



# MAXIMIZING HYDROPONIC CROP PRODUCTION

WHETHER YOU'RE GROWING WITH OR WITHOUT A SUBSTRATE, HYDROPONIC VEGETABLE PRODUCTION TAKES ATTENTION TO DETAILS.

By David Kuack

**P**enny Goff, general manager and co-owner of Gritt's Midway Greenhouse in Red House, W. Va., says all of the greenhouse vegetable growers she knows who grow hydroponically use some type of substrate.

"Hydroponics to me means growing with water, not necessarily in water," Goff says. "Growing in a substrate that doesn't have any nutrient-holding capabilities."

Goff has been using coconut coir for about three years. Prior to that, she had used rockwool.

"The substrate simply acts as a support mechanism for the plant roots," she says. "The main thing we think about on a daily basis is having the ability to correct problems relatively quickly with the substrate we are using."

Goff, who grows 1½ acres of tomatoes and a ¾-acre of English cucumbers, has been growing hydroponically for 18 years. The tomatoes are planted in late December and harvested through

the following December. The cucumbers, which are a relatively short 13-week crop, are grown through the summer.

"The reason that we switched to coir is that since we were growing the crops through the summer, we felt we needed a little more protection from the heat," she says. "We found with rockwool that we encountered more problems if we carried the crops through the summer."

Goff said that the cucumbers can be susceptible to the root disease pathogen *Pythium*. She said the coir provides more drainage than rockwool.

"The coir is a lot more forgiving than rockwool as far as irrigation," she says. "If you overwater or underwater, coir helps to avoid water-related issues."

Another reason for the substrate switch was availability.

"The availability of rockwool can be more difficult, especially in West Virginia," she says. "Coir is a little more expensive, but the freight costs are less so it is a little cheaper. And coir takes up less storage space."

*Gritt's Midway Greenhouse grows 1½ acres of tomatoes, which are planted in late December and harvested through the following December.*

Goff said that she has considered going back to rockwool.

"Coir does have some issues with consistency," she adds. "It's not as consistent as rockwool. Sometimes the particles are finer depending on the supplier."

## Right Structure, Equipment

Although having the right substrate is a major factor in successful hydroponic production, Goff said having the right structure and equipment is also important. Three years ago the company added a 1½-acre Rough Brothers greenhouse for its tomato production. Prior to putting up the new structure, a tomato crop was not grown through the summer.



## DEFINING HYDROPONICS

Growers who are unfamiliar with hydroponics may think that it is only used with greenhouse vegetables. Industry consultant Don Wilkerson, who is professor emeritus and former horticulture extension specialist at Texas A&M University, said hydroponics is related to delivering water and a nutrient solution in a soluble format.

“If you are using a soluble form of fertilizer as the principle means of delivering nutrition and using some type of irrigation system other than overhead, then you are using a type of hydroponic system,” says Wilkerson. “Any type of subirrigation could be considered a modified form of hydroponics. When someone is growing bedding plants, poinsettias or mums and not irrigating with an overhead system, it is really a form of hydroponics. Then there are closed hydroponic systems such as nutrient film technique and aeroponics where the plant roots are being misted.”

## STARTING SIMPLE

For people who don't have any experience with growing, Wilkerson usually suggests they start with a lower cost hydroponic system such as bag culture or even trying growing in ground beds.

“In-ground production can have its issues such as diseases,” he says. “With bag culture if there is problem, a grower can remove the drip emitter and toss out the bag. Usually with bag culture the water is not being recycled. The bags can also be reused a couple of times. It's a relatively low cost, low-end way of getting started. Another low-cost system is using pots, such as 15-gallon containers or something similar.”

Wilkerson says that lower tech systems tend to produce lower yields per square foot. More sophisticated systems such as nutrient film technique or troughs tend to maximize productivity because of the level of environmental and nutrient control they offer. He said this is usually the case regardless of whether the crop is tomatoes, cucumbers, lettuce or peppers.

“Once a grower starts to recycle the irrigation water, then the management requirements increase significantly,” he says. “Using a hydroponic system, water management and nutrient management go hand in hand. You have to know about plant nutrition, fertilizer requirements and how often to deliver the nutrient solution. You also need to know about the starting quality of your water source. In the startup mode, you also have to be sure you have a source that can provide enough water and that it is of suitable quality.”



“The new greenhouse is set up so that we can grow in the summer,” Goff says. “The new structure allowed us to eliminate having to replant the tomatoes in the fall. Now we grow one year-round tomato crop and don't harvest for 2½ to 3 months between January and March.”

The greenhouse is equipped with a Priva environmental control computer and NutriFlex fertigation system ([www.vtegroup.com/en/irrigation-priva/1282586017/Priva-NutriFlex](http://www.vtegroup.com/en/irrigation-priva/1282586017/Priva-NutriFlex)). One of the biggest changes Goff has seen with the new structure and equipment is the amount of fruit being harvested.

**Top:** The parasitic wasp *Encarsia formosa* is used for whitefly control.

**Bottom:** Gritt's Midway Greenhouse grows ¾-acre of English cucumbers, which are a relatively short 13-week crop and grown through the summer

“Once we started growing tomatoes in the new house we saw an increase in production,” says Goff. “On average, it was probably a one-third increase in production. Some of that was due to better climate control, some was due to being able to monitor the irrigation and the nutrients with the NutriFlex system.”



## IT'S ALL ABOUT MANAGEMENT

When Chris Higgins, general manager and co-owner of Hort Americas in Euless, Texas, talks to someone about starting a hydroponic operation, he usually breaks the conversation down into four basic categories: light management, climate management, water management and substrate or root zone management. Higgins, whose company is a horticultural products supplier, says two other issues that eventually become a part of the discussion are pest management and labor management.

## PIECES AND PARTS

Higgins says when he works with a grower he looks at the greenhouse and breaks it up into parts that are manageable.

“By breaking it down into different categories, it is easier to discuss,” he says. “For instance with light, it’s about creating an understanding of how important light is to yield and production quality. Then we take a practical look at lighting strategies that will allow the grower to manage light in a way that suits him or her. This could include a plan for supplemental lighting and could also include taking away light by shading or screening.”

Higgins says that hydroponics in its most generic form generally includes production in some type of natural or artificial substrate. This can occur during at least one stage or multiple stages of production.

“Traditional agriculture, or growing in soil, usually offers the grower some buffer capacity,” Higgins adds. “The soil holds moisture and nutrients. It also provides some wiggle room when other things are not at optimum levels.

“Typical hydroponic substrates are not designed to provide much more than a foundation for holding the plants in place. This gives the grower the ability to steer his or her crop based on individual grower strategies, climate and irrigation. In these types of systems there is little buffer capacity. The plants respond to either the grower’s actions or to Mother Nature’s actions very quickly.”



**Left:** Using bees for pollination makes it more difficult for Gritt’s Midway Greenhouse to spray any type of pesticides. Beneficials are primarily used for control of whiteflies, aphids and thrips.

**Right:** Having the right equipment, like this NutriFlex fertigation system, enabled Gritt’s Midway Greenhouse to increase tomato production by an average of one-third



## Maintaining Healthy Plants

Goff grows primarily beefsteak tomatoes in coir slabs placed in troughs that keep the plants off the ground. The plants are elevated 3 to 3½ feet.

“The slabs fit perfectly into the troughs,” she explains. “By putting the plants in troughs, it gets them off the floor and it makes labor a lot easier. The troughs keep water off the floor and keep the vines from laying on the floor. It’s much better for reducing disease issues. For the tomatoes, from the time the flowers open there is seven weeks during which you are nurturing that fruit before it can be harvested, and numerous things can go wrong.”

Goff grows multiple crops of cucumbers with no production during January through March because of lower light levels. Between crops, there is usually a 14-day period when no cucumbers are harvested.

“Those months we are not in production would require artificial light,” she says. “Growers in Canada who are growing cucumbers during that time are using lights. The natural light levels during that time are too low. It definitely is not cost effective, unless you have a cheap source of electricity.”

Planting the tomatoes in December enables Goff to begin harvesting by March 15 with plants in full production by April 1.

“Production is usually heaviest at the beginning of the crop,” she says. “Production goes down in the summer, not in the number of the tomatoes, but in the size and weight of the fruit. Because the temperatures are warmer, the tomatoes are ripening quicker on the vine. There will be periods of fruit overload where the plants basically stop producing. We had temperatures of 110° F this summer. We use bees to pollinate the plants. They don’t want to work under those kinds of temperatures, and pollination goes down.”

## Startup Considerations

Goff says growers who are considering hydroponic vegetable production need to consider which crops they

are going to produce as well as their equipment needs.

“If you try to start without the right equipment, you can end up not getting the production or the yield that you need,” she says. “When we started we didn’t have a nice greenhouse or good equipment. And we didn’t have enough heat.

“Once we purchased the right equipment, we saw it pay for itself within one to two seasons. For those initial startup costs, growers need to have the money available to put in the proper equipment right from the beginning.”

Goff says crops like lettuce and cucumbers don’t require as much startup money as tomatoes.

“The biggest challenge of growing the tomatoes is manipulating the crop with the climate,” she says. “You have to produce a certain amount of fruit per week. If you don’t maintain the correct balance between the leaves and fruit and roots, you aren’t going to be able to meet that production goal.

“The environmental computer can make adjustments based on the daily light levels and we are monitoring pH and electrical conductivity levels. We also do a water analysis every two weeks.”

## Preventing Pests, Disease Problems

Goff says disease and pests aren’t a problem if a grower starts out clean and does everything else properly. Beneficials from Biobest are used to control pests.

“We start using beneficials early, about two weeks into the crop. We receive biweekly shipments of biologicals (*Encarsia formosa*) for mainly whiteflies. For secondary pests, like the occasional aphid or thrips, we bring in additional beneficials (*Amblyseius californicus* and *Amblyseius swirskii*).”

*Gritt’s Midway Greenhouse sells its vegetables within a 150-mile radius to Kroger stores, independent grocery stores, produce vendors and through the company’s own retail outlet.*

Goff says using bees for pollination makes it more difficult to spray any type of pesticides.

“We monitor the plants and if we find aphids on a plant, then we apply insecticidal soap and that usually resolves the problem.”

Because cucumbers grow so fast and are in production for such a short period, Goff says there is not as much that can go wrong as with tomatoes.

“One of the things you have to be able to do with cucumbers is wrap the fruit,” she adds. “We have an automatic wrapping machine that can do it quickly. The cukes start to dehydrate immediately after they are harvested. And then you have to be able to cool them.”

### Expanding Markets

Goff says another thing growers need before they start producing hydroponic vegetables is a market for their crops.


“Once produce starts to be harvested, you need to have a market for it,” she says.

Goff sells her produce within a 150-mile radius to Kroger stores, independent grocery stores, produce vendors and through the company’s own retail outlet. She also works with a local distributor that sells to restaurants and hospitals.

“I am also working with West Virginia schools on the USDA Farm to School initiative ([www.fns.usda.gov/cnd/f2s](http://www.fns.usda.gov/cnd/f2s)). There was some grant money for local production of vegetables for schools, so we have just started to work on that program.”

Goff said she is hoping the Farm to School program will enable the company to expand production.

“We are particularly interested in being able to offer a product that’s grown year-round or at least through the school year,” she says. “Outdoor crops finish in the fall and there is no local produce available for the schools. We are looking at lettuce because that is an easy, low-cost startup. We are also looking at adding cherry tomatoes to our tomato mix.

“The biggest obstacle as to why we haven’t expanded is competition from Mexican produce. Once that starts to roll into the local stores it’s difficult to compete. We’re hoping if the demand for locally grown continues to be popular, that will allow us to expand.” 

*For more information on Gritt’s Midway Greenhouse, contact the company at [grittsmidway@comcast.net](mailto:grittsmidway@comcast.net).*

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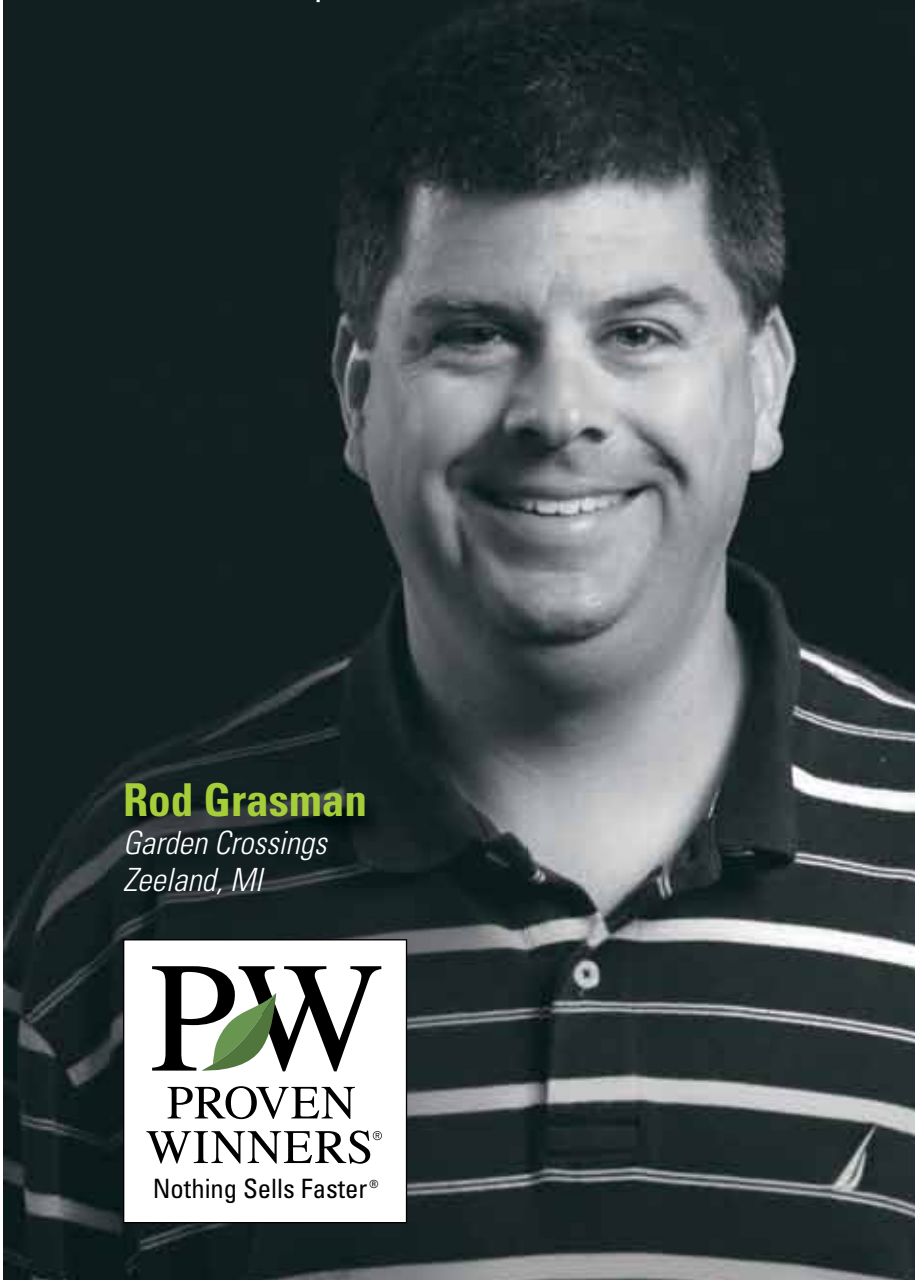
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