

URBAN AG NEWS

Issue 10 | July 2015



Mike DeGiglio
VILLAGE FARMS
USES TECHNOLOGY
TO INCREASE EFFICIENCY,
PRODUCE BETTER CROPS PG 14

**FLORIDA'S PROTECTED
AGRICULTURE INDUSTRY
CONTINUES TO EXPAND PG 6**

**DECIDING WHICH STRAWBERRY
VARIETIES TO GROW IN GREENHOUSE
PRODUCTION SYSTEMS PG 42**



URBAN AG NEWS

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Urban Ag News is an **information resource** dedicated to helping the **vertical farming, controlled environment, and urban agriculture industries grow and change** through education, collaboration and innovation.

Urban Ag News actively seeks to become a connector for niche agricultural industries, **bringing together growers with growers, growers with manufacturers, growers with suppliers and growers with consumers.**

Urban Ag News is an **educator** providing content through a variety of different media. Through its educational efforts, including its online quarterly magazine and blog, Urban Ag News seeks to provide its users with a basic understanding of the industry and to **keep them informed** of the **latest technologies.**

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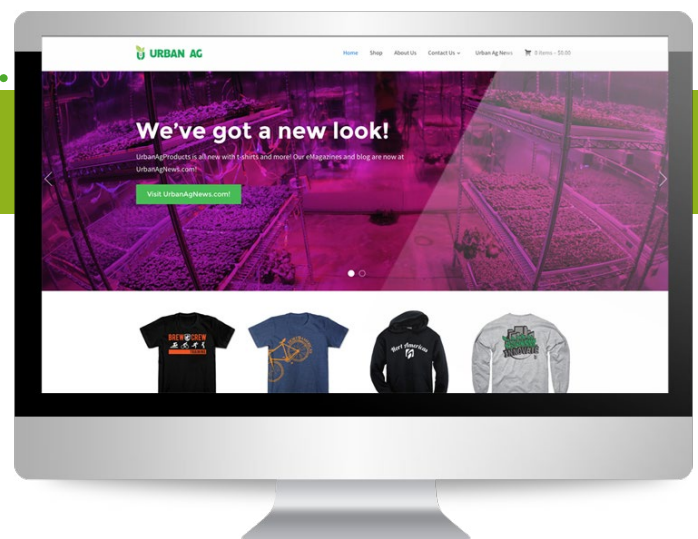


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TRENDING

WHO YOU SHOULD BE FOLLOWING

UpstartFarmers @UpstartFarmers · 24h
 In this video, learn the proper plant spacing for various crops in [#VerticalFarming](#) bit.ly/1IWdI3R

AgFunder @AgFunder · 8h
 How Adaptive Symbiotic Technologies is Using Fungi to Boost Crop Yields During Drought bit.ly/1Nr40jW [#AgTech](#)

Food Tank @Food_Tank · 3h
 1/3 of all food in the world is wasted. That's 1/3 too much. Let's end food waste: bit.ly/1HyI9aN [@takepart](#)

And don't forget to follow Urban Ag News

A University in Lima, Perú, used a billboard in a whole new way.

Check out this video >>>



“VERTICAL FARMS” A NEW WAY TO GROW

by CBS Evening News

“Vertical farms” may be the agricultural hotbeds of the future. The new agricultural technique moves the whole farming operation indoors—and it’s a trend that’s growing. Dean Reynolds reports.

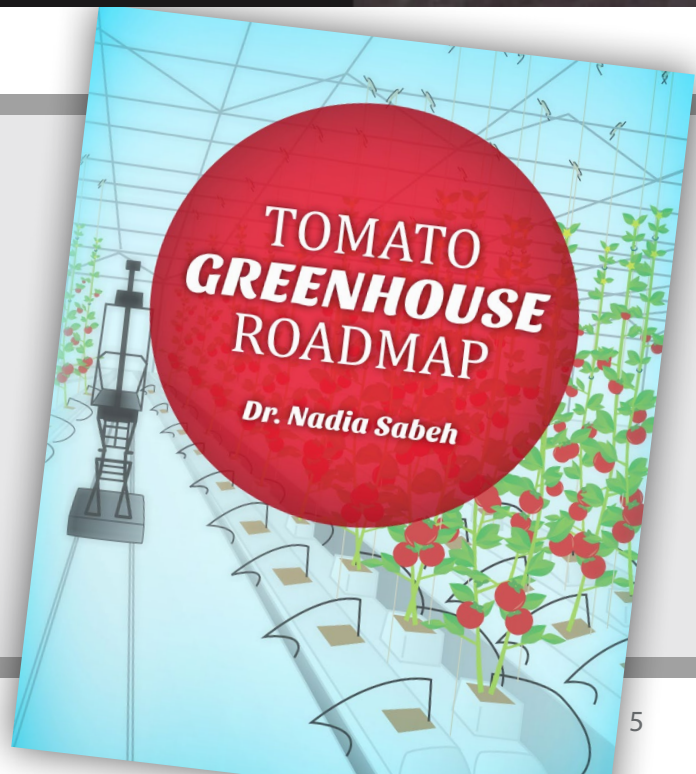


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FLORIDA'S PROTECTED AGRICULTURE —INDUSTRY— CONTINUES TO EXPAND

BY DAVID KUACK



PHOTOS COURTESY OF BOB HOCHMUTH, UNIVERSITY OF FLORIDA



EVEN THOUGH THE NUMBER OF PROTECTED AG OPERATIONS IN FLORIDA REMAIN FAIRLY SMALL IN SIZE, MORE LARGE GROWERS ARE WEIGHING THE BENEFITS AND OPTIONS OF BEING ABLE TO GROW YEAR-ROUND IN A VARIETY OF STRUCTURES.

When you think of Florida agriculture, production in greenhouses or high tunnels probably isn't the first thing that comes to mind. While the majority of vegetable crops produced in the Sunshine State are done outdoors, there is increasing interest in the use of protective structures for producing edible crops.

“We have a very diverse protected ag industry in Florida,” said Bob Hochmuth, University of Florida Multi-County Extension Agent--Vegetables and Small Farms Statewide Coordinator. “It has grown by leaps and bounds. Last year we published a 2013 survey that shows an increase of between four- and five-fold. The last survey related to protected ag was done in 2001. The majority of the increase in protected ag has occurred over the last five years. The survey also shows the diversity in terms of the types of structures, types of crops, types of production systems and types of seasons. Florida has a very diverse protected ag industry.

“Most people don't normally think of Florida as a state for greenhouse vegetables. However, there is a lot of opportunity here. In the northern part of the state, during the winter it's not unusual to have temperatures in the mid-20s every year and even low 20s occasionally. In the central and southern parts of the state there is less concern for freezing temperatures. However, there is still the risk of damage to outdoor crops from winter storms that come through and put everything in peril throughout the state that is being grown outside.”

Hochmuth said besides the cold winter temperatures, the other major reason that Florida growers are increasingly looking at protected vegetable culture is hard-to-grow outdoor crops.

“There are a number of crops, including colored bell peppers, European and Beit Alpha cucumbers, microgreens, specialty lettuces and cold-sensitive herbs like basil, that are really difficult to produce outdoors in Florida,” he said. “Putting these crops inside a protected culture system offers the advantage of being able to produce a higher quality product that can be marketed more consistently.”

CROP DIVERSIFICATION

Hochmuth said tomatoes are the major crop being grown by Florida’s protected ag industry.

“Tomatoes dominated this industry segment about 20 years ago,” he said. “Along with tomatoes, cucumbers, which are mostly burpless or the mini burpless types, colored bell peppers and leafy greens, including lettuce, are now the top crops.



“The 2013 state survey indicated there has been an increase in all of these crops. There are also a lot of herbs being grown, primarily basil. Blueberries are the main fruit crop that has expanded in protected ag production. The specialty leafy greens include kale, Swiss chard, broccolini, microgreens and arugula. Those are all less acreage, but they are by no means miniscule.”

OPERATION SIZE STILL SMALL

Hochmuth said most of the Florida growers involved with protected agriculture have relatively small operations.

“The majority of the state’s hydroponic growers are very small, ¼-acre or less,” he said. “These operations are focusing on local direct market sales. Everything is sold retail either to restaurants, local stores, farmers markets, on-farm sales or community supported agriculture. These smaller operations instead of focusing on one or two crops, they might have 15 different offerings. When these growers go to the farmers markets they can offer a wide array of products. That is where the leafy greens in particular do very well.”

Hochmuth said Florida’s tourist industry has had an impact on the development of the protected ag segment, especially on the smaller operations.

“Many of these growers are located near or on the fringe of the larger urban areas,” he said.

“The Palm Beach-Tampa area, Jacksonville, Orlando, places like that. That’s where these growers have been able to capture that segment of the market with really good prices that their clientele are willing to pay. The increase in the number of small growing operations has come in the more urbanized areas.”



Hochmuth said the cost of land in Florida has made it more difficult to start a farming operation in general. But the small acreage needed for protected ag production has made this type of operation more feasible.

“The land around these urbanized areas is very expensive,” he said. “Many of these growers either have another full career or one spouse has a full career and the other spouse is doing the growing. They may have 2 acres that is zoned for agriculture use. It doesn’t take a huge piece of property. Many of the people who have attended the [University of Florida’s Starting a Successful Hydroponic Business conferences](#), would fit into this category. They already have a small piece of land and it is zoned appropriately. They may start doing this on a part-time basis with the vision of expanding the business, becoming successful and then beginning to do it more full time.”

INTEREST GROWING IN PROTECTED AG

Hochmuth said people involved with the ornamentals industry are showing an increasing interest in protected ag for fruits and vegetables.

“There are some people coming from the landscape and/or ornamental production segments who already have structures,” he said. “The ornamentals segment has been hit hard in the last several years by the economic downturn. These people have the infrastructure, but the financial reward for ornamentals has not been there.”

Other people who have no connection to agriculture are also interested as they consider protected ag as a good way to enter the industry.

“These people like the concept of a local food movement and see protected ag as an opportunity for them to get started,” Hochmuth said.



PEPPERS (TOP PHOTO) AND LEAFY GREENS, INCLUDING LETTUCE (BOTTOM PHOTO), HAVE BECOME TWO OF THE MAJOR CROPS GROWN BY FLORIDA'S PROTECTED AG INDUSTRY.



Even though most of the protected ag businesses are small, Hochmuth said an increasing number of larger growers are looking at incorporating some type of structures into their operations.

“Some of largest vegetable operations in the state are beginning to evaluate protected culture as part of their operations,” he said. “In terms of numbers, we’re talking about a couple hundred small farms and maybe 15 operations of 5 acres or more.”

The other issue that Florida growers have to deal with when considering structures is the chance for severe storms.

“It is very expensive and a little riskier from a structure standpoint because of the hurricanes,” Hochmuth said. “There is also the possibility of growing out in the field for a long time during the season. Here it is a little more difficult for growers to make the investment in protected structures when considering the historical weather perspective. The growers know nine years out of 10 they’re going to be able to grow outdoors with no hurricanes. If the growers decide to go into protected culture they are going to maximize their control with a greenhouse or a high tunnel structure or an open-roof structure that can be opened and closed.” 🌱

For more: Bob Hochmuth, University of Florida, North Florida Research & Education Center-Suwannee Valley, Live Oak, FL 32060; (386) 362-1725, Ext.103; bobhoch@ufl.edu.

University of Florida Small Farms and Alternative Enterprises,

<http://smallfarms.ifas.ufl.edu>.

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A DIVERSE GROUP OF PEOPLE ARE ATTENDING THE UNIVERSITY OF FLORIDA'S STARTING A SUCCESSFUL HYDROPONIC BUSINESS CONFERENCES.



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International Congress on *Controlled Environment Agriculture*

VERTICAL FARMS • GREENHOUSE • AG TECH

Urban Ag News made it to ICCEA 2015 in Panama this last May and it was really an amazing experience! Incredible speakers, great information and lots of networking.

The atmosphere at ICCEA 2015 was much different than other professional agricultural events that I have attended in recent years. After a full and inspiring day 1, conference attendees were excited. They were not only excited to keep learning, but they were equally excited to network. Speakers were swamped with questions from upstart farmers. Entrepreneurs were eager to explain their ideas to one another and learn from each others' mistakes and successes. Vendors listened to the needs of the attendees and eagerly tried to figure out how their product portfolio or expertise could help provide solutions to the problems being faced by the innovative growers and farmers.

Our own Chris Higgins was there and if you haven't had the chance to read his blog updates, you need to check them out. Click here.



#ICCEA2015

How much do we really know about our food? Our global food system is precariously reliant on large, non-agile systems that offer little information about the source of our food and leaves much of the world's population struggling with food insecurity. The desire to better understand what makes it to our plate has sparked local and slow food movements, however, these strategies are not alone scalable to feed the next 2 billion people.



Caleb Harper, founder of the CityFARM research group at the City Science Initiative at the MIT Media Lab, is trying to solve this dilemma by leveraging principles that contributed to the rapid innovation of personal computing. Caleb recently launched the OpenAG network to develop the world's first open source "Food Technology" data commons. He leads the anti-disciplinary group of engineers, architects, urban planners, economists and plant scientists in the exploration and development of high performance urban agricultural systems.

Caleb is a consultant to multiple international development agencies on high-density low-income urban housing projects, and has worked professionally as an architect designing data centers, hospitals and fabrication facilities.

TEDx Beacon Street
x = independently organized TED event

This talk was given at a TEDx event using the TED conference format but independently organized by a local community. Learn more at <http://ted.com/tedx>



2015 Emerging Explorers

Caleb Harper, Urban Agriculturalist



REINVENTING OUR FOOD FUTURE WITH URBAN FARMS

Say the word "agriculture" and we imagine fields of wheat or strawberries ripening in the sun. But for Caleb Harper, a research scientist at MIT's Media Lab, the future of agriculture lies in urban farms, where plants will be grown in controlled environments close to consumers.

Talking from Boston, Harper explains why today's agricultural model is flawed, what an operating system for the farm of the future would look like, how his plants tweet to him when he is away, and why he still loves getting dirt on his boots at the family farm in Kansas. —*Simon Worrall*

Read the full article at <http://www.nationalgeographic.com/explorers/bios/2015/caleb-harper/>



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Village farms USES *technology* TO INCREASE *EFFICIENCY* & PRODUCE *BETTER* CROPS

by David Kuack

Mike DeGiglio,
president and chief
executive officer
at Village Farms
International, spoke
with Urban Ag News
about his company's
approach to
technology and how
it's using it to be
more efficient and
profitable.



MIKE DeGIGLIO
PRESIDENT & CEO
VILLAGE FARMS INTERNATIONAL

When was Village Farms started and how has it expanded in size?

I started Village Farms in 1987 with 10 acres of greenhouses in Pennsylvania and we developed and operated greenhouses in New York and Virginia. In 1996 the company started building 120 acres in southwest Texas.

In 2006 Village Farms acquired the largest greenhouse company in Canada located in British Columbia. The facility was about 140 acres. Some of the small greenhouses were sold so today there are 110 acres. In 2012 a new 30-acre facility was built in Monahan, Texas.

Today there are 240 acres of glass greenhouses in the U.S. and Canada. Village Farms also markets product from many other growers in the U.S., Canada and Mexico.

How has the use of technology evolved at Village Farms?

For the first 20 or so years, Village Farms worked off of existing European technology that was mostly used in Dutch greenhouses. Holland was considered the Mecca of greenhouse technology. And most companies worldwide looked to the Dutch when it came to higher technology. But that changed. It changed as greenhouses internationally began to quantify the tools to work in a wide variation of climates.

The Dutch technology was geared more for the climate in Holland, where it never really gets hot. It's a temperate climate with low light levels.

Village Farms eventually saw the need to develop its own technology. That is easier said than done. If a company is going to spend millions of dollars on R&D, it has to be big enough to sustain it. Even though Village Farms is successful in this endeavor, it was only achieved after 25 years in business and it could afford the costs once critical mass had been achieved to allow further expansion to build projects that cost millions of dollars. For someone just starting out that is extremely hard to do.



Mike DeGiglio said Village Farms has spent the majority of its technology dollars on "creating a greenhouse climate that is workable regardless of where the footprint is."

Photos courtesy of Village Farms International





Village Farms corporate chef Darren Brown (right) and facility manager Dirk de Jong (second from right) lead a team of chefs on a tour of the company's greenhouse facility in Delta, British Columbia.

Most greenhouse growers use existing technology. Village Farms didn't go that way. It developed its own. The company wanted to be able to have the intellectual property in creating greenhouse growing environments that can mimic the exact climate it wanted based on the crops it would grow and then locate those in areas it wanted to be in for market reasons. If this was left up to a technology company, it might not necessarily be focused on that. Village Farms is unique in that it developed its own technology as compared to most other companies that work with existing technology.

□ In what technology areas has Village Farms invested?

Most of Village Farms' technology is in software design to control the internal environment of the greenhouse. The company has done a lot with growing technology, both on the production and packing lines. When it comes to growing media, irrigation systems, etc., the company looked at these various components, but production is not where it spent most of its money. The bulk of the money was spent to create a greenhouse climate that is workable regardless of where the footprint is.

Our goal was to create the software to be able to run a very sophisticated greenhouse that could have conditions very conducive to plant growth regardless of what it is doing outside. If you can accomplish that, then you can put the greenhouses not where it is best for the plants, but where it is best for the market to lower freight costs and increase access to labor. You can be more sustainable and you can increase product shelf life and product quality.

□ What are some of the other areas of technology in which Village Farms is looking to invest?

Additional technology for the company could come on the energy side and supplementing carbon dioxide. If we can reduce energy costs, we would be much more sustainable. Village Farms has invested with Quadrogen Power Systems, FuelCell Energy and the National Research Council of Canada to build a pilot project for fuel cell technology for our greenhouse in British Columbia. Also, our new Permian Basin facility derives all of its electrical needs exclusively from wind power.

A second area we are looking at is cleaning up landfill methane gas. Village Farms acquired Maxim Power, a co-generation facility adjacent to our greenhouse facility in British Columbia. The next phase, which we are working on with the Canadian government, Hallbar Consulting and the Swedish Institute of Agricultural and Environmental Engineering, is to fund a study on the capturing carbon dioxide from landfill gas. There are hundreds of thousands of metric tons of carbon dioxide flowing out of landfills every day.

Our goal is to find the technology to clean the carbon dioxide so that we can use it in our growing processes. If we can use the potential of the carbon dioxide sequestered in the landfill, clean it and then use it in the growing process, we will reduce our costs and help clean the environment. The benefit is to lower our production costs. We won't have to burn natural gas to produce carbon dioxide and we won't have to buy carbon dioxide. We will also be reducing the amount of carbon dioxide released into the atmosphere.

What advice would you offer U.S. greenhouse growers of edible crops when it comes to making technology investments in their companies?

I would have to ask what is the crop and how do you compete? If you have the right crop, then I would ask what are the big issues?

There currently is a big labor shortage in agriculture. Using technology to mitigate labor shortage issues, then I think a grower can move forward. As more crops are being looked at for indoor production, for example berries, then you know you are going to have to have production systems that can mitigate

labor even to the point of incorporating some robotics. The use of robotics may also expand to packaging and shipping as well as harvesting and other tasks in the greenhouse.

Technology could play a role in berry picking in the greenhouse and in the field. Last year growers left a lot of berries in the field because of the shortage of labor. The use of migrant labor to go from berry farm to berry farm, which is seasonal outdoors, is becoming much more difficult.

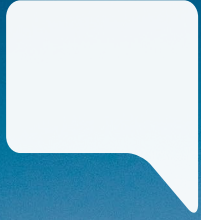
What crops are Village Farms now producing and do you expect that to change much over the next five years?

We are always looking at different varieties of our core products, including tomatoes, cucumbers and eggplant, of which we have multiple colors. We are always looking at unique varieties of our core products. We launched our unique and exclusive Heavenly Villagio Marzano tomato variety about two years ago. We have a whole pipeline of new varieties.

We continue to diversify. Berries are definitely on our radar screen. Nutraceuticals and some unique medicinals have a future. Some of the nutraceuticals are plants that have a medicinal benefit. Some of these will have to be produced in conjunction with the pharmaceutical companies. For a pharmaceutical company to sell something it has to be patentable or else it won't be interested.

We are always looking for unique, higher value products that are difficult to grow in the field due to climate or labor or not being available year-round. Our focus is on increasing value for our customers by not compromising on food safety, using IPM, and consistent quality that help us provide the best products for consumers.





“Our goal was to create the software to be able to run a very sophisticated greenhouse that could have conditions very conducive to plant growth regardless of what it is doing outside. If you can accomplish that, then you can put the greenhouses not where it is best for the plants, but where it is best for the market to lower freight costs and increase access to labor.”

-Mike DeGiglio, Village Farms president and CEO



Mike DeGiglio said Village Farms does everything on an investment basis and it really understands its costs. Its greenhouses cost nearly \$2 million an acre.



Jose Cruz (left), facility manager at Village Farms greenhouse facility in Fort Davis, Texas, and Jan Korteland, vice president regional facility manager of West Texas, which includes both the Fort Davis and Marfa greenhouse operations.

What do you think about the increased interest in vertical farming?

Vertical farming is still in the R&D phase. There is a PR value. The capital and operating costs are huge. It's limited on the size so how do you reach critical mass? It's not large scale agriculture.

Village Farms does everything on an investment basis. We really understand our costs. Our greenhouses cost nearly \$2 million an acre.

A lot of these vertical farm operations can't grow long term crops, at least not now. Vertical farms have a place for crops like leafy greens. Any crop that can be turned quickly in 28-30 days like leafy greens could potentially be grown in a vertical farm.

Looking at the lettuce industry, most of the product is grown and shipped from California to the East Coast. If those crops can be grown regionally or locally and bagged here instead, the carbon footprint for shipping the product is reduced or eliminated. On the other hand, you have to be cost effective. How are these vertical farms going to compete with field-grown product long term? You can always find niche markets where people are willing to pay a premium for locally produced.

When you make those kinds of large investments you have to be sure it is sustainable. And more importantly, that the profit is sustainable in the long term. Growing food for human consumption carries a huge responsibility along with it, this is something we have never taken lightly, and is the key driver in how we do business and measure efficiency. 🌱

For more: Village Farms International, Heathrow, Fla; (407) 936-1190; <http://villagefarms.com>

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GREEN SENSE FARMS TO BUILD 20+ FARMS IN CHINA

Green Sense Farms USA of Portage, Indiana and Star Global Holdings of the People's Republic of China have formed a partnership to build, own, and operate a network of more than 20 indoor vertical farms in China. The new partnership, Green Sense Farms, Asia Pacific, ltd. will begin building its first farm this year in Shenzhen, a major city in southern China's Guangdong Province, situated immediately north of Hong Kong.

[>> Click for more >>](#)



{ NEWS FROM THE INDUSTRY }



DLV GREENQ HAS UPDATED THEIR COURSES

DLV GreenQ provides courses for (international) professionals in the greenhouse industry. In their practical research facility called the Improvement Centre new knowledge is generated through innovations on growing concepts, techniques and cultivation. Due to this, their courses and trainings are up-to-date and include the most recent developments in the sector.

[>> Click for more >>](#)

GOODLEAF FARMS ANNOUNCES FIRST FARM CONSTRUCTION

GoodLeaf Community Farms Ltd. (GoodLeaf Farms), a wholly owned subsidiary of TruLeaf Sustainable Agriculture Ltd. (TruLeaf), has awarded a contract to Fowler Construction Services Ltd. (Fowler Construction) to begin construction of its first farm, in Bible Hill, this month. A building in the Agritech Park is being converted into one of North America's largest indoor multi-level growing facilities. The farm will have the ability to grow hundreds of thousands of pounds of fresh greens and herbs annually without the use of pesticides. "We are extremely excited and thrilled to begin construction of our first commercial farm in Bible Hill this summer," said Gregg Curwin, President & CEO of GoodLeaf Farms. "Consumers are demanding local, fresh, and clean produce, and we're going to bring that to the market by this Fall. We will deliver a culinary experience like no other."

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INDOOR HARVEST CORP CLARA VERTICAL FARM PROJECT IN TEXAS

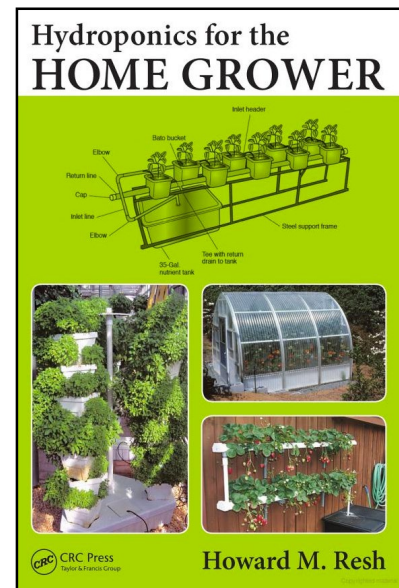
Indoor Harvest Corp, through its brand name Indoor Harvest™, is a design build contractor, developer, marketer and direct-seller of commercial grade aeroponic and hydroponic fixtures and supporting systems for use in urban Controlled Environment Agriculture and Building Integrated Agriculture. The Company is pleased to provide an update on the Pasadena, Texas, Community Located Agricultural Research Area (“CLARA”) project MOU and recent developments surrounding the project.

>> [Click for more >>](#)

NEW BOOK HYDROPONICS FOR THE HOME GROWER

Written by Dr. Howard M. Resh, it provides all the information you need to get a home-growing operation up and running. This book combines hydroponic growing with indoor and backyard greenhouse cultures that most books do not present together.

>> [Click for more >>](#)



INDOOR AG-CON NEW YORK | OCTOBER 15

For the first time, Indoor Ag-Con is coming to New York in fall 2015 with a one day event that looks at indoor agriculture differently; we’re asking 12 industry leaders to talk not about their companies or academic studies, but about their wider visions, whether that’s bringing open source big data to all farmers or placing their company in the context of the circular economy. We’re keeping the event exclusive, at no more than 120 participants, to ensure that everyone has a chance to have their voice heard, and are building in extended discussion periods. In short, it’s your chance to hear what’s driving the indoor agriculture’s visionaries, and to throw your own opinions into the mix.

>> [Click for more >>](#)



GROW NORTH TEXAS

HOW A DALLAS BASED NON-PROFIT
PLANS TO CHANGE THE WAY TEXAS EAT



Grow North Texas is a nonprofit that seeks to connect North Texans to food, farms, and community in order to create a sustainable, secure regional food system that enriches the land, encourages economic opportunity through food and agriculture, and supports equitable access to healthy, nutritious food for all.

In this video *Susie Marshall*, Executive Director of Grow North Texas, shares more about their mission.



AN URBAN AG NEWS VIDEO PRODUCTION





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A close-up photograph of a wooden basket filled with fresh vegetables. In the foreground, several dark purple eggplants are prominent. Behind them, there are green and red bell peppers. In the background, several avocados are visible. The lighting is warm and natural, highlighting the textures and colors of the produce.

ARE YOU
REALLY READY
TO START
YOUR
URBAN FARM
OPERATION?

BY DAVID CEASER

So, you have been dreaming about starting an urban farm or are about to launch your new career with an indoor farm. You have gotten funding from friends and family (and Kickstarter) but have you really dotted all the i's and crossed all the t's as far as what challenges you will be taking on as you get your business up and running?

The truth is that many urban farming operations enter the business from one perspective. They may be started by a grower who knows a ton about growing but little about the business and legal end of things. Or, the operation may be started by someone with a business perspective who wants to see a farming operation thrive, but has little knowledge of the daily ins and outs of running a farm.

Many urban farms fail. It's good to be as prepared as possible when starting out so you don't repeat the same mistakes as others.

Here are some important things to think about before getting started. Any one of these roadblocks could delay your project for several months so it's best to look at these things ahead of time rather than letting them derail your progress.

ZONING, CODE ISSUES

Since urban agriculture (as it's known today) is a relatively new field, many municipalities are unfamiliar with it and do not have any sort of code on the books for how to permit your project. If you can't obtain a permit, then you can't obtain a business license.

Your options will be to move your project to another location where it is permitted, permit under a different classification such as a food processing facility (if you can convince the planning department), work without a permit (there are work arounds depending on the location of the facility) or wait until legislation is updated. Many city planning departments will not be familiar with indoor agriculture projects so it is very valuable to do your homework first.

It is good to have at least basic drawings to show them how the facility will be laid out and will operate. It is also good to be familiar with cities that have urban farming legislation on the books so that you can show that to local planning departments as needed.

BUSINESS MODEL

What is your business model? How will you make money? Will you sell your product wholesale? To restaurants? Direct to consumers? To supermarkets? At farmers markets?

Each of these particular customers may require certifications before they will purchase your product. These might be as simple to obtain as county ag permits or as complex and expensive as organic certification or regular tests for pathogens. It is important to know what your customers will ask of you beforehand so that you are prepared.

"MANY URBAN FARMS FAIL. IT'S GOOD TO BE AS PREPARED AS POSSIBLE WHEN STARTING OUT SO YOU DON'T REPEAT THE SAME MISTAKES AS OTHERS."

WATER

Water is a key ingredient in your facility whether hydroponic or soil-based. Important questions to consider are: Can you use the existing municipal water? Will you need to invest in expensive filtering equipment to remove excessive salts or metals? Are there restrictions on water use (such as in California)? Are there disposal issues to be educated about regarding disposal of nutrient-rich water?

GROWING MEDIUM

Hydroponic farming can be done with different growing media. Do you have a guaranteed supply of that medium, especially for operations where the medium is only used for a short period of time and replaced? If you are looking for organic certification, does the medium meet the requirements for certification? If not, what alternatives are there? If you are using soil, what tests do you need to do and what adjustments will you need to make to the soil?


ELECTRICITY, ENERGY

If you are running an indoor farm, energy costs can be one of the most expensive budget items. Using lights and dehumidifiers can really be expensive.


Do you know what your power rates are? Do you know when power is most expensive? Do you know how much light your plants need? Is the electricity in your area reliable or should you have a back up generator on hand? Do you know how much power your facility needs and how much does the property you are looking at offer? Is the existing electrical system up to code? How much will an upgrade cost?

FLOORS

If you are running an indoor facility, floor design is of key importance. You need to simultaneously design your floor for multiple factors such as being able to be cleaned easily, drainage, traction and bacterial control.



"HYDROPONIC FARMING
CAN BE DONE WITH
DIFFERENT
GROWING MEDIA."



INPUT SOURCING

Just like when you are baking bread, if you run out of flour, you have a big problem. The same is true with your farm. You will have numerous inputs and if any one of them runs out, your production will be slowed or might even stop. Make sure you have a reliable source for all your inputs and a reliable backup source just in case.

CONTROLLERS

So much of indoor farming and even aspects of outdoor farming are based on monitoring data and adjusting as necessary. What controllers will you use for your operation? How will you use the data that are being produced to your advantage?

Are you the type of person that feels more comfortable seeing everything in person and making adjustments on site or are you comfortable with making adjustments to your growing operation remotely? These questions are very important to think about before you get started so that production data can be easily understood and analyzed and the appropriate adjustments can be made to your operation when needed.

PERSPECTIVE

When looking at your urban farming business, I have found it very valuable to analyze production and costs on a square foot basis. I have a background in real estate and using a square foot methodology has proven very valuable and easy to understand.

FULL CYCLE PLANNING

Many operations do intense planning for how to grow their product but don't think about the best way to harvest and package until it is upon them. Unfortunately, harvesting and packaging can be very labor intensive and if not well planned beforehand, can turn a profitable venture into one that loses money. Talk with your buyers (especially supermarkets) about specific packaging needs they may have from the start and from there, plan a system that reduces labor costs whenever possible.



These are just some of the items that need to be thought about when launching an urban farming operation. There are many more that will undoubtedly arise based on your particular situation. If you are prepared with the ones listed above, it will significantly reduce headaches, time delays and money lost in your urban farming venture. 🌱

David Ceaser has over 20 years experience working with plants and agriculture in numerous capacities and countries. He has studied agroecology, horticulture and business along with several years working in real estate development.



He currently does consulting work and operates a small outdoor urban farm specializing in herbs and salad greens. To contact David, please e-mail farmer@gsvfarm.com

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FDCEA

FOUNDATION FOR THE DEVELOPMENT OF
CONTROLLED ENVIRONMENT AGRICULTURE

The Foundation for the Development of Controlled Environment Agriculture is a private foundation created in 2014.

Mission

To join the future stakeholders of controlled environment agriculture in order to build a platform in which shared resources can be used to invest in the development of a shared industry.

How we work

To create an industry that sees the available natural resources and then develops the necessary strategies to maximize the production of fresh produce in a wide variety of climates our Foundation invest in the research and education needed to develop technology and talent.

We are committed to specific areas of need. We work with experts to define strategies and goals with a clear understanding of how we will achieving them.

Learn more and join us!

For complete understanding of who we are, what we do and how to benefit from being part of the FDCEA please contact us directly or visit our website for more information.



FDCEA.COM

URBAN AG NEWS

CONTINUES TO

EVOLVE & EXPAND

WITH THE

CONTROLLED ENVIRONMENT

AGRICULTURE INDUSTRY

BY DAVID KUACK



Chris Higgins
Founder of Urban Ag News

URBAN AG NEWS WAS STARTED AS A TOOL TO PROVIDE PEOPLE INTERESTED IN CONTROLLED ENVIRONMENT AGRICULTURE WITH AN UNBIASED INFORMATION RESOURCE.



Chris Higgins, founder of Urban Ag News, said the idea for this information resource began with conversations he had with vendors of horticultural and agricultural products.

“The idea started prior to the big movement in controlled environment agriculture specifically focusing on the production of leafy greens and culinary herbs in vertical farms,” Higgins said. “There have been a few specialized companies that have been selling products related to hydroponic production for many years. But it has only been within the last five years that controlled environment agriculture has become a hot topic. Producing vegetables hydroponically has recently become a topic of interest to both growers and non-growers.”

Many of the inquiries that the vendors were and still are receiving come from people outside the industry.

“The vendors weren’t necessarily in a position to respond to the questions coming from the people interested in learning more about hydroponics,” Higgins said. “Historically most of the questions were being fielded by a handful of people and much of the information that was provided was coming from Dutch sources. After talking with vendors and educators about the type of inquiries they were fielding, it came down to being able to provide the people interested in

hydroponics with unbiased information. And that’s how Urban Ag News got its start.”

GROWING SUSTAINABLY

A major goal of Urban Ag News is to deliver information on sustainable agricultural practices whether those are done in greenhouses, vertical farms or high tunnels.

“Controlled environment agriculture is a tool for a way to produce food and non-food crops,” Higgins said. “As a tool it gives people an opportunity in certain markets to grow food year-round, including crops that historically could not be grown year-round. Controlled environment agriculture is a tool that allows growers to do pesticide-free production and offers them the potential to do organic production that is more consistent and uniform. Controlled environment agriculture can also address environmental issues, related to water, light, nutrition and energy.

“Realistically controlled environment agriculture today is about the production of leafy greens, culinary herbs and high end produce. In order for the industry to move forward growers have to be able to do the things they are doing better. This is where Urban Ag News comes in. Offering growers an educational and informational tool to do what they do better.”

THE POTENTIAL OF VERTICAL FARMING

Vertical farming has gained a lot of media attention as new companies seem to pop up on a weekly basis. While some people have questioned the ability of these companies to become and remain profitable, Higgins has seen firsthand the production and profitability potential these operations can achieve.

“A vertical farm should be looked at as nothing more than a farm that has the ability to maximize production per cubic foot,” he said. “What vertical farming looks like when it is profitable is not like those sexy architectural drawings that can be found on the Internet. There are people who are profitable vertical farmers. For example, a micropropagation facility is a vertical farm. Plants are being grown on racks under supplemental lights, in highly controlled environments with plant densities maximized per square inch.

“Propagation facilities like Grafted Growers in Tucson, Ariz., is a good example. This company is using a controlled environment in a vertical set up to provide more control and to deliver a higher success rate. This type of young plant production, similar to micropropagation facilities, can help drive vertical farming forward. At the same time it will have an impact on companies using more conventional production practices. These types of companies will also certainly have an impact on a global scale in a mass way.”

BIG PICTURE

Even though Urban Ag News may feature companies that could have a global impact, it is not trying to focus on global issue topics.

“What Urban Ag News wants to be as it moves forward is to provide those individuals involved with food



TOP— UAN SUPPORTS TOUR DE FRESH AS THEY STRIVE TO PUT FRESH FOOD IN PUBLIC SCHOOLS ACROSS THE COUNTRY

ABOVE— ISSUE 4 FEATURED AN ARTICLE ON INTEGRATED PEST MANAGEMENT

BELOW— ISSUE 8 FEATURED AN ARTICLE ON HOW MINNESOTA IS EXPANDING LOCAL FOOD OPPORTUNITIES



Photo courtesy of Karl Hakanson, University of Minnesota Extension

production the building blocks to create changes,” Higgins said. “Urban Ag News is not trying to tell people what to do. It is trying to give people ways to think about food production. Ways to understand it. Ways to take the basic science and apply some of the ideas that they have.

“Urban Ag News seeks to unlock plant production methods, techniques and research that has been held by very few individuals. Provide people with this information and then let them take it and be creative with it. Urban Ag News can empower them with the knowledge to innovate. Knowing that it’s not going to be a quick change, but knowing the innovation is going to be a part of the long term evolution of the controlled environment agriculture industry.”

URBAN AG NEWS KEEPS EVOLVING

Just like the controlled environment agriculture industry, Higgins said he sees Urban Ag News evolving to meet the changing needs of the industry.

“As an educational tool to help the controlled environment agriculture industry, I see Urban Ag



Photo courtesy of Indoor Ag Con



VIDEO: Chris Higgins as a panelist at Seedstock's 2nd Annual Sustainable Agriculture Innovation conference (2013) discusses the role of controlled environment agriculture in urban farming.

“URBAN AG NEWS SEEKS TO UNLOCK PLANT PRODUCTION METHODS, TECHNIQUES AND RESEARCH THAT HAS BEEN HELD BY VERY FEW INDIVIDUALS. PROVIDE PEOPLE WITH THIS INFORMATION AND THEN LET THEM TAKE IT AND BE CREATIVE WITH IT.”

– CHRIS HIGGINS
FOUNDER OF URBAN AG NEWS

News developing in various forms and platforms,” he said. “I expect these will be developed with guidance of university, industry and extension professionals.

“Urban agriculture has always been inspired by organizations like the Khan Academy and TED. Urban agriculture is finding unique ways to deliver educational information to a wide variety of people regardless of their language, economic position and educational level. We have a very broad audience and we cannot expect one method of communication to effectively deliver content to every individual and to every grower.

“People like to define everything and put labels on things. In my opinion, it’s still too early to define the controlled environment agriculture industry and tell what it’s going to look like and what it’s going to do. People want sustainable agriculture. They want or are trying to do things because they feel they are better for it, be that a food system, the environment, or a business. What we are really talking about is sustainable agriculture.” 🌱

For more: Urban Ag News, (469) 532-2261; urbanagproducts@gmail.com; <http://urbanagnews.com>.

David Kuack is a freelance technical writer in Fort Worth, Texas; dkuack@gmail.com.

JANUARY 2013



JULY 2015



LIGHT QUALITY

THE COLOR OR WAVELENGTH OF LIGHT



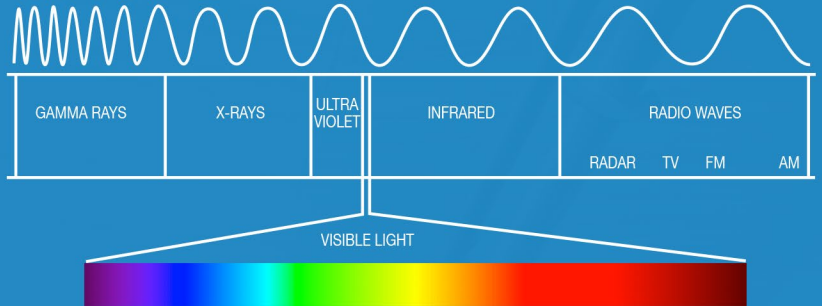
LIGHT QUALITY REFERS TO THE SPECTRAL DISTRIBUTION OF LIGHT OR THE RELATIVE NUMBER OF PHOTONS OF BLUE, GREEN, RED AND FAR RED & OTHER PORTIONS OF THE LIGHT SPECTRUM EMITTED IN A LIGHT SOURCE.



PHOTOSYNTHESIS

PHOTOSYNTHESIS REQUIRES LIGHT BETWEEN 400 AND 700 NM

ELECTROMAGNETIC SPECTRUM



SPECTRORADIOMETERS

MEASURES LIGHT QUALITY

BLUE LIGHT PROMOTES VEGETATIVE GROWTH
IF ONLY LIGHT SHORTER, HARD AND DARK IN COLOR

RED & BLUE LIGHT COMBINED PROMOTES FLOWERING

R:FR PROMOTES STEM ELONGATION
IF ONLY LIGHT SOFT, TALL

R:FR THE PROPORTION OF RED LIGHT RELATIVE TO THE AMOUNT OF FAR RED LIGHT

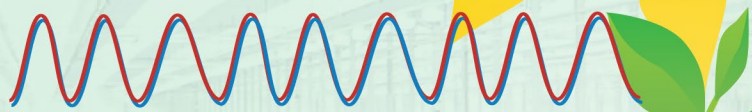
PLANTS THAT GROW BEST UNDER HIGH LIGHT (FULL SUN) ARE MORE RESPONSIVE TO CHANGES IN R:FR LIGHT THAN PLANTS THAT TOLERATE LOW LIGHT (SHADE)

LIGHT QUALITY, QUANTITY AND DURATION AFFECT PLANT GROWTH

THE DISTRIBUTION OF LIGHT AND R:FR VARIES BETWEEN LIGHT SOURCES

THE LARGE AMOUNT OF FAR RED LIGHT EMITTED FROM INCANDESCENT LAMPS AND THEIR LOW LAMP EFFICIENCY ILLUSTRATES SOME OF THE UNDESIRABLE ATTRIBUTES OF THESE LAMPS

PLANTS GROW TO POSITION THEIR STEMS AND LEAVES TO RECEIVE THE MOST AMOUNT OF LIGHT POSSIBLE



THERE ARE PEAKS IN THE RED AND BLUE WAVELENGTHS WHERE PHOTOSYNTHETIC ACTIVITY IS HIGHER

PHYTOCHROME

A TYPE OF RECEPTOR IN THE PLANT THAT IS SENSITIVE TO R:FR AND CONTROLS FLOWERING IN PLANTS THAT ARE SENSITIVE TO DAY LENGTH



NY SUN WORKS YOUTH CONFERENCE: DISCOVERING SUSTAINABILITY SCIENCE

BY YOUTH PRESS TEAM

(LANNI HARRIS, TINA ZHAO, EQUEM ROEL, AINSLEY B, ERICA MORALES-ARMSTRONG, GIOVANNA MOUZOURAS, JAELYN FELTON, WERONIKA, EMANUEL GRANJA, MARSELA DOKO, AND FINN BRENNAN)

PHOTOS COURTESY OF NY SUN WORKS YOUTH PRESS TEAM

SPONSORED BY HORTAMERICAS

On Friday, June 12, 2015, NY Sun Works held the 4th annual Youth Conference@MSC “Discovering Sustainability Science,” streaming live from the Manhattan School for Children PS333 Auditorium on 154 West 93rd Street in NYC. The conference was covered by the Youth Press Team composed by 7th grade students from PS333 and sponsored by HortAmericas, a company that develops growing media and hydroponic systems to inspire the farmers of the future.

This year’s conference featured forty-two 2nd to 12th grade students from NY Sun Works Greenhouse Project partner schools, including PS 333/Manhattan School for Children, Bedford-Stuyvesant New Beginnings Charter School, County Prep High School, PS 84 Jose de Diego Brooklyn, and PS 208/Alain L. Locke Elementary School. Special guests included Clare Lowenstein, PS333 Principal; Dave Conover, Education Director of Clearwater; Dong-Ping Wong, Founder and designer of +POOL; Manhattan Borough President Gale Brewer; Brooklyn Deputy Borough President Diana Reyna; DOE Director of Sustainability Dr. Sharon Jaye; and Emily Fano of The National Wildlife Federation’s Eco Schools USA program.

The first session, “Building Sustainable Cities,” showcased student work on solutions to current problems found in city buildings and proposed new sustainable features for a Library and a Stadium.

Students explained problems related to water conservation, energy use and renewable options, building materials, use of space, waste management, and urban food production.

“At the conference, sixth graders were talking about a lot of things that are normally used in buildings that can be very, very harmful to the environment. One example of something they talked about is Concrete. I learned a lot about how concrete negatively affects the environment and how often concrete is used in buildings” explained Finn Brennan, 7th grade student press team member.

6th grade Speaker Sophie Denhert explained how people from all the countries are starting to face challenges because we only have one percent of fresh water in our planet. “Water that we use to wash dishes, bathe and clean clothes goes straight down the drain. We each use about 40 gallons of water a day!” Sophie explained that drain water pollutes our rivers. She also explained about the benefits of using rainwater catchment systems and even suggested that designs to use in future constructions should include a collection surface, gutters, downspouts, pre-filtration systems or first-flush devices, storage tanks, and a distribution systems. “Exactly like in the [rooftop] greenhouse in my school.”

“We are responsible for the planet as it is now. And only we can make it better!” - Milah Carlone and Lea Singer, 6th grade students.

We can make a difference, no matter the size of the problem- Hayden Rainer and Danna Raqual Prusak, 5th grade students.

PS 208 students presentation expounded on the importance of urban farming and how can be connected to STEM in the classroom. They incorporate Math and ELA into their science-based elective, and lessons span far beyond plant’s life-cycle.



YOUTH PRESS TEAM

The second session “Building A Sustainable Future” showcased student work on hydroponic technology for urban environments. Students shared the final product of the innovative hydroponic systems they designed and built in their classrooms. Students from County Prep High School shared that “our goal was to construct a project that was functional and efficient. After having our design all sketched out we started construction. We used water bottles and other recyclable components to create the system. We learned so much about hydroponic technology, how can be simple, maximize space and food growth.”



SOPHIE AND NICOLE

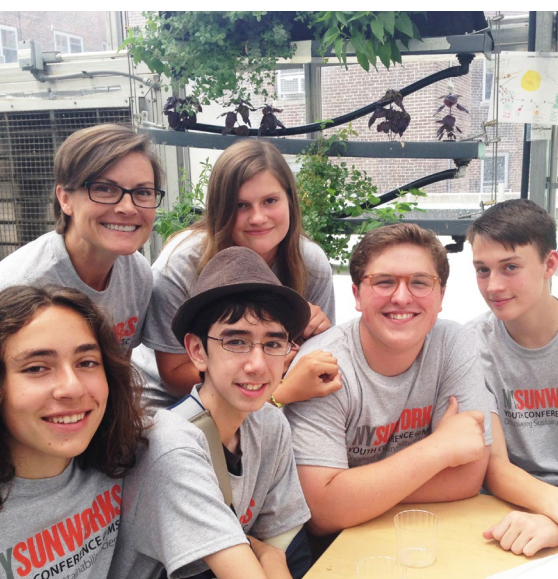


Students from Bedford-Stuyvesant New Beginnings Charter School spoke about their Hydroponic Hunger Solutions Project, in which they teach their community about indoor food production to achieve long term food security.



TECH TEAM

The third session “Building Sustainable Minds” focused on the advantages of hands-on and project-based education. Projects included the use and importance of PH data collection, the effect of additional water pumps in a hydroponic growing system, or enhanced design for the Ebb and Flow system. “We wanted to create something similar but better, and see which system affects plant growth more. We created a two-bucket system that unlike the ebb and flow system drained and refilled in one-go, and reused the water by continuously cycling it through the system. By reusing the water, this system would become more sustainable.” Sam Ferrera, 5th grade speaker.



SPEAKRES AND MC'S

The youngest students were 2nd graders from P.S. 84 in Brooklyn; they spoke about the importance of science and sustainability. “[We need to] save the plants from dying because if there were no plants we wouldn’t have fruits or vegetables,” Johan Gomez said. “It’s about the environment, because if we don’t have the environment, we will be extinct,” Olivia Tineobriones added.

Adult guest speaker Dong-Ping Wong, Founder and designer of +POOL gave an inspiring presentation about the design and purpose of +POOL which was especially engaging for Equem Rohl, a correspondent from the Youth Press Team. “Dong-Ping Wong wants to set up a way to swim

in the Hudson and East rivers! He invented a way to swim in clean but natural waters. Wong describes +POOL as “[a] tangible project. It’s Something you see and you want to be in. It’s important but it’s also fun.” Dong and his team wanted to build a pool so that when people in NYC are so hot in the summer they have a place to go and swim. They have designed a giant filter so that you are swimming in the actual river. It will feel amazing to have the city all around us.” Equem Rohl 7th grade.

The conference also included remarks by Manhattan Borough President Gale Brewer and DOE Director of Sustainability Dr. Sharon Jaye.

I am the Manhattan Borough President, and let me tell you, we are trying to learn from you, from young people, to make not just Manhattan, but the whole city, the whole planet more sustainable. And we learn from you, that is really the message of today. [...] Some are easy things to talk about, not so easy to also implement. I work with the solid waste advisory board, which is a group of 50 citizens and every single month they come together to talk about these issues. I bet you know more, you know more because you have this fabulous greenhouse classrooms, you know all about hydroponics, you know all about gardens, you know how to grow things. [...] there are aspects of sustainability science that are crucial to me, and they must be at the front of decision-making. People can learn from you. --Manhattan Borough President Gale Brewer.

A special Green Flag Award was presented to the students of PS333 by Emily Fano of The National Wildlife Federation’s Eco Schools USA program. The Green Flag Award was given to MSC-PS333 after the school completed a rigorous seven step process. Youth Press Team member LanNi Harris notes, “We got this award because our school showed energy efficiency in our facilities, and for instituting environmental-themed curriculum.”

The NY SUN WORKS Youth Conference offers students a platform to share their scientific creativity resulting from their engagement with the Greenhouse Project, a NY Sun Works program. Promoting urban sustainability through science education, the Greenhouse Project approaches Sustainability Science through hands-on study of the interaction between



humans, technology, and the environment. “I think it’s crucial to prepare grade-school children for the 21st century. They are the citizens of tomorrow. They are the ones who are going to find solutions to our environmental problems,” NY Sun Works, Executive Director Manuela Zamora said.

Youth Press Team member Marsela Doko interviewed Brooklyn Deputy Borough President Diana Reyna who believes that children are the future and that if we encourage children they can do anything. She said that’s what Manhattan School for Children has started and is a good thing for NYC. Diana added, “We are trying to create in Brooklyn, the same thing that you started here, by investing dollars. So we plan on building 12 new NY Sun Works Greenhouse labs and we are trying to be a part of the 100 labs built by 2020 that you all started here. You are the founders and we are continuing what you started, that is your legacy as students, changing the world, one laboratory-hydroponic classroom at a time.”

“This conference offers an opportunity for students to share their learning through the Greenhouse Project, which is a hands on science and sustainability education program of New York Sun Works.” -- Isabel Armstrong, 8th grade student.

CBS News coverage of the Conference:
<http://cbsloc.al/1BdKTsD>

To see a complete lineup of guest speakers and student presenters, visit www.nysyouthconference.org

To learn more about NY Sun Works and the Greenhouse Project program, visit www.nysunworks.org

FEATURED PROJECT

SAM FERRERA, REMY ROEL, AND LUCA DESIRE
LANOIX, 5TH GRADE STUDENTS AT PS333

We decided that our project would be a new variation of the ebb and flow system used in the greenhouse [classroom in our school]. We were inspired by the cool way it filled with water, and then drained the water. We wanted to create something similar but better, and see which system affects plant growth more. We created a two-bucket system that unlike the ebb and flow system drained and refilled in one-go, and reused the water by continuously cycling it through the system. By reusing the water, this system would become more sustainable.

We made our system out of two buckets stacked upon each other, with water and a water pump in the bottom bucket. A tube carried water from the pump, through the bottom of the top bucket, and poured water on the top of the top bucket. Then, after the plant had extracted the nutrients from the water, the water flowed back down a narrow hole we created in the bottom of the top bucket.

We wanted to create a water purifier to remove the algae, but then realized that the water's nutrients would have already been extracted by the plants. So instead we decided that every week we would change out the bucket water for new water.

We collected our data from two plants once a week for three weeks. We took the leaves off the plant, and held them out until they were as long as possible. Then, one of us measured the base of the stem to the tip of the longest leaf. We measured one plant in our system, and one plant in the ebb and flow system in the greenhouse.

The results we got were that in week 1, the leaves of the plant that got water from our system grew to four inches, while the leaves of the plant that got water from the ebb and flow system grew to three inches.

The results for week 2 were that the leaves of the plant that got water from our system shrunk to 3 ½ inches, while the leaves of the plant that got water from the ebb and flow system shrunk to ½ inch.

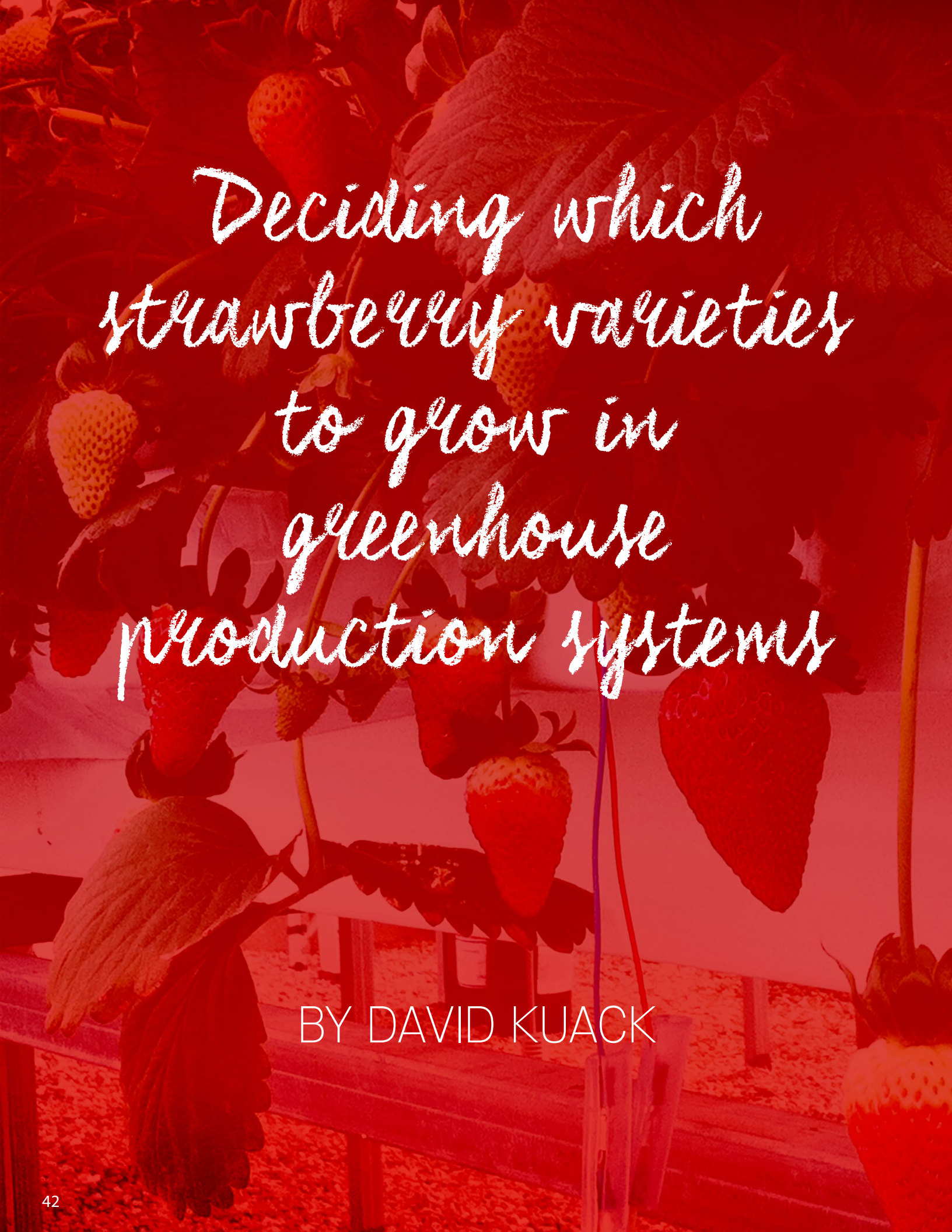
In our final week of data collecting, the leaves of our plant grew to 5 inches, and the leaves of the ebb and flow plant grew to 2 ½.

Our project taught us that plants can live in many different types of habitats/systems. The plant that was watered by our system grew, to a size different from the plant watered by the ebb and flow system. We learned that the ebb and flow system can be modified and still succeed in positively affecting plants. For example, you can change the drain times and the method of draining.

This also taught us that when you're doing an experiment, you have to identify all of the things that may cause the results to vary (the variables), and then try to keep all of those things the same, except the thing you are testing. We also learned that it is better to have more data. If we had used at least several plants with each system, instead of just one for each system, it would have been easier to see if our results were because of the watering system (the thing we were testing), or because of other things (like the amount of sunlight, or the age of the plants).


In the end, we showed that our system worked better than the ebb and flow system, and that the ebb and flow system can be improved. If we were to do this again, we would record data from more plants, and have three separate systems, two systems which we would design, to compare to the ebb and flow system.





Deciding which
strawberry varieties
to grow in
greenhouse
production systems

BY DAVID KUACK



WHICH ARE THE
BEST STRAWBERRY
VARIETIES FOR
GREENHOUSE
PRODUCTION?
COMBINING
JUNE-BEARING
AND EVERBEARING
VARIETIES CAN HELP
ENSURE FRUIT IS
AVAILABLE DURING
PERIODS OF PREMIUM
PRICING.

Trying to decide which strawberry varieties to produce in a controlled environment production system can be a challenge for growers using field-bred varieties. Mark Kroggel, research specialist at the University of Arizona's Controlled Environment Agriculture Center in Tucson, said it is possible for growers to produce strawberries nearly year-round by combining greenhouse and field production.

June bearing short day varieties

Kroggel said the traditional strawberries grown for field production are often referred to as June-bearing varieties and are actually short day plants.

“These plants require certain photoperiods to begin flower initiation just like poinsettias,” he said. “The strawberry plants are transplanted into the field and become established during late summer. Depending on the critical photoperiod, which varies between varieties, many of the short day varieties start to initiate flowers when there are 12-13 hours of day light. Flower initiation occurs on the crowns the plants have or produce in the fall.”

During the winter the plants go dormant. In spring, the flowers, which have already been initiated, open and bear fruit. During the early spring as additional growth occurs, the plants continue to initiate and produce flowers until that critical photoperiod is exceeded. Once the critical photoperiod is reached, the plants won't initiate any more flowers.

Short day varieties in the greenhouse

Kroggel said when short day strawberry varieties are grown in a greenhouse, the winter dormancy period is eliminated.

“In the fall instead of letting the plants go dormant, they are being kept actively growing in the greenhouse through temperature and nutrition,” he said. “A June-bearing, short day variety that's planted in August in the greenhouse is going to grow vegetatively until some point in the fall when the days are short enough to initiate flowers. Then it is usually 30 days from flower initiation until flowers appear. It takes another 30 days from the time of flowering until fruit is produced. So, from

the point of flower initiation it takes 60 days before fruit is ready to harvest.”

Kroggel said a grower could plant strawberries in the greenhouse during late summer and early fall to produce a crop by Christmas using the natural photoperiod.

“Starting in late September the plants are going to receive 12 hours of natural day light,” he said. “It takes several weeks for the plants to initiate flowers. Then in October there is about four weeks of flower development. In November, from flower to fruit takes another four weeks. Then in December the fruit develops.”

Kroggel said short day varieties produce fruit fairly consistently in the greenhouse.

“What we have seen with our own trials with the June-bearing or short day varieties, once the days start to exceed 12 hours of day light in April, the plants stop initiating flowers. We've found that six months is our production limit for any strawberry variety in the greenhouse. The substrate starts to break down and the plants start to lose their vigor. This applies to both short day and everbearing varieties. We also run into problems when we can't cool the greenhouse causing the fruit quality to suffer. I expect the typical crop life for winter production of greenhouse strawberries for most growers is going to be about six months.”

Inducing strawberries to flower and fruit

Because of the lack of commercially available actively growing starter plants during the summer, Kroggel said he is producing his own tip runners in 38-cell plug trays or 2-inch tree bands (with permission to propagate from patent holders when varieties are protected).

“Since we want to start growing the strawberries during the summer, this is a time of year that there usually are no starter plant material available

from most commercial propagators, and so we need to produce our own,” he said. “Usually the very latest dormant runners are available is in June.”

These strawberry plantlets are stuck in a substrate and placed on a mist bench until they are rooted in. Rooting and acclimation takes two to three weeks and the plants need several more weeks of greenhouse growth to be established enough to transplant into a growing system. The plants are ready to be transplanted when they can be removed from the plug cells or pots with roots and substrate intact.

“To initiate flowers in short day plants in this high density propagation when the natural day length is still longer than the flower-inducing day length, we provide the rooted and acclimated plants a short day treatment,” Kroggel said. “This treatment consists of eight hours of daylight in the greenhouse and then the plants are moved into a dark cooler for 16 hours at 59°F (15°C). This is the most ideal temperature for flower induction.

“The plants are moved back and forth on carts between the cooler and the greenhouse. It is labor intensive, but they can be moved relatively easily because they are in a dense planting situation. They come out of the cooler at 8 a.m., receive eight hours of light in the greenhouse, and then at 4 p.m. they are moved back into the cooler. A grower who has rolling benches could move the plants back and forth between a cooler and the greenhouse. For the short day varieties that we have grown in the greenhouse it takes three to four weeks before flower initiation occurs. Once the initiation of flower buds is confirmed under a microscope, the short day treatment is no longer needed.”

Kroggel said the 24-hour average temperature for strawberries should not exceed 77°F (25°C).

“If growers lived in regions where the temperatures were cool enough to stay below the 77°F daily average, they could probably pull black cloth to provide the required short day conditions for flower initiation as an alternative to moving the plants into a dark cooler,” he said. “As long as the plants are kept in that temperature range of 59°F-77°F pulling black cloth won’t be a problem. Growers need to monitor the temperature under the cloth to be sure not to overheat the plants.”



BECAUSE OF THE LACK OF COMMERCIALY AVAILABLE ACTIVELY GROWING STARTER PLANTS DURING THE SUMMER, UNIVERSITY OF ARIZONA RESEARCHERS ARE PROPAGATING THEIR OWN TIP RUNNERS IN 38-CELL PLUG TRAYS OR 2-INCH TREE BANDS.

PHOTOS COURTESY OF MARK KROGGEL, UNIVERSITY OF ARIZONA



Everbearing varieties in the greenhouse

Kroggel said one of the issues with everbearing strawberry varieties is the terminology used to describe them.

“Everbearing varieties are often referred to as being day neutral. We don’t know of any day neutral everbearing strawberry plants,” he said. “These varieties tend to be facultative long day plants. They will flower all the time, but if they’re provided with a longer photoperiod, they will produce more flowers.”

Kroggel said one of the ways to keep everbearing varieties flowering during the short days of winter is to provide them with photoperiodic lighting.

“During short days the everbearing varieties benefit from an extended photoperiod,” he said. “The plants need 2-3 micromoles, which is about 20 footcandles. We provide the plants with 12-14 hours of light using fluorescent or incandescent lights.”

Timing fruit production

For growers using dormant runners or propagating their own tip runners of everbearing varieties, flowers must be removed in order to allow the plants to become established before producing fruit.

“These varieties naturally produce flowers as soon as they can,” Kroggel said. “For a period of four to six weeks after planting into the production system, the flowers should be removed to allow the runners to develop roots and leaves. The plants need to have a good initial vegetative establishment period so they have well-established roots and leaves in order to support the fruit. By removing these flowers some of the fruit is lost, but this establishment period is necessary.”

Strawberry plants produce their first flush of fruit about one month after the flowers appear (short day varieties) or the flowers are left on the plants (everbearing varieties).

“At some point after the first flush, the everbearing variety plants tend to temporarily stop producing flowers,” Kroggel said. “There will be anywhere from a six-week to a two-month period when no fruit is produced. That is a real issue with producing everbearing varieties. Then there is a massive second flush of flowers and fruit.”



MARK KROGDEL, RESEARCH SPECIALIST AT THE UNIVERSITY OF ARIZONA, RECOMMENDS GREENHOUSE GROWERS PRODUCE BOTH JUNE-BEARING AND EVERBEARING STRAWBERRY VARIETIES TO ENSURE THEY ARE ALWAYS PRODUCING FRUIT.

Kroggel said this cyclical production of flowers and fruit can be accommodated by staggering planting dates and using different varieties that have varying production schedules.

“Really high yielding everbearing varieties have less cyclical production because they produce more crowns more often. Unfortunately we haven’t found a really high yielding everbearing variety yet with really good flavor. The June-bearing or short day varieties have a more linear production cycle.”

Kroggel said that he recommends that growers producing greenhouse strawberries plant both June-bearing and everbearing varieties.

“With the short day varieties, they begin flowering at some point either naturally or by being induced,” he said “Their weekly yields are fairly consistent and their cumulative yields are linear. The flower and fruit production of the everbearing varieties tend to be cyclical over the season. I recommend growers produce both June-bearing and everbearing varieties to ensure they are always producing fruit. But growers need to know how to manage both types. Being able to produce fruit during November, December and January is critical. This is the period when premium pricing occurs.” 🌱

For more: Mark Kroggel, University of Arizona, College of Agriculture and Life Sciences, The School of Plant Sciences, Tucson, Ariz.; (520) 626-3928; kroggel@email.arizona.edu.

For more information on greenhouse strawberry production, check out: Hydroponic Strawberry Information Website, <http://cals.arizona.edu/strawberry>; Sustainable Hydroponic and Soilless Strawberry Production Systems, <https://www.youtube.com/user/sustainablehydro>.

Mark Kroggel provided information on greenhouse strawberry production in Urban Ag News Issue 9, “Strawberries can be adapted to greenhouse production systems” (<http://urbanagnews.com/emag/issue-9-2>).

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PHYSIOLOGICAL RESPONSES OF *cucumber* SEEDLINGS UNDER DIFFERENT *blue* AND *red* PHOTON FLUX RATIOS USING LEDs

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Environ. Exp. Bot. (2015), <http://dx.doi.org/10.1016/j.envexpbot.2015.04.001>

ABSTRACT

Light emitting diodes (LEDs) are frequently regarded as a new light source for the production of horticultural crops under closed-type conditions. However, before use of LEDs as the sole source of light can be advanced, plant responses to light quality have to be investigated for important horticultural plants. The objective of the present study was to evaluate cucumber (*Cucumis sativus*) seedlings physiological responses to different blue (B) and red (R) photon flux (PF) ratios using LEDs. Cucumber seedlings (cv. Cumlaude) were grown in a growth chamber until the second true leaf stage (17 days) with LED lighting and 18-h photoperiod. The treatments consisted of 100mmol m² s photon flux (PPF) with B:R PF ratios of 0B:100R%, 10B:90R%, 30B:70R%, 50B:50R%, 75B:25R%, 100B:0R%.

Another treatment consisted of B, green (G) and R PF ratio of 20B:28G:52R%. Peak wavelengths of LEDs were 455 nm (B) and 661 nm (R) for the in the B:R treatments and 473 nm (B), 532 nm (G), 660 nm (R) in the B:G:R treatment. Hypocotyl length decreased with the increase of B PF up to the 75B:25R% treatment. Hypocotyl length in the 0B:100R% treatment was 164% greater than in the 75B:25R treatment. Plants under the 100B:0R% treatment had unexpected greater plant height, hypocotyl, and epicotyl length than plants under all other treatments. For example, the hypocotyl length under the 100B:0R% was 69% greater than in the 0B:100R treatment and 346% greater than in the 75B:25R% treatment. Leaf area decreased with the increase of B PF when plants were irradiated with the combination of B and R PF. The response of leaf area under

the 100B:0R% treatment was unexpected since plants in the 100B:0R% treatment had 48% greater leaf area than plants in the 75B:25R% treatment. Chlorophyll content per leaf area, net photosynthetic rate, and stomatal conductance increased with the increase of B PF. Shoot dry and fresh mass decreased with the increase of B PF when plants were irradiated with the combination of B and R PF.

Plants under 0B:100R% had the lowest dry and fresh mass from all the treatments and plants under 100B:0R% showed the greatest fresh mass from all the treatments and equal dry mass as the plants under 10B:90R% treatment. The addition of G PF to the spectrum did not have any influence in cucumber plant responses. For cucumber seedlings, morphological responses influenced plant growth since B PF responses in growth parameters (i.e., dry mass) closely matched those in morphological parameter (i.e., leaf area). More research is needed to find the optimal spectrum for the growth and development of horticultural crops under sole source electrical lighting such as LEDs.

Published by Elsevier B.V.

<http://www.sciencedirect.com/science/article/pii/S0098847215000660>



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