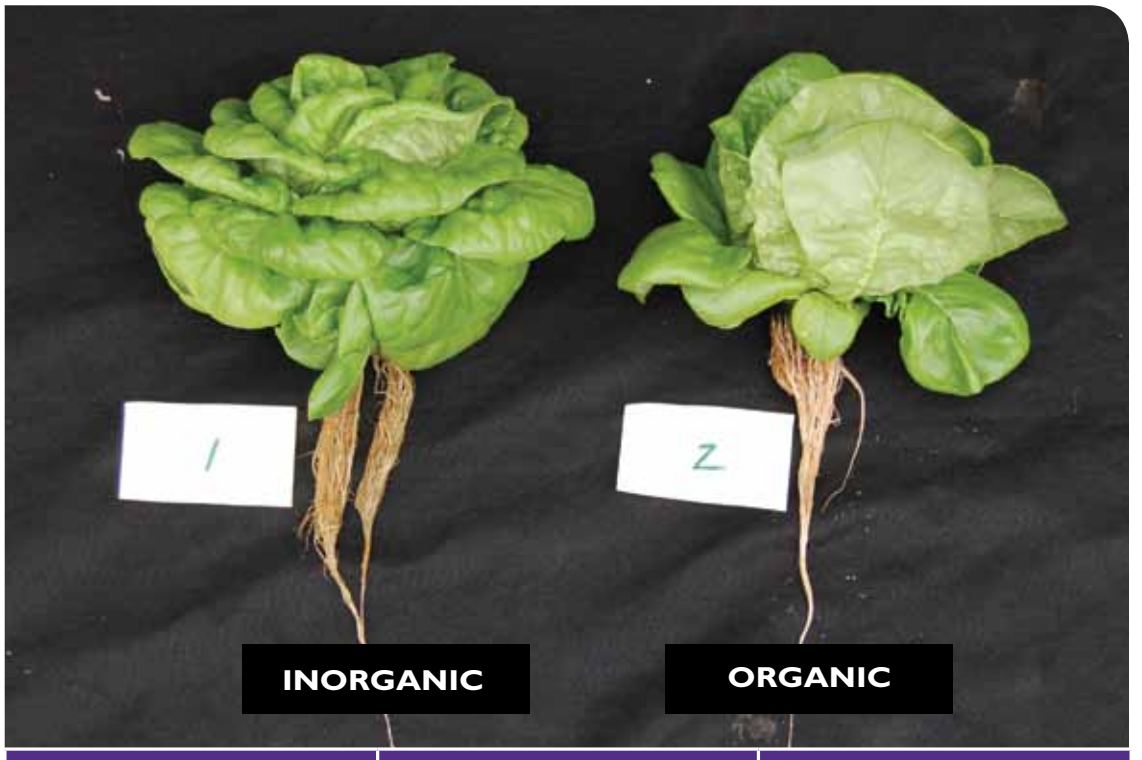
Organic fertility in nutrient film technique (NFT) hydroponic systems is notoriously challenging. One aspect of Jason Nelson's research at Kansas State University (KSU) was to evaluate hydroponic lettuce production with both organic and conventional inorganic nutrient sources. He produced butterhead lettuce 'Rex' in NFT troughs. The organic fertilizer treatments were based on Kimitec soluble organic fertilizers (www.kimitec.es/en), and we tweaked the recipe over three experiments. Some of our best growth, as shown in Figure 1, occurred when using Bombardier (8-0-0), Espartan (2.7-3.0-2.6), and Caos (10.5 percent Ca), all at 0.7 ml/L recirculating solution; and Tunda (micronutrients) at 0.3 ml/L. Potassium was delivered from the organic salt potassium magnesium sulfate dissolved at a rate of 0.02 g/L. This mix resulted in an EC of 1.9 dS/m. The inorganic fertilizer regime was derived from fertilizer salts and contained about 150 ppm nitrate-N and 40 ppm ammoniacal-N. In other studies at KSU, we have had good quality lettuce growth in an NFT system using fish emulsion as the primary nutrient source, though this is messy, smelly and difficult to manage based on recirculating solution EC and pH.

A big difference between organic and inorganic fertilizers is the form of nitrogen — the nutrients in organic fertilizers are typically components of complex molecules like proteins that need to be broken down into their constituent elements before they are absorbed by plants. That process goes from organic molecules to ammonium to nitrate, thanks to the activity of microorganisms in the system. So inorganic fertilizers have a lot more nitrate-nitrogen,

Potted herb producer Vegobel uses the fertilization strategy of incorporating the majority of crop nutrients pre-plant from organomineral nutrient sources, then providing only water or a low-rate nutrient solution as crops develop in a recirculating system.

Research conducted at KSU studied hydroponic lettuce production with both organic and conventional inorganic nutrient sources.

Figure 1. Butterhead lettuce grown in NFT troughs.



Treatment	Fresh Weight (g)	Dry Weight (g)
Inorg (1)	268a	11.2a
Org (2)	177a	6.0b

Averages with the same letter are not statistically different from each other.

and this influences both plant growth and pH. We also measured what many other researchers have: that organically-fertilized greens have much lower nitrate-nitrogen concentrations in the leaf cells compared to those produced with inorganic fertilizers high in nitrate. So while the lettuce heads may be a little smaller or slower to gain size with well-managed organic compared to conventional fertilization, the human health benefit of greens with lower cellular nitrate-nitrogen may outweigh minor differences in yield.

One key challenge with organic hydroponic production systems is the management of pH, which has a tendency to fluctuate rapidly and wildly in water culture, more so than when inorganic fertilizers are used. Daily pH management is a must when nutrients are provided from organic sources.

Potted Herbs in Recirculating Culture Using Organomineral Fertilizer

The potted herb producer Vegobel (www.vegobel.be) in Duffel, Belgium, uses the fertilization strategy of incorporating the majority of crop nutrients pre-plant from organomineral nutrient sources, then providing only water or a low-rate nutrient solution as the crop develops in a walking trough recirculating system. After a visit to this impressive operation, we wondered if we might mimic this nutrient management strategy with fertilizers available in the United States.

A trial was set up with potted basil 'Italian Large Leaf' in recirculating culture. A base mix of 70 Canadian sphagnum peat : 30 perlite was amended, per cubic yard, with 12 pounds dolomitic lime, 3 pounds gypsum, 1.5 pounds Micromax micronutrient mix, 1 pound Epsom salts and 2 ounces Suffusion granular wetting agent. Then, in a couple treatments, we pre-plant incorporated Verdanta fertilizers following the recipe in Table 1 into the substrate. We compared basil growth with either the Verdanta pre-plant herb mix only or the pre-plant herb mix plus 100-ppm nitrogen from 13-2-13, with a control of 200-ppm nitrogen from 20-10-20.

What we found (Figure 2) is that the Herb Mix with no supplemental soluble fertilizer produced good plants, but they were a little smaller than those grown with the Herb Mix supplemented with 100-ppm nitrogen from the low phosphorus, almost all nitrate-nitrogen 13-2-13. Basil growth with 200-ppm nitrogen from the high phorphorus, 40 percent ammoniacal-nitrogen 20-10-20 soluble fertilizer (and no pre-plant herb mix) produced about the same total amount of growth as the Pre-plant Herb Mix + 13-2-13, but with the undesirable characteristic of stretched internodes. This demonstrates the opportunity to manage plant stretch by keeping ammoniacal-nitrogen levels in check. Keeping phosphate levels on the lower side might also have helped mitigate plant stretch, but this is not supported by the root medium phosphate

Table 1. Pre-plant herb mix of Verdanta fertilizers used for potted basil production.

GM-2 [7-6-12] @ 1.7 lb/yd^3	Eco-Vita [7-7-10] @ 3.4 lb/yd^3	RM-1 [4-30-0] @ 1.7 lb/yd^3	Vivifos @ 1.7 lb/yd^3, a root stimulant of grape pumice inoculated with microorganisms

Figure 2. Results of pre-plant herb mix of Verdanta used on potted basil.

levels, which were actually about the same in both the 13-2-13 and 20-10-20 treatments at both the middle and end of the study because the 13-2-13-fed plants also had a phosphorus source incorporated pre-plant.

Certainly, each producer must optimize the fertilizer regime for their crops and in their production system. It is important to try out changes to the nutrient management program on a small scale before making widescale alterations, and the more that you can monitor along the way — pH and EC monitoring is a must — will help ensure that you have the knowledge in hand to make adjustments for success.

The use of the term "organic" in this article does not imply OMRI registration. Use of trade names does not imply endorsement of products named nor criticism of similar ones not mentioned. g

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