

10/28/2026

Moving On Up

Dr. Brian E. Jackson

The past decade has witnessed numerous horticultural specialty crops rising out of the field and into soilless cultivation in protected, semi-protected or open growing systems. For generations, many food crops have put down roots in good old-fashioned soil, but in many cases and places, things are shifting. The ambition is growing sky-high, with strategies to take advantage of niche local markets for some crops, and perhaps offer a solution to developing countries where increased domestic food production and security is increasingly vital.

Perhaps analogous to the 1970s sitcom “The Jeffersons” when George and Weezy left their old neighborhood in Queens for that “deluxe apartment in the sky” on the Eastside of Manhattan, many horticultural crops are getting their own elevated real estate—trading field soil for soilless substrates in containers, gutters, benches, troughs, towers and other elevated growing systems. Just like the Jeffersons weren’t content to stay where they started, growers are looking for ways to produce more, in different places, with greater control over water, nutrients, climate, pests and distance to market.

Of course, no Jeffersons parody would be complete without acknowledging the whole cast. Weezy would likely be reminding everyone that moving on up doesn’t mean forgetting where you came from, because soil-based field production isn’t going away. Florence would probably have something to say about all these fancy containers and plants growing without soil—“What’s next, vegetables living in the penthouse?” And neighbors Tom and Helen Willis might represent the old and new sides of horticultural crop production living right next door to each other: field production and soilless production, different approaches sharing the same neighborhood while the (horticulture) industry figures out where each fits best.

Considering the crops



Over the decades, many crops have been grown in both the field and in container systems—each offering different advantages and economic opportunities to a given grower in a given location. Notably, crops like leafy greens, microgreens, herbs, strawberries, blueberries, caneberries, cannabis, tomatoes, cucumbers, peppers, etc. have been grown, often in large-scale capacity, in various soilless systems while their counterpart field-production growers continue to produce and supply the majority of overall annual production for the domestic and global market. The vast majority of funded research, both public and private, has understandably focused on these crops to improve

production efficiency and to address the “barriers-to-entry or success” that have limited or dissuaded many growers from considering soilless production.

As the scale of soilless production of these crops has increased over the years, the growing media industry (substrate manufacturers) has responded with their own R&D to develop and offer new mixes catered to the optimization of these specialty crops—whatever the growing system used (Figure 1). Five to seven years ago there were far fewer substrate products specifically designed and marketed to specialty crop CEA/soilless growers, namely blueberries, strawberries and cannabis. This response is one of many showcasing how the trends and eventual shifts in growing systems and practices drive innovation and product development of many crop production inputs.

Beyond the common CEA/soilless crops we are accustomed to, the interest and attention to other traditionally field-grown specialty crops has risen sharply in recent years. Perhaps a testament to JFK’s popularized quote “A rising tide lifts all boats,” our current understanding of crop production in CEA, semi-protected, and open growing systems and the success that has been shown has resulted in many people thinking more broadly about what other crops can be potentially successful in soilless production.

Expanding the palette of crops suitable for soilless production, under given circumstances, can offer growers opportunities for regional niche markets, “shoulder season” production sales, production on land unsuitable for field production, closer proximity and less transport to markets, etc. Another strong justification for exploring new crops is the potentially tremendous opportunity to grow more high protein or caloric crops with heightened nutritional value. This could be particularly impactful (life changing) in developing regions of the world that are rapidly embracing soilless cultivation practices as a means to enhance domestic food production and improve annual food security.

Right crop, right place

Specialty Crops in Soilless Cultivation			
Avocados	Banana	Beets	Broccoli
Cabbage	Carrots	Cauliflower	Celery
Cherries	Citrus	Coffee	Cotton
Eggplant	Figs	Fodder	Ginger
Grapes	Halophytes	Hops	Kiwi
Legumes (peas)	Melons	Okra	Onions
Papaya	Pineapple	Potato	Radish
Saffron	Soybeans	Sweetpotato	Theobroma
Turmeric	Vanilla	Wasabi	Wheat (cereals)

Figure 2 offers a partial list of global crops that have either been researched and the findings published in scientific journals, examples showcased on global CEA media websites, partially adopted in some regions of the world, or whose adoption and production is expanding rapidly. When combing through the literature and other published works discussing these trends and findings, it is clear that

some crops are likely to only be feasible in specific areas with unique circumstances. For example, will hydroponic potato production ever out-scale field production? No. But in specific regions or small communities of the world, this could be feasible. The same goes for hops, grapes, fodder for livestock and chocolate (Theobroma). One example of a recent niche market success, coffee, a crop grown predominately in Central and South America, Africa and the south Pacific (known as the ‘Bean Belt’) is being grown hydroponically here in my home state of North Carolina at Big Guns Coffee (Figure 3).

Other applications and benefits of research in CEA systems extend beyond evaluating the potential of growing new crops. Many examples in the literature highlight the use of controlled environment research in plant breeding as a way to accelerate plant growth cycles, control pollination and other parameters, and for the evaluation of various phenotypes—often using AI and digital/imaging technologies. Recently published works on cotton, soybeans and wheat (cereal crops), among other agronomic and allied crops, have also shown the benefits of using CEA as a tool for understanding physiology and plant responses to environmental variables and cultural production inputs.

Big Guns Coffee

Brewing up a farming revolution — indoors



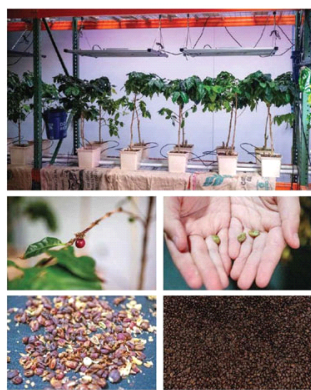
Clark and her father, © Blake Johnson stand in front of coffee plants growing hydroponically at Big Guns Coffee's facility outside of Tyson.

The scalable, sustainable
functionality benefits
veterans and the disabled

By Dana Reeves

North Carolina Farm Life 1/18

Back to the future: Blake Johnson, a veteran and disabled, is growing coffee beans in a hydroponic facility. The facility is a small, one-story building with a large open space. The facility is a small, one-story building with a large open space. The facility is a small, one-story building with a large open space.



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One of the main takeaways, at least for me, is that the past and current developments and innovations in CEA systems have created new opportunities (globally) and has led to increasing transitions of non-traditional crops into some type of soilless production—even if on a small, yet positively impactful, scale for those doing it. I also believe that many people today are more open-minded and receptive to bold ideas and possibilities regarding the future of plant/food production than, as a society, we were in the past. Now, when many people are

approached with a bold new idea—completely out of the box—the answer is less often a quick and assertive “NO” but instead the response may be “Hmm ... is it economical? Is it scalable? Could it actually address current problems and limitations?”

Just as George Jefferson saw an opportunity to move his family into a different place, researchers and growers are looking at ways to move new/more crops into production systems that make more deliberate use of space, water, technology and environmental control. The question isn't whether the crops are still “down to earth.” It's whether they're ready for the deluxe apartment in the sky. Some are. Some are not. **IG**

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