insideGROWER
CONTROLLED ENVIRONMENT AGRICULTURE
February 2017

Selling Fresh

NatureFresh Farms is betting that Americans are ready for fresh, locally grown greenhouse tomatoes. p. 14

PAGE 18
Making CEA a little greener

PAGE 20
FSMA: "Audited" vs. "inspected"

PAGE 32
Biological Control in Hydroponic Systems

Fresh and different!
HandPicked Vegetables boast superior flavor and a wide selection.

Go CUKE CRAZY with NEW Gherking Pickling and NEW Martini Slicing Cucumbers, part of the first-of-its-kind HandPicked Collection. This novel group of vegetables and herbs offers home-grown flavor, exceptional fruit quality, earlier and longer harvests, and options for smaller growing spaces. Both fresh market farmers and hobby gardeners will love these high-quality, easy-growing varieties.

PanAmerican Seed.

Order from PanAmerican Seed or your preferred supplier today.

panamseed.com
630 231-1400 800 231-7065

HandPicked VEGETABLES

Reader Service Number 200

ALYSSUM TO ZUCCHINI

NEXUS HELPS YOU GROW

Trust the Nexus team of experts to provide turnkey solutions that deliver the ideal growing environment for ALL your crops. Whatever you need – heating, cooling, lighting, curtain systems, insect control, benches, irrigation and fertigation systems, growing systems and environmental control systems.

NEW CROPS. NEW NEEDS. NEW OPPORTUNITIES.
NEXUS GROWS WITH YOU.

allied 40/40

Reader Service Number 201

www.nexuscorp.com | 800.228.9639

NEXUS GREENHOUSE SYSTEMS
LEADERS IN GREENHOUSE SYSTEMS INTEGRATION™

What We Don't Know

As I think about the stories in this issue of *Inside Grower,* I keep coming back to an old Donald Rumsfeld quote. I'm not particularly a fan of the former Secretary of Defense, but there's one quote of his that sticks in my mind (it's a long one—bear with me): "There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know."

When I first heard it way back when he said it in 2002 in relation to weapons of mass destruction, I thought it was convoluted thinking. Now that I look at it again, I realize it applies in a lot of different ways, particularly in our fields of expertise. The concepts that sometimes make the difference are the "unknown unknowns." The things we don't know that we don't know. How do you find them out?

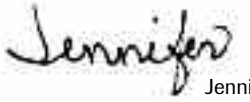
As we head solidly into 2017, it seems there are more ways than ever to find out about the unknown unknowns: magazines like this one; e-newsletters (like the twice monthly *Inside Grower,* for example); trade shows with educational seminars; online courses like those offered by the CEAC at the University of Arizona, Michigan State University, University of Florida and others; grower tours and just good, old fashioned networking.

Let's start in these pages by working on the unknowns relative to auditing. We tapped freelance writer Dave Kuack to delve into the intricacies of the Food Safety Modernization Act and how audits come into play. You might be surprised to pick up what he's laying down on page 20.

One of those known unknowns you might have is marketing. It's certainly not an unknown for NatureFresh Farms, our cover story this month. I took a road trip out to their brand new Delta, Ohio, facility to check out the growing side of things, but I also spent time with Director of Marketing Chris Veillon to unravel just how important the marketing side is to the new venture. You can read all about it on page 14.

I'm going to add to Rumsfeld's quote: sometimes there are things you think you know, but you actually don't. You know, those "conventional wisdoms" that just are, but in reality, they aren't that way at all. Like when everyone thought poinsettias were poisonous (they aren't) or that fresh goji berries taste good (they don't). In this issue, check out page 24 to find a breakdown on the best facility in which to grow cannabis: greenhouse vs. indoor (a warehouse-type setting). The results may defy what you previously believed.

There's lots more packed into this issue as we journey between the things we know and the things we don't. In 2017, I'm hoping to transfer lots more knowledge from the unknown category into the known. Here's to a lifelong love of learning—in this industry, I think it's something we all have in common.



Jennifer Polanz
MANAGING EDITOR-AT-LARGE
feedback: jpolanz@ballpublishing.com

insideGROWER

A Friend Remembered
G. Victor Ball, Editor from 1949–1997

GrowerTalks general offices are located at:
PO BOX 1660, West Chicago, Illinois 60186 U.S.A.
PH: 630.231.3675 **FAX:** 630.231.5254
TOLL-FREE: 1-888-888-0013
www.growertalks.com

BALL PUBLISHING

GrowerTalks (ISSN 0276-9433) is published monthly by Ball Publishing, PO Box 1660, West Chicago, Illinois 60186, United States. Subscriptions are free to qualified readers in the US. Subscription price for non-qualified readers is $35 per year US and Canada. All other foreign subscriptions must pay $99/year to receive/continue to receive *GrowerTalks* and *Green Profit*. *GrowerTalks* is a registered trademark of Ball Horticultural Company in the U.S. Periodicals postage paid at West Chicago, IL and at additional mailing offices. Postmaster: send address changes to *GrowerTalks* Magazine, PO Box 1660, West Chicago, Illinois 60186, United States. Posted under Canada publications mail agreement #40612608. Canada returns to be sent to Bleuchip International, P.O. Box 25542, London, ON N6C 6B2
Printed in the U.S.A.

GreenProfit Supplement Enclosed

insideGROWER

CONTROLLED ENVIRONMENT AGRICULTURE

ON THE COVER

Chris Veillon took editor Jen Polanz on a tour of NatureFresh Farms' newest location. The Ontario-based company recently opened 45 of what will eventually total 180 acres of state-of-the art tomato greenhouses in Delta, Ohio, to offer fresh, locally grown produce all year 'round.

DEPARTMENTS

FEATURES

Detecting Diseases Early On

Imagine if you could tell that a tomato plant was infected with a plant virus, even though it looked totally healthy to the human eye.

That's what Penn State researchers have just received federal funding to figure out. They're testing whether a nanotechnology device can be used to actually concentrate a plant virus, making it easier to detect early on.

"Our goal is to adapt a nanotechnology micro-device to concentrate pathogens in plants, insects and other organisms so that modern diagnostic procedures can be employed earlier in an infection, when virus levels otherwise may be too low to detect," says Cristina Rosa, assistant professor of plant virology in the College of Agricultural Science, who's leading the interdisciplinary team. "This technology will make these diagnostic tools more effective in catching infections at the early stages when growers can manage them more easily and effectively."

Cristina's team received a $325,000 grant from the USDA's National Institute of Food and Agriculture for the two-year research project.

Indoor Ag-Con White Papers

In looking at the 2017 Indoor Ag-Con lineup and registration details (it runs May 3-4 at the Las Vegas Convention Center), we were hooked into some great resources that come out of the show. Each event has a white paper associated with it and attendees receive a free hard copy of the newest white paper. These papers also are available after the shows on the website.

Titles include "Indoor Crop Production: Feeding the Future," "Robotics & Automation in Indoor Agriculture" and "The Impact of Legal Cannabis on the Indoor Agriculture Industry," among others.

A Better Kale Plant? Yes, Please.

Everyone knows kale is very healthy for you. And we've all desperately tried to like kale for that reason (kale chips, anyone?). But some people just can't get past the bitter taste that often accompanies the leafy greens. Now, a new program at Cornell University is trying to align kale plants more with what consumers might like. Cornell vegetable breeder Phillip Griffiths, a professor at the School of Integrative Plant Science in the horticulture section, and doctoral student Hannah Swegarden, are trying to identify some of the characteristics that consumers would prefer and breed those into kale plants.

"We have been able to identify and generate diversity through natural cross-breeding, enabling selection of unique types that may be important—not just for international and emerging markets—but also for supporting the production of a crop that's highly nutritious and can promote new markets in the U.S.," Phillip says.

The characteristic changes include color, texture, plant shapes and leaf style. Hannah has been gathering feedback from seed producers, growers, supermarket managers and consumers to formulate the strategy for breeding. She's also partnering with Cornell's Sensory Evaluation Center to do consumer trials to "develop a consumer kale lexicon and establish a trait hierarchy that can be used to guide the breeding program."

The research is supported by the U.S. Department of Agriculture's Specialty Crop Block Grant Program.

The Consumer Angle of Hydroponics

OPCOMLink USA's new indoor gardening systems are now available on their website and Amazon. The company is offering a tabletop system and a vertical wall model, both with LED lights and a water system that uses 90% less water than traditional outdoor gardening. The bonus: fresh greens and veggies all year round. The GrowBox retails for $499 and the GrowWall at $599.

Will consumers pay that to grow their own? They may see shelling out $2.50 a pop for hydroponically grown leafy greens at the store as a better value. But, with the option to grow either 50 or 75 plants at a time and the peace of mind of knowing exactly how your food is grown, it may be worth it. Ease of use also comes into play and it looks like these systems are pretty turnkey.

"You don't have to be a gardener to enjoy our products," says Rajeev Mishra, vice president and general manager of OPCOMLink USA. "We are finding a lot of interest among urban dwellers, conscious consumers looking for pesticide free and non-GMO produce, and parents wanting to nurture an interest in their kids for healthy eating. It's also a great option for seniors and others who would like to garden without the physical toll."

Want to see the products for yourself? Visit www.OPCOMFarm.com.

AutoFog

Safe, Automatic, Effective

Apply Bio Pesticides and Oxidizers Automatically & Effectively.


Small


Medium


Large


Extra Large

Dramm has an AutoFog for every size greenhouse.

Call to find out which one is right for you.

75th DRAMM

Integrated Plant Health
information@dramm.com
www.dramm.com
920.684.0227

Reader Service Number 202

New Bacterium Out of Montana State University

Barry Jacobsen, the associate director of the Montana Agricultural Experiment Station, discovered the plant-disease-fighting bacterium, *Bacillus mycoides* isolate J, more than two decades ago during a disease outbreak in a nearby sugar beet field. After years of research by biopesticide company Certis USA to fully understand the bacterium's effectiveness, it's finally been registered for commercial use and sale by the U.S. EPA. It's the first time Montana State University has had a technology registered by the EPA for commercial use. The patented BmJ spray, licensed for use by Certis USA and called LifeGard, has also been approved by OMRI for use in organic production.

"When I first started working with this I thought we really had something special with which to protect sugar beets," Barry says. "Subsequent research by Certis discovered it could do more than I ever dreamed. It is so gratifying to see how this will help protect so many different crops around the world."

It's effective in fighting disease in a wide variety of crops, including tomatoes, peppers, eggplants, tomatillo, okra, lettuce, cole crops and all cucurbits, among others.

OASIS Grower Solutions Announces New Products

Hydroponic and young plant growers now have more offerings from OASIS Grower Solutions. The company announced recently the addition of several products to the portfolio, a couple of which are from the eS platform of products that deliver an ecological and/or sustainable benefit:

- **Horticubes eS**—Enhanced biodegradable engineered media for hydroponic propagation and production of a wide variety of crops. Manufactured in a "sheet" style that easily fits into the industry's standard 1020 trays.
- **Fertiss eS**—Stabilized media plug wrapped in a 100% bio-based and natural material that's ready to stick for young plant production.
- **PlantPaper**—A product distributed by OASIS Grower Solutions that's a 100% natural, bio-based paper wrap for plant propagation media used in young plant production.
- **OASIS Easy Plant**—This hydroponic propagation system is available in a plug, block or slab. The inert, pathogen-free media provides excellent moisture and optimal aeration for better root development and bountiful results, according to the company.

Find out more about these products at www.oasisgrowersolutions.com.

Tweaking the Genes

What if you could change the makeup of a plant to allow it to produce fruit faster or thrive in an environment it normally wouldn't?

That's what researchers at Cold Spring Harbor Laboratory say they've done. "Our work is a compelling demonstration of the power of gene editing—CRISPR technology—to rapidly improve yield traits in crop breeding," says CSHL Associate Professor Zachary Lippman, who led the research.

The team there "tweaked" genes native to two popular varieties of tomato plants to make them flower and produce ripe fruit more than two weeks faster than commercial breeders can right now.

But the applications go beyond tomatoes and also include major food crops like maize, soybeans and wheat.

"It's really about creating a genetic toolkit that enables growers and breeders in a single generation to tweak the timing of flower production, and thus yield, to help adapt our best varieties to grow in parts of the world where they don't currently thrive," he says. The full research appeared online earlier this month in Nature Genetics.

Cold Spring Harbor Laboratory is a private, not-for-profit research center and education facility that's home to eight Nobel Prize winners. It has helped shape contemporary biomedical research and education with programs in cancer, neuroscience, plant biology and quantitative biology.

USDA Hands Out Record Amount in Grants

The USDA recently announced 325 projects from 47 states received more than $45 million in grant money through the Value-Added Producer Grants Program (VAPG).

The program is designed to help farmers and ranchers develop new products, businesses and markets. The amount given represents the largest single-year award in the program's history and $35 million of the total came from money Congress provided for the grants via the 2014 Farm Bill.

According to a statement released by the National Sustainability Agriculture Coalition (NSAC), "VAPG provides funding to individual independent agricultural producers, groups of independent producers, producer-controlled entities, organizations representing agricultural producers, and farmer or rancher cooperatives. VAPG may be used for working capital or to develop business plans and feasibility studies for new ventures. Up to $75,000 is available for planning grants and up to $250,000 is available for implementation grants, with project periods lasting from one to three years depending on the complexity of the project."

Each year the NSAC publishes a free resource called the "Farmers Guide to the Value-Added Producers Grants" to help farmers navigate the process. USDA tentatively plans to publish the fiscal year 2017 request for proposals in December, so after that announcement, the NSAC will release its newest edition of the guide. When it comes out, it will be posted under this link: http://sustainableagriculture.net/publications/

Just to give some examples of what the grant money will go to, some of the 2016 awards include:

- Over 50 local food projects
- Over 30 organic food projects
- A dozen grass-fed meat, and pastured poultry and egg projects
- A handful of non-GMO feed grain projects
- Food hubs and mid-tier value chain development projects

Extending Shelf Life

A Southern California start-up called Apeel Sciences is looking to extend shelf life by creating an edible barrier around produce that could make it last five times as long. The company has already used its product to stretch the shelf life of cassava (a tuberous root vegetable) in Africa, according to a story last week in *The New York Times*.

"It takes 30 days to get blueberries grown in Chile to market in the United States, which means they have to be picked before they're ripe and shipped under heavy refrigeration," the story quotes James Rogers, the founder and chief executive of Apeel. "We can change that."

However, the company's product is still untested commercially, the story goes on to report, noting "It faces several potential hurdles beyond effectiveness. Consumers may be wary of a new coating on fresh food, for example, and growers may decide it adds too much cost."

Colorado Cannabis Sales Top $1B

Yes, you read that right—that's a "B" after the $1. And it wasn't even for the full year. Based on October data from the Colorado Department of Revenue, the state's cannabis stores sold nearly $1.1 billion worth of marijuana and marijuana-related products, according to a story in the *International Business Times*.

The state also hit another high (pun intended) with the amount of marijuana business licenses issued, which saw a sharp rise of about 70% in October. All told, active business licenses appear to be at their highest at 2,913 as of the first of December.

Four more states voted in November to legalize recreational marijuana: California, Maine, Massachusetts and Nevada. On top of that, 20 states allow only medical marijuana and at least 12 have decriminalized it.

Belgian AgTech Company Opens U.S. HQ

Urban Crops, based in Belgium and known for building the largest European automated indoor farm—which it uses for R & D and test runs—is expanding into the United States with a regional headquarters in Miami, Florida.

The new office will be responsible for North and South American sales. The company bills itself as a total solution supplier in the closed-environment vertical farming industry. Its offerings include turnkey, automated and robotized growing solutions that can be integrated into existing growing facilities. Urban Crops has its own range of growth container products and can supply seeds, substrates and nutrients for all of its growth recipes. The company has more than 160 varieties of crops that can be grown in its systems using its growth protocols.

Pieter De Smedt is leading the U.S. operations for Urban Crops. Find out more at www.urbancrops.be.

Canadian Vertical Farming Company Secures $8.5M in Financing

TruLeaf Sustainable Agriculture Ltd., an indoor, multi-level farming company from Nova Scotia, announced recently it secured $8.5 million in additional financing to continue to develop sustainable vertical farming systems.

The company wants to scale its GoodLeaf Farms consumer brand to allow growers to offer locally grown food and plants for medicines anywhere in the world, regardless of environment. The goal is fresh, nutrient-dense, pesticide-free produce to be grown locally all year round.

The funding came from Mike Durland, former CEO and Group Head of Scotiabank's Global Banking and Markets division, as well as a small group of strategic investors from Toronto. Mike and Neil Murdoch—Former CEO of Connor, Clark & Lunn Capital Markets—will become members of TruLeaf's Board of Directors.

New Tomato Research at Vineland

The Canadian government recently pledged nearly $1 million to the Vineland Research and Innovation Centre for the development of disease-resistant greenhouse tomatoes and apples. The money, $920,000 to be exact, will go to build on projects carried out by Agriculture and Agri-Food Canada scientists who've played a crucial role in developing new breeding lines, according to details in a statement released by the Vineland Research Centre. Greenhouse tomatoes bring in $516 million annually, as well as $311 million in exports, and the goal is to strengthen the crop's long-term growth and profitability.

"Our Government is committed to helping farmers stay on the cutting edge of the market with superior varieties of crops," says Minister of Agriculture and Agri-Food Lawrence MacAulay. "These innovative new varieties of apples and tomatoes being developed by the Vineland Research and Innovation Centre will help drive the sector forward as a leader in job creation and innovation."

Considering some of Canada's largest growers are starting to build greenhouses in the U.S., this research could impact varieties grown here, as well.

America's Shifting Shopping Habits

The Atlantic recently posted a fascinating story about America's shift in grocery spending. Initially, the article seems to pin the problem on Millennials, but then the writer digs deeper. It turns out all of America is shifting toward eating out more, and dividing their shopping among several stores and not just one market.

In fact, according to the story, for the first time ever Americans spent more on restaurants and bars than on groceries in January 2015. Also, according to the story, in 2005 two-thirds of shoppers said their local supermarket was their primary shopping destination, while in 2016 fewer than half only shop at one place. The story points out a shift toward convenience stores and all-in-one retailers grabbing a larger share of the grocery market, too.

Spear: Harnessing Nature's Assassins for Novel Biological Pest Control

Spear® is Vestaron's new family of biopesticides for control of key pests in commercial farms and greenhouses. Field trials of Spear demonstrate results equivalent or superior to conventional control chemicals. Our Spear formulations use technology that employs naturally occurring venom peptides that form the basis of a highly specific, environmentally benign bioinsecticide. No harm to mammals, honeybees and other beneficial insects, birds or fish.

www.vestaron.com

4717 Campus Drive, Kalamazoo, Michigan 49008
269-372-3108

VESTARON®
NATURE BY DESIGN

A New Builder in the U.S. Hort Biz

There's a new player in the contracted greenhouse-building business: Dominion Builders just announced it launched a new division called DominionAG, which specializes in the planning, construction and design of agriculture growing facilities.

Marc Finch will be the division's director of operations, who along with a team of executives, boast more than 40 years of experience in development and construction. Dominion built BrightFarms' Chicagoland greenhouse, a 177,441-sq.-ft. hydroponic farm west of Chicago. That greenhouse produces approximately 1 million pounds of produce a year, including baby greens and tomatoes. But it doesn't seem like tomatoes are the only crop that's spurred Dominion into the ag market.

"We are proud to launch this new division, which resulted from a demand within the emerging locally grown vegetable and cannabis industries," says Mark Gemignani, president of Dominion Builders. "DominionAG will offer clients a complete design-build solution that will quickly translate concept to reality."

Dominion also completed a 110,000 sq.-ft. greenhouse for BrightFarms in Elkwood, Virginia, along with two other greenhouses that are currently in the design phase—one in Kansas City, Missouri, and the other in Wilmington, Ohio.

You can find out more about this Miami, Florida-based company at www.dominion-ag.com.

Growtainers Provided to Oklahoma Food Bank

In the October *Inside Grower* supplement, our contributor Dave Kuack interviewed Glenn Behrman, founder of GreenTech Agro LLC and developer of the Growtainer, a system that allows growing in shipping containers.

Now, Glenn writes to let us know that his organization has provided two Growtainers at a substantially reduced price to the Community Food Bank of Eastern Oklahoma, the largest private hunger-relief organization in that area. They provide food and other donated product to 450 partner programs in 24 counties in eastern Oklahoma. With the partner programs, they provide more than 339,000 meals to hungry Oklahomans each week, including the Food for Kids program.

According to Glenn, 25% of the food distributed by the Food Bank is fresh produce, and after spending a few hours at the organization to see the work they do, he agreed to provide the Growtainers. Complete with energy-efficient LED lighting, a proprietary Growrack system, and climate and environmental controls, these indoor farms can produce a substantial amount of the Food Bank's leafy greens requirements 12 months a year.

Reader Service Number 208

Reader Service Number 209

Selling Fresh

Leamington-based NatureFresh Farms opened new facilities in Delta, Ohio, and with it, the potential for a whole new market when it comes to greenhouse-grown tomatoes in the United States.

Story & Photos by **JENNIFER POLANZ**

The marketing proposition is simple: fresh tomatoes grown year-round from the same grower with the same quality, every time. Sounds easy, right? The execution is far more complex, though.

NatureFresh Farms of Leamington, Ontario, is betting on the fact that Americans are ready for locally grown greenhouse tomatoes and it's invested more than $50 million so far in a multi-phase plan that tops out at 180 acres and $200 million. Currently, there are three phases of the greenhouse operational at 45 acres total, and according to Director of Marketing Chris Veillon, it's the most state-of-the-art tomato greenhouse operation built in the U.S. Once it comes to fruition, it also will be one of the largest greenhouse ranges in the states.

The first phase encompassed the trademarked OhioRed tomatoes on the vine, which began shipping a year ago from the Northwest Ohio facility. "We created the brand OhioRed for customers to be able to ask for the tomato by name," Chris notes. "It took off like wildfire."

When the second phase came online, it housed the TOMZ line of snacking tomatoes (red, yellow and orange grape tomatoes, red cherry tomatoes, sweet red cocktail tomatoes and mixed medley tomatoes). "We worked with our team to not only encompass one variety, but all snacking tomatoes, and we came up with the TOMZ branding," Chris explains.

A third range just came online in December, designed to produce beefsteak tomatoes also under the OhioRed designation and will be ready in March. All products carry the Ohio Proud logo from the Ohio Department of Agriculture showing they're Ohio grown.

The Delta location was chosen purposefully because of the size of the tract available (250 to 300 acres) and its easy access to U.S. Interstates 80 and 90 from Indiana through Ohio and into New York. Delta is a sleepy little town of 3,100 people just west of Toledo, Ohio. Located near a steel plant, the greenhouse range is less than two minutes from the Ohio Turnpike. There's approximately 20 million people within a five-hour radius and some of NatureFresh's major retail partners have distribution centers nearby. Some of

those partners include Kroger, Heinen's, Giant Eagle and Wegmans, among others.

It's also a pretty easy shot from the Leamington, Ontario, headquarters, where the whole shebang started about 18 years ago under the leadership of founder Peter Quiring. In 1999, Peter built Phase I of the Leamington greenhouse as a "build and sell" concept via his greenhouse construction firm South Essex Fabricating Inc. It didn't sell, though, and he kept adding on, hoping a larger size would attract a buyer. Eventually, he started NatureFresh Farms and continued to expand it to the 130-acre range they have today, growing a wide variety of tomatoes, bell peppers and cucumbers.

The concept of Canadian growers entering the U.S. market isn't new, but NatureFresh Farms has a distinct edge in that partnership with SEF, which not only builds greenhouses, but creates designs, provides project management, installs energy systems and fabricates storage tanks.

Living the message

Remember that marketing proposition? The fresh is what NatureFresh excels at, and Chris proudly states that tomatoes are handpicked, packed and shipped to retailers in 24 hours. That's a big distinction—especially in the middle of a cold, Midwest winter—when tomatoes are typically traveling thousands of food miles from Mexico or other countries.

"It comes from the same grower, same greenhouse, with brand and quality consistency across all products," he says. "It instills confidence in the consumer and they are supporting the Ohio Proud brand messaging by supporting a local grower in the region.

"The brand generates loyalty and, hopefully, consumers for life."

Quality control is part of that fresh message and NatureFresh uses a Priva program to manage the product. Each team has a handheld scanner and each row has tags so team members can scan the row after completing a task, recording what task was completed by whom. "It's all part of the traceability initiative," Chris adds. "We can track it right down to the house."

Along with quality and freshness, the packaging is vital to the overall marketing, and last fall, NatureFresh unveiled its new colorful top-seal design for the TOMZ snacking tomatoes at the PMA Fresh Summit in Orlando. The top seal reduces the plastic content by nearly 25%. It also recently debuted the TomBar at select Kroger stores throughout the Midwest, where customers can mix and match up to 13 different varieties of snacking tomatoes from the TOMZ line.

NatureFresh communicates its brands and message via many avenues, including (but not limited to) a robust website with news, blogs and recipes; an active social media presence that include 74,000 followers on Facebook, 4,000 followers on Twitter and 1,400 followers on Instagram, as well as presences on Pinterest, LinkedIn and YouTube; and in person through the Mobile Greenhouse Education Center (see sidebar).

There's more to the company's values than just the fresh, but that's the main message the end consumer sees. However, the company also focuses on sustainability, from recycling 100% of the nutrient water used by running it through an ozone system (a big deal right now in the Toledo area, which has seen toxic algae from Lake Erie as a result of fertilizer runoff compromise the drinking water) to a robust IPM program (more on that below). Once crops are picked through, they're cut down, left to dry out, then baled up and composted—yet another component to its commitment to sustainability.

FACING PAGE: An example of the OhioRed tomatoes with the branded sticker.
CLOCKWISE FROM RIGHT: Tens of thousands of bumblebees from Biobest are released for pollination into the greenhouses. ● A birds-eye view of the OhioRed tomatoes on the vine greenhouse range. ● 2015 *GrowerTalks*/Dümmen Orange Young Grower Renato Zardo is now a greenhouse grower in the snacking tomatoes segment at NatureFresh's Delta operation. ● The TOMZ line of snacking tomatoes comes in a variety of styles, from individual packages to a medley. NatureFresh also is introducing the TomBar concept into Kroger stores, where customers mix and match from 13 different varieties. ● Workers use carts like these to travel down the rows and up to the tops of the vines to scout and harvest tomatoes.

The nuts and bolts

On the day I visited the facility, tens of thousands of bumblebees from Biobest were being released into the Phase I and II greenhouses for pollination. During my visit, I saw Renato Zardo (some readers may remember him as our 2015 *GrowerTalks*/Dümmen Orange Young Grower Winner), who's now a grower focused on the snacking tomato greenhouse range. I followed up with him on the technology in use and the IPM program.

"Here, we have a vertical integration that allows us to track back and analyze several data points, from all aspects of growing to labor," he says. "We record all climate data, irrigation and inputs done on the crop, and the final and most important, the yield.

"We record our daily yield per variety—this allows us to look back and see when was the highest or lowest yield, and track back what were the factors that led us to that, so we can either repeat them or work to avoid those undesirable ones."

On the IPM side, the first line of defense is massive traps above the extension of each tomato line in the greenhouse. The floor is sprayed weekly with sanitizer and beneficial insects are released weekly, Renato says. The greenhouse employs a full-time scouter for every 15 acres who goes through every other line weekly and report daily. Growers receive a report weekly from IPM Specialist Danielle Ferreira, showing the health status of the crop and anticipating beneficial needs for the upcoming week.

"Those practices allow us to suppress any pests such as aphids, whitefly, mites and perhaps any other pest when they are at a very low level, making it easy to control, avoiding as much as possible chemical applications," Renato says. The IPM program plays a vital role in reducing pesticide usage, especially because of the bumblebee population required for pollination. "The consequence of that is all practices must be bee- and worker-friendly," he adds. "Which is ▶

Timeline of Growth

January 2015: NatureFresh Farms announces new Delta, Ohio facility

April 2015: Broke ground on Phase I—15.3 acres

November 2015: First OhioRed TOV tomatoes planted in completed Phase 1 greenhouse

January 2016: Broke ground on Phase II—15.3 acres

February 2016: First crop of OhioRed picked for retail

September 2016: First TOMZ snacking tomatoes planted in completed Phase II greenhouse

August 2016: Broke ground on Phase III—15.3 acres

November 2016: First crop of TOMZ picked

December 2016: First beefsteak OhioRed tomatoes planted in completed Phase III greenhouse

good because it forces us to be very proactive and use an extensive biological control."

Getting back to the technology side, workers use a rail system to get between rows of plants to inspect and pick. The rails the carts travel are radiant heat to keep the plants warm, while high-pressure sodium lights provide supplemental lighting during the gray days of Ohio winters. The HPS lights are used during off-peak hours late at night and early morning, providing heat as well.

While fairly automated, particularly in the packing warehouse, the greenhouse still employs about 70 to 90 people at peak season. When asked about labor and the future of labor availability, Chris responded: "Labor is always a challenge; we are using a variety of programs to help strengthen our workforce. We're actively engaged with H2A. We don't know what the future holds in the New Year, but you can't run a business on what ifs." So when is peak for a year-round tomato greenhouse operation? Still summer—for now.

"That's why we're trying to change things and shift that," Chris says.

Overcoming Obstacles with Education

It isn't all sunshine and roses (or in this case, high pressure sodium and juicy tomatoes) when it comes to getting the general public to bite on greenhouse-grown tomatoes. There are obstacles to overcome. The idea that they're some sort of "franken-food" for example, or that an excessive amount of chemicals are used to grow them—or worse even yet, that they don't taste good.

That's why NatureFresh Farms has deployed the mobile Greenhouse Education Center (GEC), a 38-ft. trailer that houses the same setup as in the greenhouse. Dubbed the #GreenInTheCity Tour, the GEC travels to schools, summer camps, grocery stores and other community events to educate the public about exactly how greenhouse tomatoes are grown. In 2016, the company did 105 events and more are planned for 2017.

Why is it important? "Without greenhouse technology, we're going to have a very difficult time trying to feed the world," Chris Veillon, director of marketing, says. "People need to embrace the use of technology combined with Mother Nature; they work hand in hand."

All of the educational efforts they make, from the videos on the website showing the growing process to the 25,000 bookmarks printed and handed out to school kids, it all makes for a more educated consumer.

"People don't know how their produce is grown and who grows it, let alone where it comes from," Chris says, adding their efforts are designed to break those barriers down so consumers know who grows their tomatoes. You can visit the website at www.naturefresh.ca to check out the videos, blog and recipes.

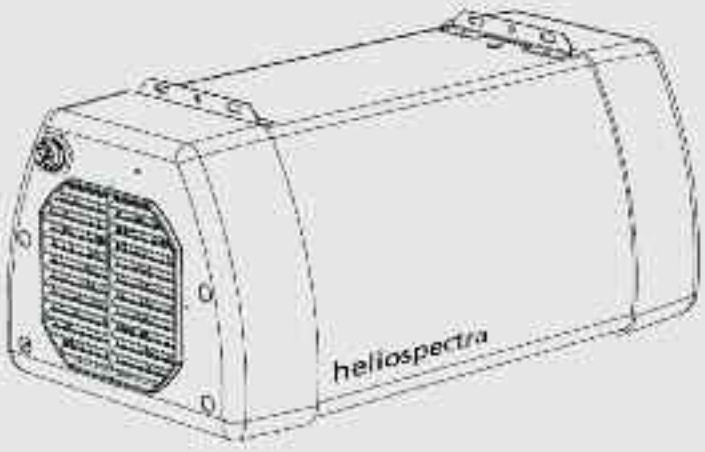
heliospectra.

GET THE QUALITY RESULTS YOU WANT WITH PERFECT LIGHT 365 DAYS A YEAR

BETTER GROWTH THROUGH RESEARCH with the Heliospectra LED Lighting

INCREASE SALES
Exceed your targeted sales numbers and reduce costs by controlling every aspect of your operation.

IMPROVE QUALITY
Boost the quality of your crops with an optimised light spectrum, creating a better product, putting you miles ahead of your competition.



MAXIMIZE PRODUCTION
Increase harvest rates by providing the perfect environment for your plants all year round.

1-888-942-GROW | sales@heliospectra.com | www.heliospectra.com

Reader Service Number 211

Alternative Energy

Making the controlled environment a greener, more stable place.

by **JENNIFER DUFFIELD WHITE**

In the world of controlled environment agriculture, we spend a lot of time hanging our hats on how our products have lower environmental impacts, how they use less water, travel fewer miles and have a smaller carbon footprint than traditional agriculture. In many cases, growers have made those attributes a value-added part of their offerings.

But some critics refute those claims.

While indoor growing operations may be reducing food miles and water usage, there are tradeoffs. Using electricity from the grid to light your crops has a high cost—financially and environmentally—especially if it's powered by fossil fuels.

Louis Albright, an emeritus professor of biological and environmental engineering from Cornell University, has controversially argued that indoor urban farming with artificial lighting would actually increase the carbon footprint over conventional methods. According to his calculations, a head of lettuce grown under indoor conditions with electric lighting would create 8 lbs. of carbon emissions, while the same lettuce grown in a greenhouse would create about 2.7 lbs. of carbon emissions (though there are number of "buts" that could counterpoint that).

If environmental sustainability is on your agenda—and especially if it's one of your products' selling points—you have to, at some point, ask what can be done better. Alternative energies give a business a way to boost sustainability and to put a transparent stamp on who they are and what their products stand for.

As you'll see, sometimes the most economical projects mean partnering—either with other growers or other businesses—to create innovative systems.

COGENERATON

Cogeneration—or combined heat and power (CHP)—systems are a triple deal, providing heat, power and supplemental CO2. Power can be used to run lighting and excess electricity can be sold back to the grid. The bonus? With supplemental lighting, it's been shown that plants can absorb even more CO2, increasing harvest yield, making cogen attractive from multiple standpoints. While they're quite common in Europe, we've just begun to see adoption in North American greenhouses. General Electric says the estimated payback on a large cogen system for a 25-acre U.S. greenhouse is about 4.7 years. For smaller growers, cogen may not make sense. Clark Energy, which specializes in engine-based power plants, advises that cogen systems become efficient for greenhouses that are at least 2.47 acres in size.

Houweling's facility in Camarillo, California, is one such greenhouse that has made the switch, installing General Electric's Jenbacher combined heat and power (CHP) system to reduce operating costs and also improve production.

If you don't have your own CHP system, sometimes you just need to find someone else who has one. Last year, greenhouse vegetable grower-shipper SunSelect Produce Inc. announced they were going to partner with construction equipment giant Caterpillar Inc. on a new project in Mossville, Illinois. Caterpillar already has a cogeneration facility on site—Advanced TriGen Power Systems (ATPS), with natural-gas-powered turbines. The exhaust gas from the turbines goes to a heat recovery steam generator, the steam from which is sent to the Caterpillar facility. They also have steam turbines that generate additional electricity.

Still, after all that, they currently have low-grade exhaust heat leaving through a stack. That's where SunSelect comes in. They plan to build a hydroponic greenhouse next door. With a duct system connecting the two facilities, they'll use the excess energy and carbon dioxide from the cogeneration plant to heat the greenhouse and enhance CO2 levels. (SunSelect still plans to have supplemental heat for backup, though.)

Reinhold Krahn, director of SunSelect, says, "This collaboration is a significant step in our long-term growth strategy. Building on our existing distribution footprint, this Midwest base will allow us to expand our ability to grow fresh and healthy vegetables, safely and responsibly, on the smallest amount of land possible."

GEOTHERMAL

Geothermal heat continuously flows from the core of the Earth outward, mostly by conduction, and solar energy from the sun is also stored in the top 100 meters of the Earth's crust. Considered by some to be the cleanest energy of all, geothermal systems use this heat to provide continuous, 24-hours-a-day, sustainable energy production. Not every greenhouse is lucky enough to be perched over a geothermal hot spot. Yet, today's technologies offer numerous ways to harness the temperatures below the Earth's crust—from mild 50 to 60F temperatures to 185F water.

If that water or steam is trapped under a layer of impermeable rock, it can form a geothermal reservoir, which can be harnessed for energy. This might be close to the surface, or in the case of greenhouses in the Netherlands, they're drilling deep into the earth to tap into hot water. Even without the presence of geothermal water, technology can take advantage of the constant temperature 10 ft. to 300 ft. below the surface.

Direct geothermal heating/cooling uses the geothermal water from a reservoir directly, without a heat pump. Alternatively, geothermal or ground-source heat pumps use the moderate temperatures (usually 50 to 60F) of the Earth 10 ft. to 300 ft. below the surface and circulate water or other liquids through pipes buried in a continuous loop, either horizontally or vertically or in a pond. To heat, the pipes pull heat from the earth, through the loop and to the structure, where it can be used as hot water heat or distributed through a conventional duct system. To cool, it just reverses the loop, extracting the heat from the structure back through the earth loop, where it cools.

Steve and Kris Van Haitsma at Mud Lake Farm in Hudsonville, Michigan, put a geothermal system in their house 15 years ago, and it worked so well, they put one in their greenhouse, too, in 2009. When they built a new range in 2012, they added yet another geothermal system.

"We grow hydroponically and the geothermal was a perfect system for us since we were interested in primarily heating water and water-to-water systems are incredibly efficient," says Steve.

In the Netherlands, where greenhouses are often clustered close together and oil and gas prices are some of the highest in the world, groups of growers have begun going in together on drilling deep geothermal wells. The Aardwarmte Vogelaer geothermal project began installing wells and a related heat network in 2016. Another project, the Consortium of Geothermal Vierpolders, has created a network of pipes that utilize geothermal water from wells in excess of 6,000 ft. deep. The nine growers in that group haven't eliminated fossil fuels from their operations, but they're reducing their use and thus improving both energy sustainability and shielding their businesses from volatile gas prices.

SOLAR

The good news is that solar has, in the last few years, become a much more affordable technology—with solar photovoltaic (PV) modules seeing a 75% reduction in cost from 2009 to 2015.

It's true that solar cell technology doesn't have an enormous conversion efficiency. (And critics of indoor urban agriculture often point out that natural sunlight is much more efficient; it'd be difficult to set up enough solar panels to substitute for the sun's natural light, watt for watt.) However, what solar lacks in conversion efficiency, its advocates argue, solar makes up for in being renewable, bringing with that label a long list of advantages, from its low carbon footprint to portability and reliability. So if you need electricity in your operation, and you're realizing other benefits by being a greenhouse or indoor ag operation, it's a viable option.

Photovoltaics (PV) are the most common form of solar energy, using PV panels to convert sunlight into electricity, which can then be used, stored or converted for transmission. However, you can also use various technologies, including passive solar, that collect thermal energy and then heat water and spaces. They can also be used for cooling.

Most growers hook into the grid with their PV panels, though a few smaller growers prefer not to pay the hookup fee and just use battery storage instead.

Looking toward the future, Soliculture has developed a solar system for greenhouses that defies the general norms. The thin-film technology is transparent, and bright red, and growers can put the panels on the roofs of their greenhouses. According to the developers, using a dye on solar panels makes them more efficient; and it just so happens that the red light generated is the same as that used in commercial grow lamps. After three years of research trials, they say that it really is possible to remove a portion of the solar spectrum with the red panels on the roof without negatively impacting plant yield. They've already installed their LUMO solar panels in a couple of commercial greenhouses in California, with more planned for 2017. They say they're also completing an off-grid research greenhouse at University of California—Riverside this spring.

Photo courtesy of Soliculture.

The solar panel of the future for greenhouses? The new transparent LUMO solar panels from Soliculture sit on a greenhouse roof and allow just part of the solar spectrum through—but it seems to be the right light for plants to thrive in.

COSTS

Lured in by the concept of renewable energy, very often it's the incentives that enable many growers to actually install these systems. Admittedly, for U.S. growers, the low cost of oil in recent years has made renewables less urgent for many, as the savings aren't as dramatic. Should the price of fossil fuels rise, that will change.

As a rule of thumb, without outside assistance, renewable energy projects often take five to 10 years to see payback, but grants, incentives, utility/state rebates and energy credits can often cut that payback time in half. For now, in the U.S., the Rural Energy for America Program (REAP) is enjoying renewed funding—providing both loans and grants to cover part of the cost of renewable technologies. The USDA's Natural Resource Conservation Service (NRCS) and their Environmental Quality Incentives Program (EQIP) for energy audits and rebates is another widespread source of funding.

BEFORE YOU START

Especially where solar, cogeneration and geothermal are concerned, the technologies have improved (and changed) greatly in the last decade. Before you do anything, be sure your current system is as efficient as possible and that you've reduced the demand for heating or electricity as much as possible.

Once you have a project in mind that's right for your operation and your location, work with a supplier to create a budgetary design that fits your needs. Talk to growers who've gone before you. Figure out how incentives and funding will fit into the picture—and be sure to read the fine print on funding requirements. (For REAP grants, for instance, you must submit your grant application before investing any money in the project.)

After that, leave time for the applications (often your supplier can help with this), contracts, zoning and permits.

While renewable energy requires vision and commitment, it's an investment that can protect a business from less stable energy costs—and it can also be a large part of what makes an operation resilient and sustainable for the long run.

What's the Difference?

by **DAVID KUACK**

"Audited" and "inspected" are easy to transpose. A Food Safety Modernization Act inspection is not the same as a food safety audit.

There's a misconception being made by some food producers that the Food Safety Modernization Act (FSMA) requires that a food safety audit be conducted of their growing facility. The FSMA Produce Safety Rule covers standards related to growing, harvesting, packing and holding of produce for human consumption.

"The Food Safety Modernization Act and food safety audits are two completely different things," said Phil Tocco, food safety educator at Michigan State University Extension. "FSMA is not an audit. A lot of people are making that mistake, including buyers and people who are looking to be 'certified' FSMA-compliant. There is no certification for FSMA. The way FSMA is created, there are certain things that growers need to be doing.

"At some point, someone from FDA or the state department of agriculture or the state department of health may call and schedule a time to visit a grower's operation to make sure that the grower is doing the things required by the FSMA rule. If a grower qualifies, this could take as long as five or 10 years. Just because someone at FDA or a state regulator comes in to perform an inspection, they aren't going to give the grower a certificate when they are done with the inspection. All they are doing is basically inspecting for FSMA rule compliance."

Phil said if growers qualify under FSMA, they won't need to call anyone or hire anyone to do an FSMA inspection; the FSMA inspection is conducted by the regulators and not by a third-party company.

"Even though a grower passes an FSMA inspection, there are buyers who are going to still want a food safety audit done at the grower's facility," he said. "The audit is different than the FSMA inspection."

WHO QUALIFIES FOR FSMA?

There are two things that FDA or state regulators look at to determine who qualifies for FSMA.

"The first is income based on gross sales," he said. "Companies grossing less than $25,000 in annual gross produce sales are exempt. However, that does not mean that the FDA is not going to stop and look at an operation. FDA or state regulators are not going to know a grower's operation is exempt until they make a visit. FSMA requires growers to maintain records that show they are exempt. Growers need to have these records on file.

"There are also requirements for having the company name and address on individually packaged goods if the goods are sold at retail, like a grocery store. If a grower does point-of-sale sales at a farmers market, a placard with the grower's name and address has to be posted so people know who is selling the product."

People who qualify for the FSMA rule will have traceability requirements.

"Although the federal rule does not speak to traceability, officials are

working on it," he said. "The reason is, because those people who don't qualify for the rule are exempt, FDA still wants to make sure that there is a measure of traceability back to the growers."

Another aspect of FSMA is whether growers are selling their product to a qualified end user.

"A qualified end user is someone who is the immediate end user of that product—such as a restaurant, a university, a school or to a consumer at a farmers market, CSA or farm stand market," he said. "A grower can grow up to $500,000 in total food sales. By 'food,' it's a very broad definition. If a grower sells more than half of his produce to qualified end users within 275 miles of where it's grown, then the grower would be considered qualified exempt.

"Growers have to be able to prove that they are qualified exempt. They have to do the recordkeeping to show they are exempt. Most growers who are dealing with controlled environment agriculture—including greenhouse growers—are not selling their crops for processing during which the product is cooked. This is another exemption. If the crop is going to be processed, then the grower would be exempt."

Phil said it doesn't matter what controlled environment growers produce when figuring this $500,000. If they sell more than $500,000 in food and they grow a produce item that FSMA regulates, they qualify for the FSMA rule.

"I know a grower who does 15 acres of vegetables, but he also produces a lot of microgreens," he said. "That is a crop that a lot of people might do in controlled environments. This grower is doing sales of $200,000 in just microgreens. If a grower is producing high-end microgreens in a controlled environment and selling them to restaurants in cities like Chicago, New York or L.A., I can see that grower having some major sales. If those sales exceed $500,000, the grower would qualify for FSMA."

WHO'S REQUIRING FOOD SAFETY AUDITS?

When it comes to doing food safety audits, it's totally up to the discretion of the buyers that growers work with.

"Buyers may want the growers who they purchase from to be audited on an annual basis," he said. "It is totally up to the buyers. A buyer can say, "We will buy your product, but we won't buy it until you are audited under this particular audit scheme.' That could be any type of buyer from a grocery store to a restaurant to a university. We actually have had a university in Michigan purchase accounts as small as $1,000. The university is requiring growers to be GAP (Good Agricultural Practices) certified and to have an audit done."

Phil said growers don't have much choice when it comes to choosing what audit company does the audit.

"A grower may work with two or three buyers who have two or three different audit schemes that they want the grower to do," he said. "A grower may have to deal with several different audit companies and the audits are expensive. A grower is looking at anywhere from $500 to $2,000 for each audit. That is an annualized cost that a grower is paying every year.

"The buyers generally don't know much about the specifics of what an audit entails. Some buyers may have an idea about some of the things that are in an audit, but most of them are going on a relationship between the individual audit companies that are marketing to the buyers."

At trade shows, buyers see the audit companies, who are very good at talking about points of difference and compliance rates, Phil explained.

If growers qualify under the Food Safety Modernization Act, they won't need to call anyone or hire anyone to do an FSMA inspection. The FSMA inspection is conducted by the regulators and not by a third-party company.

"The buyers are being marketed to by these audit companies," he said. "That is usually what the buyers are basing their decisions on when choosing an audit company. The buyers are going to tell growers what audit company they have to work with."

DIFFERENCES IN AUDITS

According to Phil, the majority of food safety audits being conducted are very similar.

"Looking at all of the different audit schemes, about 80% of them would be the same across the board," he said. "Each of the different audit companies is very good at marketing the 20% points of difference between their audit and every other audit. The 80% of the audit that a grower needs to do to be FSMA-compliant, for instance, would be the same.

"Many of the audit companies right now are moving in the direction of if there is a discrepancy between what their audit requires and FSMA requires—for example, if their audit's water requirements or their requirements on employee health and hygiene or employee training are not up to FSMA standards—they are improving [them] to bring them up to FSMA standards." ▶

Phil said part of the 20% difference between audits may be related to worker equity or social responsibility issues.

"As much as the audits should be all about food safety, they're not all food safety," he said. "Some of these audits start with food safety and then there will be audit questions that will help buyers be able to justify saying, 'We're doing everything we can to promote sustainability in our supply chains.' So the buyers can get behind that statement and not have to worry about working with growers who may be causing havoc because they may not be socially responsible or environmentally sound."

"Most of the audit companies are nationally or internationally based. Growers will be able to find representatives from the audit company wherever their production operations are located. Primus is a good example. It is one of the larger audit firms with operations across the United States. Another one is USDA GAP, which operates across the United States."

DIFFERENCES IN AUDITS AND INSPECTIONS

The first thing a grower should do when working with an audit company, said Phil, is to obtain its audit scheme.

"All of these audit companies publish the audit schemes that they are measuring growers by," he said. "They are available to everyone. Obtain the latest version of the company's audit and look through it and start to understand it. Audits use different language than what most growers use. It is important to understand the language as much as possible."

"When USDA GAP auditors do an audit, the auditors are specifically told not to answer questions on 'how.' They can answer questions about the mechanics of the audit. They can give 'yes' and' 'no' answers about the audit itself. They can't offer any information other than to say something is wrong and a grower needs to fix it. They can't answer the question on how to fix it or what a grower should use in order to fix it or what would be a better way of doing something. They can't answer those types of questions."

Phil said this is the major difference between a food safety audit and an FSMA inspection.

"When an FSMA inspection is done, the inspector will go through the facility with a grower telling him what should be fixed and how he should consider fixing it," he said. "It is very much educating while regulating. The grower will do the walk-through with the inspector who will point out problems and good ways to fix them. It's very much a collaborative effort."

HOLDING DOWN AUDIT COSTS

If a buyer requires a grower do a food safety audit, and doesn't have a preference as to what audit is done, Phil suggests doing a general USDA GAP audit.

"This is a good first audit for growers to cut their teeth on," he said. "There is a general section and seven subsections, including farm review, harvest, postharvest, storage, packing, transportation, distribution and preventative food defense procedures.

"A lot of time, the only thing the buyers care about is if a grower has done a GAP audit. The buyers don't really care about the particulars of the GAP audit, like how many sections a grower did. However, there are some cases where buyers are very particular about which sections a grower does. We had one case in Michigan this year where it wasn't enough to just do a USDA GAP audit. The buyer required the grower to be audited in some of the other sections. In my experience, there are not a lot of buyers who know enough about the GAP audit to be able to tell a grower to do audits in specific sections."

If growers sell more than $500,000 in food and they grow a produce item that the Food Safety Modernization Act regulates, they qualify for the FSMA Produce Safety Rule.

An advantage of doing a USDA GAP audit is the grower pays the auditor by the hour instead of a flat fee.

"A lot of the private company audits may be $750 and they take as long as it takes to complete," Phil said. "The cost of doing a USDA GAP audit is $92 an hour, so if a grower is only doing section one and the general audit, he could keep his costs relatively low."

USDA has created a "harmonized" GAP audit. "The harmonized GAP audit is an audit that is more widely acceptable that USDA is trying to broker between a number of audit companies," he said. "It's kind of working, although there are still a lot of buyers asking for a USDA GAP audit that is not a harmonized audit. It is sort of challenging that way. The harmonized audit has been available for about five years. It's a good audit. What makes the harmonized audit different is that it has been tweaked to better align with global standards."

Phil said another option for growers doing a GAP audit is a program called GroupGAP that started in April 2016. This program enables small- and middle-sized growers to receive food safety certification by allowing growers, food hubs and other marketing organizations to work together

to undergo GAP certification as a group. Group members are able to pool resources to implement food safety training programs and share the cost of certification. The GroupGAP program helps to make it affordable for smaller size operations to obtain food safety certification, allowing them the opportunity to access larger markets.

"With GroupGAP, a grower is part of a cohort of several operations with an overseeing backbone organization," he said. "The backbone organization essentially does an analysis to figure out what a grower needs to fix in order to pass the audit. The grower would fix any problems and then the backbone organization does an internal audit and the grower passes or fails based on that internal audit. A subset of the total number of farms involved in that particular GroupGAP group would be fully audited by USDA. As long as a grower passes the internal audit, then he would be good to go even if his operation doesn't get audited by USDA."

Photo courtesy of Phil Tocco, Michigan State University Extension.

If a buyer requires a grower do a food safety audit and doesn't have a preference as to what audit is done, the grower can do a general USDA GAP audit.

For more: Phil Tocco, Michigan State University Extension, (517) 788-4292, ext. 6; tocco@msu.edu; http://msue.anr.msu.edu/resources/food_safety_for_small_farmers; http://msue.anr.msu.edu/program/info/agrifood_safety.

DAVID KUACK is a freelance technical writer in Fort Worth, Texas. He can be reached at dkuack@gmail.com.

Indoor or Greenhouse Growing?

The winner for Best Cannabis Growing Environment goes to ...

by **LEIGH COULTER**

Last November, amid the heady excitement of eight more states voting in legal marijuana programs, the annual Marijuana Business Conference was held in Las Vegas. In one session, there was a debate on indoor growing vs. greenhouse growing. A cannabis grower explained to the audience that he felt indoor growing was the clear winner because he just can't get the same yields or the same THC content from his greenhouse crop that he gets from his indoor crop. At the end of the debate, the audience voted and 55% of the room agreed indoor cultivation is better than greenhouse growing for marijuana.

Later that day at our booth, a customer from Colorado came by. He was so excited to tell us that despite his initial apprehensions, his greenhouse way outperformed his indoor grow. His greenhouse cannabis yields were higher and he was able to get higher levels of THC from his greenhouse crop.

So which is really better? Greenhouse or indoor cannabis?

This should remind us all that there are no absolutes. Perhaps the first grower didn't have greenhouses designed properly for growing cannabis in his area. Or maybe the second grower didn't have the best lighting for indoor marijuana production. Or maybe the environment isn't what made the difference.

Exceptional cultivation is magic; it requires an artistic touch and a scientific mind. Those of us who build greenhouses and design indoor growing rooms know that what we offer in a growing environment is only a tool to assist the accomplished grower in producing his or her best crop.

Whether you're considering growing cannabis for indoor CEA or as a commercial greenhouse crop, here are a few of the advantages and disadvantages offered by both.

CAPITAL COSTS FOR AN INITIAL SMALL GROW

For small indoor facilities, a whole new industry of warehouse landlords has bloomed. In November, a cannabis REIT was even listed on the New York Stock Exchange. Some of these rental agreements include the capital costs of the indoor build amortized over the rental period.

In the case of a small greenhouse, unless you already have an existing greenhouse facility and are portioning an area to cannabis, there's no rental option. Capital costs will include the physical greenhouse structure, irrigation, blackout, environmental controls, etc. and probably land acquisition, plus the initial cash outlay and time required to bring electrical services, water and gas to the site.

For these reasons, with regards to capital costs for an initial small grow ... **ADVANTAGE: Indoor cannabis.**

SCALABILITY OF CANNABIS FACILITIES

Indoor scalability is achieved by expanding into the next warehouse unit or growing up. Vertical towers can increase production without increasing the rental footprint. However, vertical growing requires considerable investment and presents operational challenges. Although promising, this technology still has a long way to go before the return regularly justifies the investment.

Greenhouses, in particular gutter-connected greenhouses, are completely designed for ease of scalability. With decades of large scale agriculture preferring greenhouse growing, the most advanced technology in environmental controls, irrigation, heating, lighting, benching, etc. are designed to expand with greenhouse construction. And on a large scale, the capital investment for greenhouse cultivation is less than their indoor counterparts.

For these reasons, with regards to the ability to scale your cannabis grow ... **ADVANTAGE: Greenhouse cannabis.**

HUMIDITY CONTROL

Typically, there are less external factors impacting indoor grow rooms. However, the positive effects of insulated walls and concrete floors that keep outside humidity out are also detrimental in keeping excess humidity in. Indoor cultivators should use a system for collecting water runoff—like ebb and flood tables—to redirect excess water out of the grow room. Once humidity indoors is above the desired relative humidity (RH), the only solutions for bringing it back down are mechanical and very expensive.

Indoor growing facilities offer lower capital costs and better pest control … but aren't as energy efficient or as flexible as a greenhouse if you want to expand.

Greenhouses by nature contend with a greater range of external variables. For example, the position of the sun can influence the amount of radiant heat hitting a particular area, and thus, influence the RH in different areas of the greenhouse. Most greenhouses largely depend on outside air for cooling. If outside air is humid, you'll bring in humid air. In a cold-weather climate, opening roof vents and boosting heat is cost effective humidity control, but this won't work in Florida. Greenhouse dehumidifiers are available, but they take up a significant amount of floor space and are expensive.

All things considered, balancing flexibility and limitation for each system to control humidity … **STALEMATE: Indoor and greenhouse cannabis.**

PEST CONTROL

Indoor facilities tend to have better sealed perimeters and more compartmentalization inside, which makes it easier to prevent pests from gaining entry and to prevent problems from spreading. However, if operating 24/7, there's little opportunity for total cleanout and sanitization without causing serious production delays. So, once a pest population does get established, it can be very difficult to get it under control. Adding to the complexity: indoor pests don't experience the same seasonal dormancy as in a greenhouse and treatment options for enclosed environments are considerably less flexible.

Greenhouses are generally built in rural areas, often surrounded by agricultural land—places where pests are already thriving. Insect screening can impede airflow through greenhouse vents and require additional strategies for ventilation. Even with the finest insect screening, complete exclusion of pests in a greenhouse is generally considered unrealistic. IPM is a vital ongoing component of any greenhouse operation.

For these reasons, with regards to controlling pests on your marijuana crop … **ADVANTAGE: Indoor cannabis.**

ENERGY COSTS

Indoor cannabis requires significant lighting, which draws substantial electrical power. In turn, these lights tend to generate more heat than the crop requires, which means the indoor facility requires air conditioning or chillers to remove excess heat. Add in mechanical dehumidifiers and it's easy to see how energy is a significant operating cost for indoor cultivation.

The greenhouse value proposition is free solar lighting. While supplemental lighting is generally recommended, the quantity of lights and the hours of use are reduced. In a greenhouse, typically the largest energy consumption is for heating, so in this case, the heat generated by lights is often a benefit. Greenhouse cooling and ventilating commonly use natural means, which also reduces the mechanical energy draw.

For these reasons, with regards to the ability to be energy-efficient… **ADVANTAGE: Greenhouse cannabis.**

LABOR EFFICIENCY

For proximity to labor force, industrial warehouses and strip malls generally have an advantage. Unfortunately, compartmentalizing grow rooms hinders developing scalable efficiencies.

With greenhouses—normally set in rural environments—finding a reliable labor pool may be more difficult. On the other hand, time-tested agricultural technology is available to dramatically reduce the amount of labor required to tend an acre or more.

For these reasons, with regards to labor … **ADVANTAGE: Greenhouse cannabis.**

COST TO GET TO CONSUMER MARKET

For vertical integration to the retail level, there's a lot to be said about urban agriculture. This has been a successful model for many dispensaries with grow rooms in the back. No transportation costs, but location, location, location. Expect to pay a premium for high-traffic sites.

Greenhouse grown marijuana will either require transportation to consumers or you'll need to become a "destination garden center." In horticulture, independent garden centers have had booming success attracting shoppers, so this may be a future avenue for marijuana businesses as well.

STALEMATE: Indoor and greenhouse cannabis.

This is just the beginning of a debate that extends much further than any particular crop. And while there's no single definitive answer to the question, in conclusion, we need to realize that in different geographies—with different restraints and different growers—the best answer won't always be the same.

LEIGH COULTER is President of GGS Structures Inc. a manufacturer of greenhouses and indoor growing facilities. www.ggsstructures.com/ig

Far Red is the New Red

Adding far red to red and blue light from LEDs brings control of plant growth to the next level.

by **QINGWU (WILLIAM) MENG & ERIK RUNKLE**

Indoor farms are burgeoning in the United States and Asia as growers and entrepreneurs find niche markets for year-round production of high-value specialty crops. According to a recent survey conducted by Agrilyst, leafy greens, herbs and microgreens are the most popular crops grown in vertical and container farms. The survey also reveals operating costs as the biggest challenge for indoor growers and that 28% of participants expressed interest in adding light-emitting diodes (LEDs) in the next year.

Aside from benefits, such as energy savings, LEDs allow for customized lighting to achieve specific crop characteristics. Light quality, intensity and duration can be manipulated to elicit desired attributes of leafy greens, including leaf shape, leaf color, nutrition, flavor, texture and aroma.

Most LED fixtures used in the horticulture industry look purplish because they primarily emit red (600 to 700 nm) and blue (400 to 500 nm) light. It's no secret that red and blue light are effective in driving photosynthesis and LEDs of these colors are efficient in converting electrical energy into light. Other LED arrays combine red, green, blue and/or white LEDs to generate a broad spectrum that appears more white.

Regardless of the spectrum, the intensity of photosynthetically active radiation (PAR, 400 to 700 nm) is crucial for plant growth. Plants not only convert PAR into chemical energy for photosynthesis, but also use light as a signal that elicits adaptive responses to the environment. Radiation outside the PAR range, such as ultraviolet (UV, 300 to 400 nm) and far red (700 to 800 nm), regulates numerous signaling pathways in plants. For instance, UV signals plants to commence protective mechanisms against stress.

Far red is best known for its role in the shade-avoidance response, which is mediated by phytochrome photoreceptors. A low ratio of red to far red is indicative of shade that triggers elongation growth, upward leaf orientation and reduced branching. The potential of using far red to obtain desirable morphological traits merits consideration in horticultural lighting. Although the dynamics between red and far red is fairly well understood, how far red interacts with both red and blue isn't clear. We investigated the value of adding far red to red and blue LEDs for indoor production of leafy greens and herbs.

EXPERIMENTAL DETAILS

We grew Rex green lettuce, Cherokee red lettuce and Genovese basil from seed in a peat-based substrate. After germination under fluorescent lamps, we started treating the plants with six different spectral combinations using red, blue and far-red LEDs (Figure 1). The photosynthetic photon flux density was maintained at 180 $\mu mol \cdot m^{-2} \cdot s^{-1}$ across all light treatments. Two ratios of blue to red (blue:red), 30:150 and 90:90 (in $\mu mol \cdot m^{-2} \cdot s^{-1}$) were delivered with and without 30 $\mu mol \cdot m^{-2} \cdot s^{-1}$ of far red. The same amount of far red was also added to 180 $\mu mol \cdot m^{-2} \cdot s^{-1}$ of red or blue alone. The spectral distributions of the light treatments were measured at the plant canopy using a spectroradiometer.

Lettuce and basil were grown at 72F (22C) under a 24-hour photoperiod for nine and 13 days, respectively, before data collection. We weighed the shoots and roots on a fresh and dry basis, and measured hypocotyl length, leaf length, chlorophyll content and leaf color indices. Relative chlorophyll content was measured using a SPAD-502 chlorophyll meter. Leaf colors were quantified in a *Lab* color space using a tristimulus colorimeter.

RESULTS

Biomass. The two lettuce cultivars responded to the light treatments similarly. Without far red, increasing blue:red from 30:150 to 90:90 reduced shoot fresh and dry weight by 17% and 22% for Rex and Cherokee lettuce, respectively (Figure 2). However, blue:red did not influence the biomass of basil. On the other ▶

Figure 1. Plants were grown in a growth room housing six LED chambers with different spectral distributions.

Custom Control Solutions | **Intelligent** Monitoring and Alarms | **Comprehensive** Data Acquisition and Analysis | **Nutrient** Management System | **Remote** Access and Control

Multi-Feed RM Nutrient Injection System

ADVANCED
Climate Control Systems

Argus provides advanced climate control systems that are customized to each grower's requirements - and are adaptable to their changing needs - enabling them to operate their facilities exactly the way they want.

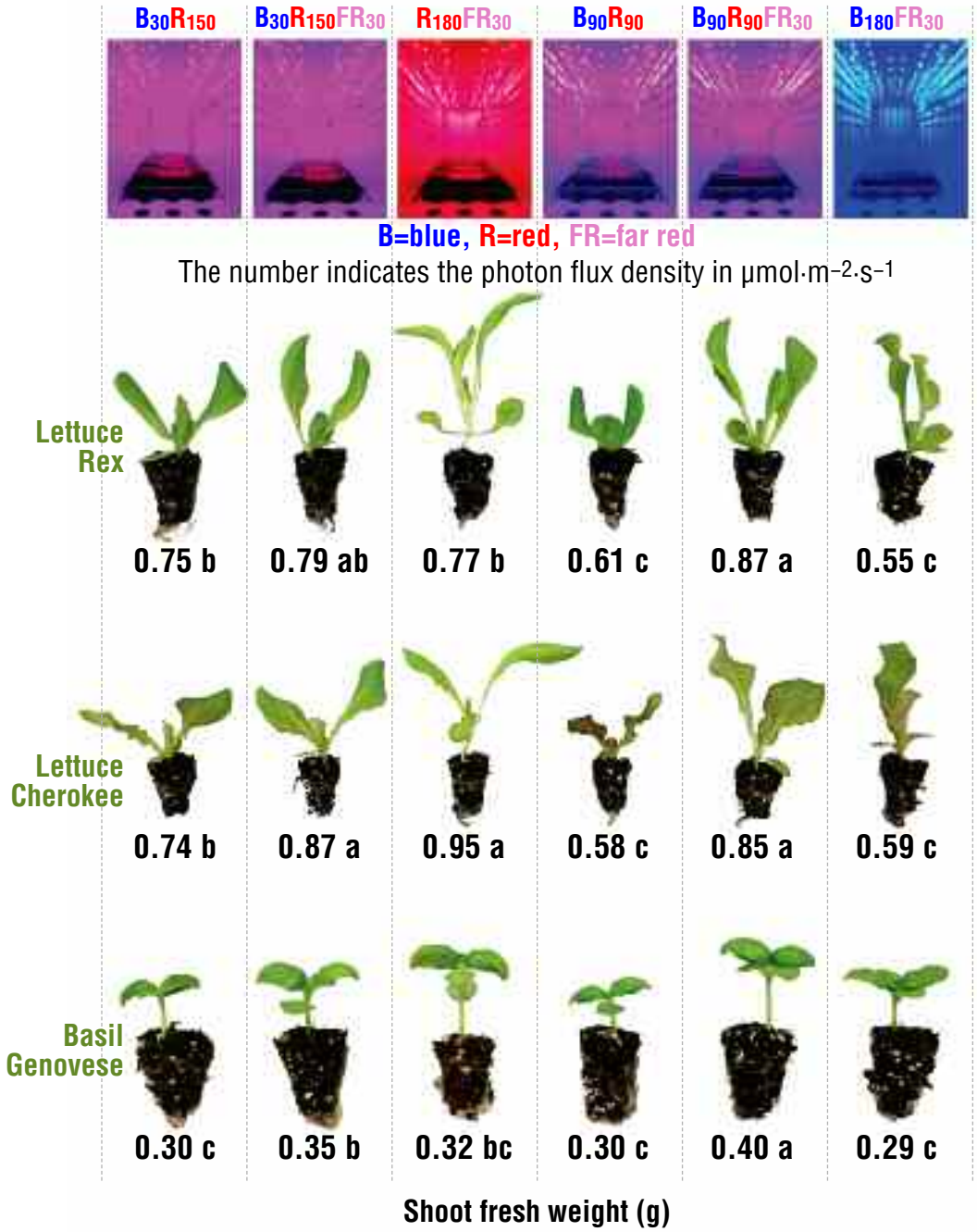
To learn how we can customize a solution for you, contact sales@arguscontrols.com or visit **www.arguscontrols.com**

ARGUS CONTROLS

hand, adding far red to red and blue increased the shoot fresh/dry weight of both lettuce and basil, especially when blue:red was 90:90. For example, the addition of 30 µmol•m^{-2}•s^{-1} of far red increased the fresh weight of Cherokee lettuce by 17% when blue:red was 30:150 and by 48% when blue:red was 90:90 (Figure 2).

The mixture of blue, red and far red resulted in the greatest shoot dry weight, regardless of blue:red. In comparison, the treatments that lacked either blue or red generally produced low shoot biomass. As for root growth, adding far red to red and blue increased the root dry weight of basil by 18% to 26%, but generally didn't affect that of lettuce. The added far red increased the lettuce shoot-to-root ratio when blue:red was 90:90, but had no influence when blue:red was 30:150.

Figure 2. The shoot fresh weight of three crops grown at 72F (22C) under six different LED treatments. Means followed by different letters are different based on Tukey's HSD test (α = 0.05).



■ **Elongation.** Hypocotyl length of Cherokee lettuce and basil increased by 33% to 37% when far red was added to the 90:90 blue:red treatment. For basil grown in the absence of far red, increasing blue:red from 30:150 to 90:90 reduced hypocotyl elongation by 19%. Adding 30 µmol•m^{-2}•s^{-1} of far red to red and blue increased the leaf length of both lettuce and basil irrespective of blue:red. However, the percentage increase was greater when blue:red was 90:90 than 30:150. Without far red, increasing the proportion of blue decreased lettuce leaf length by 12 % to 20%.

■ **Pigmentation.** Without far red, the relative chlorophyll content of lettuce increased by 10% as blue:red increased from 30:150 to 90:90. The addition of far red to red and blue reduced the relative chlorophyll content of lettuce by 10% to 19% in some cases, but didn't affect that of basil. In the absence of blue, lettuce and basil grown under red and far red had pale green leaves with the lowest relative chlorophyll content.

The redness of Cherokee lettuce leaves indicates the anthocyanin concentration. Adding far red to red and/or blue reduced their red pigmentation (Figure 3). In contrast, plants grown without far red appeared reddest in a blue-rich environment.

INTERPRETATIONS

Our results show that supplemental far red at a moderate intensity is a viable tool to manipulate extension growth. When added to red and blue, far red can increase leaf size, and thus, fresh weight, but at the expense of pigmentation. As leaf area increases from more far red, the plant captures more radiation that can be used for whole-plant photosynthesis. Moreover, recent research at Michigan State University indicates that far red can—to some extent at least—promote instantaneous photosynthesis.

Blue, red and far red have antagonistic effects on biomass accumulation, extension growth and pigmentation. For instance, blue inhibits leaf expansion, but promotes pigmentation, whereas far red does the opposite. The spectral distribution for plants should have an appropriate balance in these three wavebands. Because different crops often have ▶

Figure 3. Adding far red to red and blue reduced the red coloration of Cherokee lettuce.

unique responses to light quality, it would be ideal to develop and use crop-specific light recipes. However, there's no such thing as a "perfect" spectrum, even for the same crop, because the desired crop traits often vary among growers and markets. To complicate the issue, light quality also interacts with other environmental factors, such as light intensity and temperature.

The "best" spectrum is what produces the crop characteristics growers want for their customers in their particular growing environments. Some lighting companies have already included far red in some of their commercial LEDs for horticultural production. Growers can take advantage of far red to increase yield and extension growth, but should keep in mind that the effects of far red often depend on blue:red and species. In some cases, far red can cause unwanted responses, such as reduced plant pigmentation and compactness.

Regardless, far red opens the door to more sophisticated control of plant growth. It's the new kind of red that can be valuable to indoor farming.

QINGWU (WILLIAM) MENG is a Ph.D. student and **ERIK RUNKLE** is a Professor in the Department of Horticulture at Michigan State University.
Funding for this project was provided by Michigan State University's Project GREEEN. The LED modules were developed with Osram Opto Semiconductors. A video presentation of this research is available at https://youtu.be/WX90R_dmEIM.

PRO-MIX®

NOTHING SAYS GROWING MEDIA BETTER™

MP MYCORRHIZAE™ ORGANIK™

PRO-MIX MP MYCORRHIZAE ORGANIK provides the perfect solution for growers in need of an organic-certified growing medium that delivers well balanced air/water qualities. Enriched with mycorrhizae, this growing medium will not only improve the overall growth and increase yields of your crops, it will also increase plants' resistance to environmental stresses.

PROVEN RESULTS*

+150% DRY WEIGHT

BROCCOLI
MP MYCORRHIZAE ORGANIK

+82% DRY WEIGHT

TOMATO
MP MYCORRHIZAE ORGANIK

* Results obtained from independent plant growth trials. Individual growth results may vary to a degree. Additional results are available are available.

1 800 667-5366
VISIT **PTHORTICULTURE.COM**

Reader Service Number 216

Biological Control in Hydroponic Systems

by **SUZANNE WAINWRIGHT-EVANS**

Hydroponics is a segment of the market that's undoubtedly expanding. Many conventional growers are leaving traditional growing jobs and heading over to these new cutting-edge facilities. Once there, they learn quickly that hydroponics is a very different growing system and they are frequently working with unique crops. Within the hydroponic world, there are many different approaches to growing, and this often adds another challenge: finding information for the specific crop grown in their version of hydroponics.

Some of these systems are a one-of-a-kind operation. Growers have to take the knowledge that they'd learned throughout their career and adapt those skills to meet the challenges of growing in a very different system. This is true for the pest management end of it.

I've been personally working with hydroponic growers for several years now. For many hydroponic systems, we end up developing individualized programs specific to the system and pests being dealt with. Often the pest control strategy focuses on biocontrol agents primarily to mitigate concerns about pesticide resistance issues, achieving good spray coverage and preservation of any pollinators working in the crop. However, this doesn't mean pesticides are not or cannot be used.

Pests in hydroponic systems are similar to what you would find in a traditional greenhouse operation. Depending on the crop, location and time of the year, you'll have different pest complexes. Many of the fast-turn crops, like microgreens, turn so quickly there's no real time for a pest population to build. For longer-term crops—such as head lettuce, peppers or tomatoes—pest populations can establish themselves and present a serious problem.

SHORE FLIES

One common pest I see across many types of operations is the shore fly *(Scatella stagnalis).* This small fly wasn't very common years ago, but we're finding it now in higher numbers and across many kinds of operations. Shore flies are damaging to the plant, but they can be a nuisance when product goes to retail if they're in the media or packaging. Also, the adults are known to leave fecal matter on leaf surfaces, looking like small black dots. Disease vectoring may be a small threat, but nothing like that with fungus gnats (who

Shore fly pupa.

Shore fly damage.

A shore fly adult has dark wings with white spots. Larva lives in wet areas.

are feeding on roots and causing plant damage).

Shore flies thrive in Nutrient Film Technique (NFT) systems. With rockwool cubes placed inside dark tubes and a nutrient solution flowing past, it makes a perfect environment for shore fly larva to multiply. In traditional grower operations using media in a container, we treat the media with beneficials, such as nematodes, rove beetles or predatory mites. In an NFT environment without soil, these beneficials cannot really survive.

Many would think with an environment so moist it would be ideal for beneficial nematodes, but research has shown that nematodes have a hard time persisting in rockwool and disappear from it. It seems they mostly get washed away. The soil-dwelling mites and rove beetles cannot live in the wet conditions either.

For now, one of the better control options for shore fly is really good sanitation. Keep the system clean from algae build-up. Cleaning systems between crops won't only help slow the shore flies, but also reduce incidents of disease.

If a product needs to be applied, *Bacillus thuringiensis* ssp *israelensis* (BTi) is one of the products approved for use in hydroponics. The challenge can be getting it to where the fly larva is. BTi needs to come in contact with the larval stage and be ingested for it to kill the larva; it won't control adults or the pupa. For adult control, mass trapping with sticky tape is a good option. You do have to be careful when using mass trapping if you're also using flying biocontrol control agents; you don't want to trap out the good guys.

THRIPS

Thrips are another pest that most growers are familiar with, but when you say thrips, most think western flower thrips *(Frankliniella occidentalis).* This can get some growers into trouble because in vegetable systems, like lettuce production, you may end up with other thrips species like tobacco thrips *(Frankliniella fusca).*

We're also seeing Echinothrips *(Echinothrips americanus)* on the rise in greenhouses in both vegetable and ornamental production. It's important to always positively ID your pest to make sure you get the right biological control agent or pesticide to control the specific pest species. This is especially important today with many products being more precisely targeted. If you're unsure which thrips you're dealing with, contact your local extension office to help get them identified. Do not guess.

You can still get western flower thrips (WFT) in hydroponic systems, but once again, you cannot use the same tools the same way as you would in traditional growing systems. Many growers rely on beneficial nematodes to treat for WFT pupa in the soil, but this method doesn't really work in Deep Water Culture (DWC) systems or NFT; there's no exposed media to apply the nematodes to. If using soil (not rockwool), you could pretreat the soil with beneficial nematodes to help, but it cannot be your only control strategy.

Predatory mites *(Neoseiulus cucumeris* and *Amblyseius swirskii)* can and do work very well in this setting, but they only target the first instar WFT. Often other agents, like the minute pirate bug, are needed to target the later stages *(Orius insidiosus).* Keep in mind this beneficial needs pollen in its diet, so if pollen isn't available in your crops, banker plants can provide this essential food.

When using predatory mites, you have to think about which application method will be best for you. If treating heads of lettuce, broadcasting may not be the best option. With lettuce heads being "V" shapes, the carrier the mites come in will just fall down into the heart of the lettuce. If treating cucumbers, broadcasting can cause a lot of mites to fall to the floor. Also, if the mites are in a bran carrier, and there's a high humidity situation, the bran may mold.

Some predatory mites come in (or can be special ordered in) vermiculate to prevent the molding issue. Another alternative is to use release sachets. These sachets will release predatory mites onto crops for around six weeks (depending on temperature and humidity). There are a few different designs, depending on your need. They come on sticks, so they can be stuck in soil. Some have hangers to hang on the plant or you can just get plain sachets and tuck them into the plants. Many growing operations are moving in this direction because of the labor savings, as well as the benefit of predatory mites being released 24/7. Not all predatory mites come in sachets, but many do. *A. swirskii, Amblyseius andersoni, Neoseiulus californicus* and *N. cucumeris* are all available in sachets.

The minute pirate bug *Orius insidiosus* is a generalist predator that loves thrips. Keep in mind they need at least 12 hours of light a day to keep them from going into diapause (insect hibernation). This can be achieved with artificial lighting.

AQUAPONICS

Aquaponics offers its own unique set of challenges. Adding fish to the system basically eliminates the ability to use almost any traditional pesticides. There are a few products like *Bacillus thuringiensis* ssp *israelensis* and Mycotrol (containing *Beauveria bassiana*) that can be used under close supervision. These should only be used after other biological control options have been tried first.

There are many more pests and many more control options in hydroponic systems. This article was just to give you a helpful starting point. When looking to solve pest issues in hydroponic systems, make sure to think about how you're growing. Think about your particular system and whether the biological control agents work in the environment where you plan to apply them. Will they live in the specific media type? Or on that plants' surface? If you're unsure, ask your supplier for help. We're learning more each day about pest management in these unique systems and sometimes just asking can get you the information you need. IG

SUZANNE WAINWRIGHT-EVANS helps growers all over the country through her business, Buglady Consulting.

AmHydro Inc. The AmHydro "Get Growing!" Bundle is a unique all-in-one hydroponic farming package specifically designed to enable one to quickly establish a profitable and sustainable greenhouse business. A "Get Growing!" Bundle provides a high-quality commercial greenhouse, environmental controls, professional growing system, growing supplies and technical support.

Reader Service Number 225

New Products *February 2017*

Growers Supply The HydroCycle Vertical NFT System allows customers to grow hydroponically in tight, confined spaces. The system contains four tiers of NFT channels enabling customers to maximize usable space within their grow room. The four-tier vertical system is perfect for growing lettuce and herbs hydroponically while using a fraction of the space taken up by traditional one-level NFT systems. HydroCycle Vertical NFT Systems are available in 5-ft. and 10-ft. lengths with the option of 24 4-in. Pro NFT channels or 20 6-in. Pro NFT channels.

Reader Service Number 227

Philips Lighting Philips GreenPower LED Interlighting is a bi-directional LED module that provides light within the canopy of high-wire crops, including tomatoes, peppers, cucumbers and eggplant. Philips Interlighting ensures crops receive the needed micromole levels of light (220 µmol/s) when natural sunlight is inadequate in duration and intensity. Photosynthetic active radiation light is targeted and contained throughout the crop canopy, stimulating crop growth. Aluminum module encasement is rated IP 66 and is durable for humid greenhouse settings. Low-power consumption of 117W and high efficacy of 1.9 µmol/Joule. **Reader Service Number 226**

PanAmerican Seed SimplyHerbs offers the easy and economical way to grow the most popular herb classes. One plug gives a nice fast fill. No more seed broadcasting or unbalanced mixes. For Try Basil, each Precision Multi-Pellet includes three basil varieties: Genovese, serrated and dark red selections. Greenhouses produce a very uniform mix of basil from sowing just one pellet.

Reader Service Number 228

Index of Advertising Partners

GrowerTalks Magazine salutes these fine businesses for their support and involvement in bringing *Inside Grower* to you!

Company Name	Page #	Phone	Reader Service #	Website
Argus Control Systems, Ltd.	27	800-667-2090	213	www.arguscontrols.com
Atlas Manufacturing, Inc.	30	800-346-9902	215	www.atlasgreenhouse.com
Beaver Plastics	13	888-453-5961	209	www.bpgrower.com
Biosafe Systems	23	888-273-3088	212	www.biosafesystems.com
DeWitt	16	800-888-9669	210	www.dewittcompany.com
Dramm	7	800-258-0848	202	www.dramm.com
Green Safe Solution LLC	13	239-465-1890	208	www.hydroponic-moonshine.com
Growers Supply	29	800-476-9715	214	www.GrowSpan.com
Heliospectra	17	888-942-GROW	211	www.heliospectra.com

Company Name	Page #	Phone	Reader Service #	Website
HEVECO, Ltd.	12	800-323-7638	207	www.hecomix.com
Ludvig Svensson U.S., Inc.	9	704-357-0457	204	www.ludvigsvensson.com
Nexus Greenhouse Systems	3	800-228-9639	201	www.nexuscorp.com
PanAmerican Seed	2	630-231-1400	200	www.panamseed.com
P.L. Light Systems	9	800-263-0213	203	www.pllight.com
Premier Tech Horticulture	31	800-667-5366	216	www.pthorticulture.com
Rough Brothers	35	513-242-0310	217	www.roughbros.com
Vestaron Corp.	11	269-372-3108	206	www.vestaron.com
Westbrook Greenhouse Systems, Ltd.	36	800-263-0230	218	www.westbrooksystems.com

Please refer to the Product Information Card in your February 2017 *GrowerTalks*

Insert the product's Reader Service number in the box in the lower right-hand corner. Mail it in, and we'll make sure the information is sent your way!

ENOUGH SAID

LET'S TALK ABOUT YOUR NEXT GREENHOUSE. 800.543.7351

STRUCTURES • EQUIPMENT • DESIGN • INSTALLATION

RBI
ROUGH BROTHERS, INC.
GREENHOUSES
www.roughbros.com

Reader Service Number 217






Optimize your potential.

Westbrook Greenhouse Systems has been an industry leader for decades, not only because of our innovative spirit and technologically advanced facilities, but because we're growers ourselves. We understand what's needed and we've developed our products from a grower's perspective. Your perspective.

We begin by listening. Learn how we can provide you with a custom growing environment: 1-800-263-0230.

Westbrook
GREENHOUSE SYSTEMS LTD.

westbrooksystems.com

Reader Service Number 218