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URBAN AG NEWS

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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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INDOOR AG-CON SINGAPORE JANUARY 18-19

As it offers solutions to drought, food supply chain challenges and the scarcity of new farmland, indoor agriculture is one of the fastest growing aspects of global farming. Indoor Ag-Con –the U.S. indoor agriculture's industry's leading conference –will be hosting its first event in Asia on Jan. 18-19, 2016, to discuss the prospects for this tech-rich industry in the region.

The two-day seminar will be hosted at Microsoft's campus in Marina Bay, Singapore, and is tailored toward corporate executives from the technology, investment, vertical and greenhouse farming, and food and beverage industries, along with hydroponic, aquaponic and aeroponic startups and urban farmers.

"As a company that is all about empowering organizations and people to achieve more, we are very committed to growing the startup ecosystem," said Nobuhiro Ito, Director for Developer Experience & Evangelism, Microsoft Singapore. "Microsoft is excited to partner with Indoor Ag-Con for its inaugural Asian event and looks forward to the innovation that will be showcased as well as germinated in the areas of tech-focused indoor agriculture."

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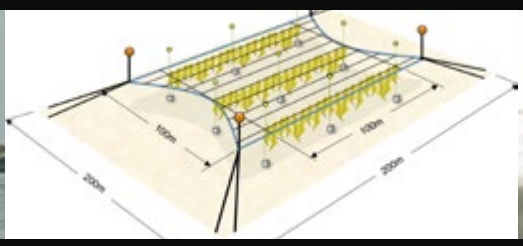
3D OCEAN FARMING

The Least Deadliest Catch
Bren Smith at TEDxBermuda 2013

TEDx Bermuda
x = independently organized TED event



TAIWAN'S PLANT FACTORIES FOCUSED ON FAST-GROWING CROPS WITH *HIGH* YIELDS, *HIGH* ECONOMIC VALUE

Plant factories in Taiwan are operated primarily by private companies. Currently there are less than 100 of these operations in the country, producing primarily salad greens. The market demand for plant factory product is good and companies are looking to produce crops that have low inputs and high yields.

Dr. Wei Fang, a professor in the Department of Bio-Industrial Mechatronics Engineering at National Taiwan University, has been doing research on plant factories since 1993. He has been studying the use of LEDs in plant factories since 1996. He has served as an international consultant for Japan's plant factory association. He has also been invited to be a keynote speaker about plant factories in many countries, including the United States, China, Korea, Kuwait, Panama and Japan.

Hort Americas spoke with Dr. Fang about Taiwan's plant factory industry, how it is developing and its potential for growth.

Q. *How large is the average plant factory in Taiwan and can you describe what type of equipment is used in one of these operations?*

A. Most of Taiwan's plant factories are small, harvesting less than 1,000 plants each week. The largest factory has daily production of 6,000 plants at full capacity.

Some of the equipment being used in these operations include reverse osmosis water treatment, sanitation equipment, including electrolyzed oxidation and ultraviolet light treatment of water, air conditioning, air showers at the entrances for the removal of dust/small particles from people entering the facilities, hydroponic systems, artificial lighting including LEDs, T5 fluorescent lamps and cold cathode fluorescent lamps (CCFL), duct fans for air circulation, control of temperature, humidity, carbon dioxide concentration, pH and electrical conductivity (EC) of nutrient solutions, epoxy floors and thermally insulated walls.

Taiwan's plant factories are looking to meet the increasing demand for **out-of-season** *and* **specialty greens** *and to reduce the dependence on imported food crops.*

By David Kuack

Q. *Are most of the plant factories located in renovated buildings or are the buildings housing these operations constructed specifically for these factories?*

A. Almost all of the plant factories are located in renovated buildings. There are also two located in greenhouses.

Some people consider greenhouses equipped with artificial lights as a kind of plant factory. I don't consider these greenhouses to be plant factories. In Taiwan only some orchid greenhouses have installed artificial lights. When I'm talking about plant factories I am always referring to plant factories equipped with artificial lights (PFAL).

Q. *How do the plant factories in Taiwan compare in technology to the plant factories in other countries?*

A. Taiwan has many advantages when it comes to the construction and operation of plant factories. Information and computer technology (ICT), LED lights, cheap labor and low utility fees, have led to lower construction and operating costs.

The market demand for plant factory product is good and produce prices are almost the same as Japan and much better compared with China. In China not many people eat salads. Also, it takes much more effort to convince the Chinese people that hydroponics and artificial lights can be used to produce healthy food crops. Taiwan overall is in a better situation for the development of the plant factory industry.

Q. *Are most of Taiwan's plant factories operated by private companies and/or corporations or are there some of these factories operated as family farms?*

A. As of October 2015, there are 97 plant factories in Taiwan. Eighty-three are run by private companies and 14 by universities and research institutes. This information was collected by Photonics Industry & Technology Development Association, which has held four plant factory exhibitions in Taiwan. Greenhouses with artificial lights are not included in these figures.

Some companies operate multiple factories. There are currently no family-run plant factories in Taiwan.

Q. *What are the most common crops grown in Taiwan's plant factories?*

A. Lettuce is the primary crop, with more than 20 varieties being produced. Brassica (*Cruciferae*) plants are the second largest crop. Specialty plants, including ice plant (*Mesembryanthemum crystallinum*) and rocket lettuce or arugula (*Eruca sativa*), which have high market value, have received a lot of attention in recent years.

Q. *Are there any limits (i.e. space restrictions, size of the plants, light requirements, etc.) to the types of crops that can be grown in these plant factories?*

A. There is no limit from a technology standpoint. However, from a business standpoint, only cost-effective crops are candidates for production.

Fast-growing, small plants that need low light levels that have a high economic value and a

Most of the plant factories in Taiwan are run by private companies. Lettuce is the primary crop followed by brassicas. The preferred plants are small, fast-growing, need low light levels, have a high economic value and very little waste.

high harvest index are preferred. These plants have little waste. For example, with lettuce only its roots are discarded.

Tomatoes can be grown in plant factories, but only the fruit can be harvested, so they have a low harvest index. Tomatoes are only grown as seedlings in plant factories and then planted out into greenhouses for fruit production.

Q. *How are most of the crops grown in the plant factories marketed to consumers (i.e. local grocery stores, large supermarket chains, farmers markets, restaurants, etc.)?*

A. All of the above plus on the internet and through memberships, including community-supported agriculture and health clubs.

Q. *Is there any type of marketing done for plant factory crops on television, radio, online, newspaper, etc.?*

A. No marketing is done through these channels. However, all of these channels introduced plant factories to the Taiwanese people. My colleagues and I have been visited and interviewed by these media several times. National Taiwan University offers a plant factory workshop twice a year. Consulting companies also offer one-day seminars on plant factories. The workshop and seminars are promoted online and in newspaper advertising.

Q. *In regards to the production systems currently being used in plant factories, where could the greatest improvements be made?*

A. No greatest improvements, only better improvements. These would include:

- Identifying specific LED light spectra for specific crops.
- Development of total performance evaluation techniques.
- Ebb-and-flood systems are better than deep water and nutrient film techniques. Ebb-and-flood systems equipped with siphons are better than tradition ebb-and-flood systems.

- In addition to salad greens, new crops with higher market value and higher concentrations of beneficial compounds for medicinal and cosmetic purposes are being investigated.

Q. *What are the benefits/advantages of plant factories over greenhouse production and traditional field crop production?*

A. A common question I encounter is: If the light from the sun is free, why not use it to produce crops in a greenhouse or in the open field? Also, there is the issue of having to use a lot of energy to operate the artificial lights in plant factories.

Making such a comparison requires looking at production from beginning to end of a crop. In traditional open field production, land preparation is needed to plant a crop. This requires having to operate some agricultural machinery. Upon harvest of a field crop, it likely has to be placed in cold storage and then shipped to markets, which are normally far from the original production sites.

For plant factories, one of the slogans we use is "Local for local." This means local production for local consumption, so the food mileage and carbon footprint are small making plant factory production more environmentally sound.

Plant factories usually require no pesticides and less land, water and fertilizer to produce crops.

The plants harvested from plant factories don't usually need to be washed before they're eaten or cooked if they are grown in clean rooms. Plant factories can provide off-season and stable year-round production. Production can be done on demand and there are few risks associated with production.

Q. *What are the benefits/advantages of greenhouse production over plant factories?*

A. There are many more crops to choose from for greenhouse production. Also, greenhouses have lower production costs than plant factories.

Q. *Do you think that Taiwan's plant factories will be able to overcome their current limitations to compete with greenhouse and field production?*

A. There really is no need for the plant factories to compete with greenhouse and field crop producers. They can operate hand-in-hand and serve different groups of customers.

For example, lettuce can only be grown in Taiwan during the winter season, but consumers eat a lot of it during the summer. Most of these out-of-season crops are imported from the United States.

The first goal of Taiwan's plant factories is to replace these imported crops. Most of Taiwan's plant factories have differentiated themselves from traditional farmers by producing different varieties or out-of-season plants with special properties, including high levels of iron, calcium, vitamins A and C and anti-oxidation capabilities and low potassium content.

Q. *What aspects of plant factory production are being studied at National Taiwan University?*

A. Ion selective sensors, LED spectra for particular purposes, fuel cells, and all technologies related to cost reduction and quality improvement of crops, facilities and systems.

For more: Dr. Wei Fang, National Taiwan University, Department of Bio-Industrial Mechatronics Engineering; weifang@ntu.edu.tw.

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

CIFV2012: TOYOKI KOZAI

Chiba University

Challenges in Vertical Farming

Toyoki Kozai is professor emeritus and chief director of the Japan Plant Factory Association Center for Environment, Health and Field Sciences at Chiba University in Japan. Previously, Toyoki held several positions at Chiba University associated with environmental engineering, health and field sciences, bioproduction science, horticulture and agriculture. He also served three years as president of the university. His goal at the Workshop on Challenges in Vertical Farming was to convey the diverse roles of closed plant production systems and methods for resource-efficient environmental control. He also wanted to introduce the state of the art of plant factories in East Asian countries.

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Urban Ag News is a *connector* for a niche industry. We bring together farmers, growers, researchers, educators, manufacturers, suppliers, as well as everyone else interested in controlled environment agriculture (CEA). Our goal is *education*. By providing a unique blend of entertaining and educational content our readers and viewers will achieve a basic understanding of the science, leaders and technology shaping the industry and leading us into the future.

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WHY WE NEED MORE HYDROPONICS

SOIL SOLUTIONS TO CLIMATE PROBLEMS

BY CENTER FOR FOOD SAFETY




INNOVATIVE FOOD PRODUCTION SYSTEMS BY EAT FOOD FORUM

Presentation by Louise O. Fresco, President, The Executive Board of Wageningen UR during the 2015 EAT Food Forum.

CROP DIVERSIFICATION HELPS ENSURE WESTLAND ORCHIDS WESTLAND PRODUCE STAY PROFITABLE

BY

& E

David Kvack

AS THE U.S. MARKET FOR ORNAMENTAL AND FOOD CROPS CONTINUES TO EVOLVE, WESTLAND ORCHIDS AND WESTLAND PRODUCE ARE LOOKING FOR PRODUCTS THAT CONSUMERS ARE WILLING TO PAY FOR AND ARE PROFITABLE.

When Jerry Van Wingerden started growing greenhouse cut flowers at Westland Orchids Inc. in Carpinteria, Calif., in 1971, he never imagined that someday he would be growing greenhouse food crops along with flowers. But in 2010 a sister company, Westland Produce Inc., began growing hydroponic lettuce. Even before a lettuce crop was planted, Westland Orchids went through an evolution in terms of the flowers it was producing.

"We started with carnations and chrysanthemums and then later added cymbidium orchids," said David Van Wingerden, who is Jerry's son and president of Westland Produce. "We were also doing bouquets for the supermarkets, but we evolved and stopped doing those and began to specialize in orchids. Five years ago we started growing the produce."

Cut flower competition

Van Wingerden said the reason for the change in the cut flower crops was a direct result of the flowers that started to be shipped in from South America.

"The flowers coming from South America were competing too much with our standard crops including chrysanthemums," he said. "Chrysanthemums were one of our biggest crops. These were the flowers that would go into our bouquets. Bouquet prices were driven down by offshore product. We were not able to increase prices on our bouquets, yet our costs were rising. Since we weren't able to make much money on the bouquets, we discontinued them and started focusing on the floral crops that generated more revenue and profit for us.

"We grow primarily cut orchids and sales are increasing every year. We also have an 8-inch pot program for cymbidium and phalaenopsis orchids and we do some poinsettias for Christmas sales. Our floral products are sold to supermarkets across the United States. There are some that are sold wholesale. The cut cymbidiums are sold in the form of sprays in a sleeve. Sometimes we add aspidistra leaves to make spray bouquets. For the holidays, including Mother's Day and Easter, we sell a lot of orchid corsages."

VanWingerden said sales of the potted orchids have remained steady.

"At one point sales of our potted orchids had declined because several other U.S. orchid growers were pushing 6-inch plants, which have a lower price point to make it more affordable for consumers. We lost some traction on the potted plant side.

"More recently our 8-inch orchid program has started to gain in popularity because consumers have begun to value larger plants. These plants have taller spikes, more flowers and larger flowers. About 80 percent of our orchid sales are cut flowers and the remaining sales are potted plants."

Hydroponic production

The cut orchids are grown in 12-inch plastic pots containing rockwool.

"Rockwool is an inert growing medium that allows us to control the fertility of the crop in order to maximize yields," Van Wingerden said. "We have our own tissue culture lab in which we multiply all of our orchid varieties to rejuvenate the crop. It takes six to seven years before we have a sizable plant that is producing flower sprays.

"The cut orchids stay in the same pots until the yields start to decline. The orchids remain in the pots from 12-15 years depending on the variety. Every year we evaluate the plants for vigor. We pull out some plants with less vigor and replace them with ones from the tissue culture lab."

Adding vegetables

In 2006 Van Wingerden went to the Netherlands to look at potential vegetable crops that could be added to Westland's production.

"There were other growers in Carpinteria

Photos courtesy of Westland Produce Inc.

David Van Wingerden (left) and his father Jerry Van Wingerden have changed the product mix at Westland Orchids and Westland Produce to meet customer demand and to stay profitable.

The latest addition at Westland Produce is Vanessa Rose Van Wingerden, born Oct. 5, 2015.

who were producing hydroponic greenhouse vegetables and it was a crop that we wanted to take a look at," he said. "We knew we had to diversify what we were doing because we didn't know for how long cut flowers would be sustainable. In Holland they grow a lot of hydroponic vegetables and they have the technology to grow those vegetables.

"We looked at various Dutch crops. Lettuce seemed to be the most economical crop to grow. So it was relatively easy to add to our production. Our total greenhouse production area for both the floral and vegetable crops is about 32 acres."

Water-saving production system

Van Wingerden said some changes were made to the infrastructure of the greenhouses to accommodate the deep water culture system used for vegetable production. The biggest investment was in a water treatment system to clean recycled water.

"The deep water culture system is a less expensive investment initially than nutrient film technique or water film," Van Wingerden said. "We are using well water for both the orchids and the vegetables, but it is sterilized before it used with the vegetables.

"We don't replace the water in the deep water culture. The plants are floated in extruded polystyrene foam rafts on the water. The only water that is lost in the system is taken up by the plants. The system refills the bath with fresh water and fertilizer once it has dropped below a certain level. We never change the water out in the bath."

With the drought in California, Van Wingerden said water is always an issue.

"People ask us what are we doing to help conserve water for the drought?" he said. We haven't been doing anything different than what we've been doing for many years. Hydroponic production in itself is water conservation. Using hydroponics allows us to produce the highest yield per acre foot of water vs. conventional field growing."

When Van Wingerden first began trying to grow lettuce he used a small trial bath.

"I'm still using it," he said. "Anything that I want to trial I use the small bath. I can move it wherever I want. That's how I started with the different varieties to find out if we could even do this. We gradually built a full production size bath. We trialed it and it proved to be successful. We are now producing over 1.2 million heads of lettuce per acre per year."

Marketing food crops

Westland Produce grows lettuce (green butter and red butter), upland cress and a mix of red oak lettuce, green oak lettuce and red multi-leaf lettuce that are grown together and called a Medley. Green butter lettuce is the biggest crop.

"Everything we grow and harvest is with the roots attached," Van Wingerden said. "We sell our produce to a mix of wholesale and retail outlets. We sell to a lot of wholesale markets in California, which distribute our product across the United States. We also sell to wholesale customers across the United States."

The upland cress is packaged in a poly bag. It is marketed in a retail bag or a food service bag that is sold to restaurants.

Butter lettuce is a soft variety so it is packaged in recycled plastic clamshells.

"We also have a food service pack for the butter lettuce," Van Wingerden said. "It's a freight-saver for shipping across the United States. It allows us to ship double the amount of product we can with the clamshells. It's good for food service because it cuts down on unnecessary costs."

Van Wingerden said Westland Produce adheres to a stringent testing protocol for food safety. The company is certified by Primus GFS. The company also grows some of its lettuce organically and it is certified organic. The company also is certified by the Non-GMO

Project for not producing genetically modified food crops.

Van Wingerden said he could grow many different food crops in the deep water system.

"Growing the crops really isn't the issue," he said. "The issue is whether or not there is a market for the crops and whether there are customers willing to pay for them. Growing hydroponically it costs more to produce so we need a higher price for the product. Another question is will consumers see the value in the product and be willing to pay for it? Growing hydroponically results in higher yields and the product is cleaner and has a longer shelf life."

For more: Westland Orchids Inc., (805) 869-1440; http://westlandorchids.com. Westland Produce Inc., (805) 684-1436; http://westlandproduce.com.

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

GROW NORTH TEXAS

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

AN URBAN AG NEWS VIDEO PRODUCTION

ONWARD: UNDERGROUND FARMING IN A LONDON BOMB SHELTER

NATIONAL GEOGRAPHIC

MARCO VAN LEEUWEN JOINS GREEN SENSE FARMS ADVISORY BOARD

Marco van Leeuwen has joined the Green Sense Farms Advisory Board. Van Leeuwen is Managing Director of Rijk Zwaan, a world leader in the market of vegetable seeds. Based in the Netherlands, Rijk Zwaan produces more than 1,000 varieties of seeds representing 25 vegetable crops.

Formed earlier this year, the Green Sense Farms Advisory board will assist Green Sense as it continues expanding in both domestic and international markets.

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INDOOR HARVEST CORP SET TO DESIGN-BUILD EDUCATION CAMPUS

Indoor Harvest Corp Set to Design-Build World's First Publicly-Owned, Open Data, Crowdfunded, Vertical Farm Research and Education Campus. On December 1, 2015, the City of Pasadena, Texas, unanimously voted in favor of a Chapter 380 Economic Development Agreement with Indoor Harvest for the purpose of establishing an open source, vertical farm and education campus on the City's north side.

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{NEWS FROM THE INDUSTRY}

VALOYA DRIVES QUEEN MARY UNIVERSITY'S RESEARCH INTO HIGHER YIELDS IN AGRICULTURAL CROPS IN COLLABORATION WITH MICROSOFT

Valoya (Helsinki, FInland) a leading provider of advanced plant lighting systems, worked with Microsoft Corp. to create next generation of state of the art lighting system, using Valoya's advanced LED lights, Microsoft Azure and Microsoft Azure Internet-of-Things (IoT) technology.

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TRULEAF GROWS TEAM WITH ADDITION OF CFO AND TWO NEW STRATEGIC ADVISORS

TruLeaf is wrapping up 2015 with a firm eye on its future. It is pleased to announce the addition of Jeff McKinnon as a Vice President of Operations and Chief Financial Officer, and Martin Jamieson and Pete Luckett as new investors and strategic advisors.

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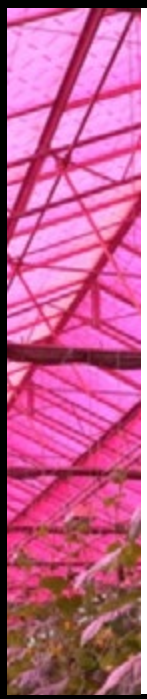

SOLICULTURE GREENHOUSE PHOTOVOLTAIC PANELS GIVE GROWERS A SECOND HARVEST OF ELECTRICITY WITHOUT IMPACTING PLANT GROWTH

Soliculture (Scotts Valley, California) has released a new type of commercial greenhouse panel that both improves light quality by amplifying colors that are beneficial to plants and generates electricity with no loss to production. Soliculture has completed 3 years of commercial plant growth trials including vegetables, ornamentals, cut flowers, and berries that have shown that these panels mounted directly above crop production have neutral to positive effects on plant growth. Positive effects have ranged from early maturation, disease resistance, and longer production time.

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EMPOWERMENT WITHOUT BORDERS: MEET MODULAR FARMS

Today, we're very excited to announce that ZipGrow towers will now be manufactured and distributed in Canada!

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THE BRIGHT AGROTECH ZIPFARM™

The ZipFarm uses hydroponics, a soil-less growing technique, and delivers the perfect nutrient ratios to plants via water. The water is mixed in the main sump tanks, and an optional add-on may be selected to control pH and nutrient levels automatically. Unlike many indoor growing system, the ZipFarm uses vertical growing planes. This increases production by square foot while keeping labor costs down.

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USDA GRANT TO AGRILIFE RESEARCH CENTER & GREENTECH AGRO

On Monday, the U.S. Department of Agriculture awarded more than $113 million nationwide in program grants to support farmers growing fruits, vegetables, tree nuts, and nursery crops, also known as "specialty crops," through research, agricultural extension activities, and programs. The goal is to boost demand and promote food safety and better crop yields, officials said.

Including a grant to Texas A&M Agrilife Research Center and Greentech Agro LLC to introduce new technologies in indoor farming (Growtainers™) to help improve and increase artichoke growing by optimizing germination and early growth conditions in Growtainers™ so that time from sowing to planting out is reduced; by optimizing vernalization conditions so that vigorous plants can be sowed out after the last frosts; and by starting and/or growing artichokes in indoor farms during the off season when prices for artichokes are higher.

MANCHESTER'S HOME OF HONEST COFFEE TURNS HYDROPONIC WITH THE HELP OF REFARMING AND HYDROGARDEN

Creative working space and artisan coffee shop, Home of Honest Coffee, in the city of Salford, United Kingdom, has taken one more step towards sustainability following the installation by Refarming Ltd & Co-operative and Mutual Solutions of one of HydroGarden's VydroFarm vertical hydroponic systems in its basement.

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SHAN HALAMBA, CEO OF RIOCOCO WINS STEVIE GOLD AWARD, EXECUTIVE OF THE YEAR

Entrepreneur Shan Halamba, CEO of Texas-based Ceyhinz Link International, Inc., won the Gold Stevie Award for Executive of the Year, Management Award under the category of All Other Industries.

Nicknamed the Stevies from the Greek word "crowned," the awards were presented at a gala event on October 23, 2015, at the Ritz-Carlton Hotel in Toronto, Canada. Michael Gallagher, President and Founder of the Stevie Awards, presented Shan Halamba with the award.

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THE ASSOCIATION OF VERTICAL FARMING

The AVF is an internationally active non-profit organization focusing on advancing vertical farming technologies, designs and businesses. AVF consists of individuals, companies, research institutions and universities. And all of them are united by the goal to foster the sustainable growth and development of the vertical farming movement through collaboration, education, and transparency.

Association for Vertical Farming

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from Agenda Gotsch

"Life in Syntropy" is the new short film from Agenda Gotsch made specially to be presented at COP21 - Paris. This film put together some of the most remarkable experiences in Syntropic Agriculture, with brand new images and interviews.

THE TOUR de FRESH 2015 was an INTENSE RIDE, SUCCESSFUL at PUTTING SALAD BARS in SCHOOLS

This year's Tour de Fresh was an amazing success.

For the second year in a row Hort Americas sponsored their General Manager and avid cyclist, Chris Higgins in the 2015 Tour de Fresh. This is a first-of-its-kind, collaborative event that unites the most significant brands and influencers in the fresh produce industry for a four-day cycling event that raises funds to benefit the Let's Move Salad Bars to Schools campaign.

I have been asked many times why we support the Tour de Fresh. For me the answer is simple, we want to support healthy life options. For Hort Americas this starts with supporting our customers (farmers and growers) who have committed their lives to providing healthy, safe and nutritious food options for the American consumer. (In this I also include all the ornamental growers we work with that beautify the world and create a better environment for everyone to live, play and work.)

Supporting healthy life options also includes investing in our future, and what better way to do that than to invest in the children at our public schools. It's obvious that healthy kids will have a better chance at being stronger students. The Tour de Fresh allows us to partner with others in the fresh produce industry to create situations where public schools can have the tools needed to not only educate the kids about healthy food options but also fight childhood obesity.

In addition to all this, we as riders get to physically challenge ourselves and enjoy some of America's most breath-taking scenery! This year's adventure took us through the Great Smokey Mountains. For many of us this was the most difficult ride we had ever attempted, but all of us successfully rose to the challenge. And more importantly the 2015 Tour de Fresh raised more than $160,000 to fund salad bars at public schools.

Finally, it gives Hort Americas an opportunity to team up with customers and vendor partners. This year's TDF partnerships successfully hit our combined goal of placing salad bars in St Louis Public Schools.

Thank you very much to Village Farms, Riococo, Houwelings, Grodan, Age Old Organics and Urban Ag News. Your support made all of this possible!

— *Chris Higgins*

FDCEA ADVANCING RESEARCH *and* EDUCATION *for the* CEA INDUSTRY

by David Proenza

The Foundation for the Development of Controlled Environment Agriculture (FDCEA), has been busy on many fronts. From organizing the first days educational event for the Indoor Ag–Con Asia, in Singapore, scheduled for 18-19 January 2016, organizing the first CEA and Plant Factory (Vertical Farm) event in Chile and initiating and structuring the development of a world class Research and Development and Training Center, (named; International Center for Production in Controlled Environment Agriculture (ICPCEA)) and starting in the first quarter 2016, the FDCEA will start promoting the Second International Conference on Controlled Environment Agriculture (ICCEA 2017) in Panama.

In this report I will highlight a recent trip organized by FDCEA to three countries with a delegation composed of Panamanian government officials and other individuals. The delegation was composed of Dr. Victor Sánchez, Senacyt, Mauricio Revés, Latin American Development Bank, Dr. Willy Del Valle, Ambassador and David Proenza, President of the FDCEA, the delegation was representing the Committee that was formed to develop the ICPCEA. The main purpose of this trip was to gain knowledge and ideas to set up the ICPCEA in Panama, establish alliances and knowledge transfer between Universities and private companies.

Our first leg took us to Holland. We met with Dr. Leo Marcelis of Wageningen University, Rijk Zwaan, Plant Lab, Phillips City Farming and Priva. We had the opportunity to see first-hand the advancements in research in plant cultivation under LED lights, new products developed for specific use in Plant Factory and gained interest from these distinguished companies to participate in the ICPCEA.

From Holland we traveled to Taiwan. We visited with Dr. Wei Fang of National Taiwan University and witnessed their advancements in plant production in a controlled Plant Factory. We also visited private companies advancing in this field and attended the Taipei International Plant Factory & Greenhouse Horticulture and Product Show. One of the companies we visited was Cal Comp, a 40 billion a year electronics manufacturer. Cal Comp has two Plant Factory at their HQ testing the viability of the Plant Factory to sell turnkey Plant Factory's.

On the last leg of our trip we visited Dr. Toyoki Kozai, Dr. Yamaguchi, Dr. Takagaki, Dr. Kikuchiand the administration of Chiba University. Unbeknownst to most people, Chiba University is where the Plant Factory

Dr. Leo Marcelis

Dr. Wei Fang, Dr. Victor Sánchez, David Proenza

Dr. Toyoki Kozai & David Proenza

concept started and took shape and not in New York as most people are led to believe. The delegation spent two days with Dr. Kozai and Chiba University showing us their most recent advancements, which are many, and discussed collaboration between Chiba University, the ICPCEA, the University of Panama and the Technological University of Panama. In January 2016, six (6) graduate students, (3 from each University in Panama) will attend a 71 day training course on Plant Factory at Chiba University and in February 2016 six (6) graduate students from Chiba University will go to Panama to intern at Urban Farms and have an opportunity to visit Panama. The collaboration for technology and knowledge transfer between Chiba University and Panama is in full swing.

Overall it was a successful trip. Made lots of new friends, saw cutting edge research, new products under research, like; strawberries, blueberries (yes, blueberries growing spectacularly under LEDs, tomatoes and other products), made alliances and established working relationships for the development of the ICPCEA in Panama.

NOTE: The ICPCEA is open to everyone that would like to participate at any level. It will be an open source research and training center for anyone interested in learning Controlled Environment Agriculture and Plant Factory food production and operation.

For more: http://www.fdcea.com/

David Proenza is CEO at Urban Farms in Rio Hato, Panama; http://www.uvf.com.pa.

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.

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DUTCH COMPANIES LOOK TO MARKET THEIR HORTICULTURAL EXPERTISE

A NEW INITIATIVE IN THE NETHERLANDS LOOKS TO BRING TOGETHER DUTCH COMPANIES IN AN ORGANIZATION THAT WOULD MARKET THEIR HORTICULTURAL EXPERTISE WORLDWIDE.

Photos courtesy of Peter van den Bosch

BY PETER VAN DEN BOSCH

Though a small country, the Netherlands has an important economy and is a key world player in both horticulture and agriculture. Its success is driven by innovative production methods, high tech growing and plant breeding. Holland is the biggest "roundabout" in flower trading, selling product locally as well exporting product to many other countries.

The Dutch have always acted with an international frame of mind. In the past the Dutch sailed the world's oceans for trading purposes and these international activities continue. Regardless of the size of their country, the Dutch people have always looked at themselves as playing an international economic role.

ADAPTING TO CHANGING MARKETS

The international horticulture industry is changing rapidly. For the Netherlands, which depends heavily on international trade to maintain its economy, it's needed to adapt to this evolving situation. An increasing amount of horticulture production is shifting to areas in the world with optimal climates and low production costs. One of the limitations with production in these locations is the cost of transporting product to international markets.

In the Dutch flower industry a common question asked by growers is whether a product is "easy to fly?" For instance, a major amount of rose production moved from the Netherlands to African countries. These African roses are finding

their way back to the world's markets either through the Netherlands or the involvement of Dutch distributors. Chrysanthemum cuttings used for Dutch flower production are also coming from East African propagation operations. In many of these countries the increase in local production is leading to the development of a wealthy home market.

The shift in the production of horticultural crops is posing a challenge for the historically strong Dutch horticulture industry. In order for Dutch horticultural suppliers to remain profitable they have had to follow where crop production has moved. Consequently, Dutch greenhouse builders are more active in other countries including Brazil, South Korea, Turkey and the United States.

In most cases, these greenhouse projects are "turn-key" facilities. Once these projects are completed, it depends on the capability of the local growers to properly manage their companies to ensure they make a profit and develop a long term strategy.

A NEED FOR DUTCH KNOWLEDGE

Because of the Netherland's renowned international reputation, an increasing number of companies worldwide are seeking Dutch expertise in high tech production methods, growing advice and other related topics. In some cases, growers in other countries have been required to solicit the assistance of Dutch companies by local financers, including banks, credit unions and private investors. These financial institutions are looking for re-assurance that the horticulture companies they are investing in will be profitable. In many countries there's a knowledge gap that has led to an international need for Dutch production and business expertise. There is a Dutch idiom: "You can buy a nice car, but if you don't know how to drive it, you need help, otherwise it won't work."

MARKETING DUTCH EXPERTISE

To help fill the international need for horticultural knowledge, a group of 25 Dutch companies have started a new project, which in Dutch has been

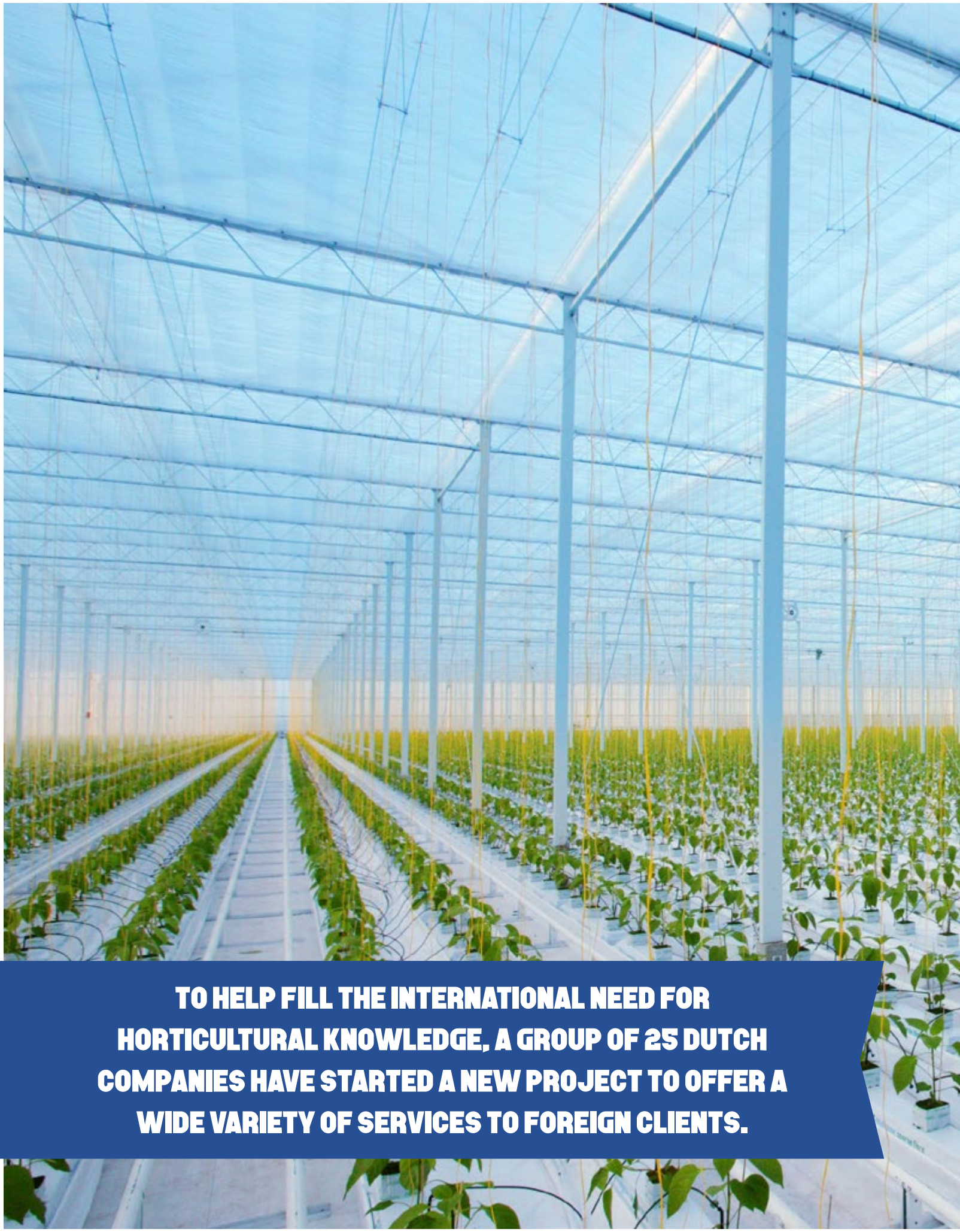
called "Grenzeloos groeien." These companies are outstanding in their specialty areas and realize that exploring international markets on their own isn't easy.

The purpose of this project is to combine each of these companies' experience, to bring together their networks, to help each other and to protect each other from making mistakes to avoid failures when active in other countries. Combining their expertise makes them stronger and more attractive to foreign clients.

This group of companies is very diverse, including large tomato and pepper growers, pot plant flower growers and small breeders. This diversity makes the group more attractive to potential clients. What one company may lack another company has the expertise to fill the void.

Having a group of 25 companies means dealing with different business ambitions, company structures and ideas on how to conduct business outside of the Netherlands. Some of these companies are already active abroad, while others see the need to start marketing themselves in other countries. Bringing some type of structure to this business diversity is a challenge. It will require time to establish a professional organization that can offer some guarantees that it will work in the long run.

The companies have conducted three pre-



TO HELP FILL THE INTERNATIONAL NEED FOR HORTICULTURAL KNOWLEDGE, A GROUP OF 25 DUTCH COMPANIES HAVE STARTED A NEW PROJECT TO OFFER A WIDE VARIETY OF SERVICES TO FOREIGN CLIENTS.

operational meetings to familiarize themselves with each other and to find a mutual organizational structure that suits everyone. The third in-depth meeting was facilitated by a professor in entrepreneurship at Erasmus University-Rotterdam, who offered a lot of eye-opening ideas on how to create a business model.

A fourth and final meeting is scheduled for January 2016. During this meeting decisions will be made on what to do, where to do it and how to do it. By the fourth meeting proposals must be ready for an easier to understand and better name.

The goal of the new organization is to start its activities in spring 2016. The organization is looking to offer a wide variety of services, including "bold" consultancy, licensing and even partnerships. Services offered will depend on the needs of the clients and the ambitions of the organization's members. The organization is seeking to find the best match of companies that fit together for client projects.

The organization's companies see the horizon is open and the atmosphere is "Let's go in the green meadow. And see how we can grow." To be continued...

Peter van den Bosch is a plant breeder and cut flower producer in Valkenburg, Netherlands.

He is co-owner/director of breeding company Celex b.v. (http://www.celosiabreeding.com, http://www.celex.nl) and co-owner of Van der Boog & Van den Bosch (http://www.boogbosch.nl). Peter is also a webmaster responsible for a mutual website of PanAmerican Seed Co., Ball Horticultural Co., Florensis and Celex b.v.(http://www.celosia.eu).

Editor's note: Peter's van den Bosch's LinkedIn contact: https://www.linkedin.com/in/petervandenboschvalkenburg

When connecting with Peter van den Bosch on LinkedIn, please mention "Urban Ag News."

Peter works with his associate Henk van der Boog. Both have joined the new Grenzeloos groeien organization with their companies Celex b.v. and Van der Boog & Van den Bosch.

JAPAN SPECIAL REPORT

JAPAN PLANT FACTORY ASSOCIATION (JPFA) *and* SMART CITY, KASHIWA-NO-HA TOWN

The Japan Plant Factory Association is a nonprofit organization founded in 2010 by the faculties of Chiba University engaged in the Plant Factory Project funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan. JPFA targets to support the industry of sustainable plant factory systems to expand locally and globally, which could be a viable solution to current international issues, including food, the environment, energy and resource use.

Research and development

JPFA has been conducting a R&D program of plant factories with artificial lighting (PFAL) and greenhouses (semi-closed system) with an environmental control system, with a focus on the development and commercialization of those fields, introducing new technology. The organization also supports member companies, offering consulting services for R&D and plant factory business, providing technical support and various business opportunities.

There are several PFAL and greenhouse facilities on site facilities on site in Kashiwa-no-ha town for research, education and training. So far, over 30,000 people from all over the world have visited the sites to learn about and understand plant factories.

This educational program (training course, intensive lectures) has been conducted since 2011 in collaboration with Chiba University. Intensive lectures cover science, business and the operation of plant factories. Moreover, business workshops have been held on a monthly basis on a wide range of issues for business people by planning workshops, excursions and instructor dispatches.

JPFA consists of more than 100 corporate members and another 100 individual members. The association is pursuing economic rationality through collaborative activities, and hoping to share and cooperate with more people with diverse backgrounds in order to move forward in a greater way.

Kashiwa-no-ha town - Smart city with PFALs

JPFA and Chiba University are located at Kashiwa-no-ha town in Chiba prefecture, a suburb of Tokyo. An ongoing social experiment in Kashiwa-no-ha has been conducted by Chiba University and JPFA towards changes in life style and social infrastructure for sustainable societies.

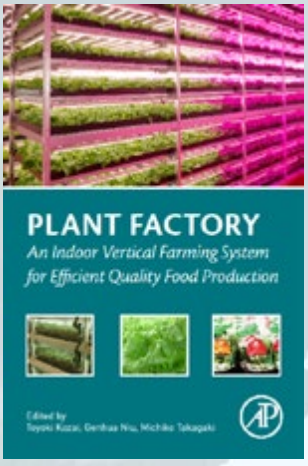
In this town there are multiple PFALs of different sizes for different purposes, including commercial large scale farms (10,000 heads of lettuce per day, 3,000 heads of lettuce per day), medium scale unique facilities (700 heads of lettuce per day), CPPS for seedling production, mini PFALs at a shopping center, restaurant, hotel and for home-use.

Kashiwa-no-ha town - A smart city with urban agriculture

- Rooftop farm, organic city farm, organic restaurant
- Mini PFALs at the shopping center, food shop, café restaurant, hotel restaurant,
- Commercial PFALs
- Household PFALs
- Greenhouses at Chiba University
- Solar panel and wind power generation, batteries
- Oriental medicine clinic, acupuncture clinic, herbal garden
- Honey bee house

For more: http://npoplantfactory.org/english.html

"PLANT FACTORY-An Indoor Vertical Farming System for Efficient Quality Food Production." Published by Elsevier on Oct. 26, 2015; 423 pages
Edited by T. Kozai, G. Niu and M. Takagaki



-Eri Hayashi
Japan Plant Factory Association (JPFA)
E*Green Lab Inc.

Photos courtesy of Mike Dixon, University of Guelph

meeting the environmental challenge of growing food crops

MORE PREDICTABLE PRODUCTION LEVELS AND HARVEST DATES ARE DRIVING GROWERS TO ADOPT CONTROLLED ENVIRONMENT AGRICULTURE.

by david kwack

Even though most greenhouse vegetable growers are producing fewer types of crops than ornamental plant growers, trying to control the environment of these food crops can be a much bigger challenge.

"The environmental control challenges for vegetables are much tougher because the produce is going to be consumed," said University of Guelph professor Mike Dixon, who is director of the Controlled Environment Systems Research Facility in Guelph, Ontario, Canada. "The fact that they are destined to be a food commodity requires more attention to things like pest control.

"For vegetable production, since the margins are typically small for food crops, growers are trying to tightly control inputs as much as they can without compromising the quality and productivity of the commodity. This is a significant challenge and requires a great amount of detail to environmental control than for typical ornamental crops. Ornamental commodities, since they are not eaten, are not subject to the same kinds of stringent controls, especially with pesticide residues. But it's more than that. The food safety regulations for food crop inputs and production outputs (e.g. nutrient runoff) are much tighter than they are for ornamental commodities. That means that environment control is a key factor in maintaining production standards and quality standards in a competitive market."

meeting market expectations

Dixon said part of the issue with trying to maintain the proper environment for vegetable production is consumer expectations for "perfect" fruits and vegetables.

"Consumers have been conditioned by generations of what today are considered environmentally unacceptable cultural management practices, using chemicals and pest management protocols, that occasionally leave residues," he said. "Consumers don't want peppers with spots on them. Consumers don't want roses with blemishes on the flower petals. In the minds of consumers, they expect virtual perfection and don't appreciate that the means to achieve this are not necessarily environmentally correct today.

"There is a transition between the old ways of doing things and the new ways of doing things. In terms of controlled environment agriculture, growers are transitioning to production practices that don't compromise quality and productivity and yet meet environmental standards as well. That can be a tough balance."

Dixon said that growing food crops in the northern latitudes year-round requires some type of controlled environment production.

"In Canada, six months out of the year food crops can't be produced unless they're grown in a controlled environment," he said. "This requires that the growing has to be done in a nearly subtropical environment in which many disease pathogens and insects thrive. These pests gravitate toward these ideal controlled environment conditions. It's the growers' challenge to maintain some kind of balance and still meet the quality and production requirements of the market."

minimizing costs maximizing production

Dixon said the degree of sophistication that is achievable with today's technology should really be taken advantage of by growers especially in regards to minimizing labor.

"Labor is the top line in the cost of production in a controlled environment commodity," he said. "Automation, including computer controlled environments and automated irrigation can mitigate the labor bill. Energy is a close second in regards to major costs."

Dixon said the winter environment in the northern areas of the United States and in Canada is a major challenge for controlled environment growers.

"Winter production in these areas requires a

bringing space technology back to earth

One of the major elements of Mike Dixon's research program at the University of Guelph's Controlled Environment Systems Research Facility is the development of technologies for food production (i.e. life support) in the context of long term human space exploration missions. Dixon said the technologies being transferred from his program to the greenhouse sector are those that were developed for these missions.

"These technologies are being adapted to terrestrial agri-food sector applications in as economical a way as possible," Dixon said. "Some of the technologies being developed include LED systems, environment control protocols, recycling systems, environment sensors and imaging systems for diagnostics. Terrestrial agriculture is benefiting greatly from research activities taking on the challenge of growing food on the Moon and Mars."

Mike Dixon, director of the Controlled Environment Systems Research Facility at the University of Guelph in Guelph, Ontario.

higher level of technical sophistication than is needed for operations located further south," he said. "The farther south an operation is located the issue then becomes heat extremes. In the middle latitudes, which include a large portion of the United States, environment control challenges are not as extreme as they are in Canada, Mexico and South America.

"In more moderate climates, growers tend to be slower in adopting more sophisticated technology because the cost benefit is harder to justify. Labor costs will be the major factor that will drive the conversion to automation for a lot of middle latitude growers. Up until recently they haven't

been required. What has changed is that the capital cost requirements for a lot of technology enhancements or retrofits in older greenhouses have become very attractive. For example, the cost of LED lighting is not only energy conservative, but it can also enhance productivity with the appropriate technology and application information."

more predictable profitable production

Dixon said since the margins on food crops are relatively small compared to many ornamental crops, growers need to have relatively large greenhouse operations in order to be profitable.

"We're talking on the order of 50-200 acres of controlled environment greenhouses," he said. "To consider manually managing that scope of a greenhouse production system is prohibitive. It's not realistic, growers couldn't do it. It's absolutely required that that they engage some form of automation, controlling especially irrigation, lighting and conventional environment control including opening vents, etc. The largest controlled environment food production area in North America is in the Leamington area in southwest Ontario. This area is typified by very large, highly sophisticated controlled environment agriculture systems for the production of tomatoes, peppers and cucumbers."

Dixon said automating irrigation to reduce labor costs and automating basic temperature and humidity control in the greenhouse will significantly enhance the production system.

"It comes down to the cost benefits analysis," he said. "Each grower has to look at it on the basis of their own specific case. It depends on the commodity. It depends on the local market and the margins growers can obtain with a more homogenous quality that they realize with automation. Automation offers more predictable production levels and predictable harvest dates. These are the kinds of issues that drive the adaptation to controlled environment computer automation and even robotic systems.

"Adding more sophistication gives more reliability in some cases as well as predictability in terms of production and quality. And that can only enhance a grower's attractiveness to the market."

Dixon said automating irrigation to reduce labor costs and automating basic temperature and humidity control in the greenhouse has been shown to significantly enhance the production system of a grower's greenhouse.

"That's really the goal," he said. "Look at the capital cost requirement to obtain that level of technical sophistication and amortize over a reasonable three- to five-year period. Then look realistically at the labor savings, energy savings and the environmental impact savings including waste and runoff that would be realized by doing it. If it makes economic sense then there's the answer.

"Sometimes it's difficult to line up all of the things that need to be considered in a cost-benefit analysis. Depending on the size of an operation, if it's a small-scale operation, it may not make economic sense to incorporate this automation because the cost-benefit is probably going to take 10 years to realize. But as the scale of the operation goes up, generally the justification for automating the system and reducing labor costs is greater."

For more: Mike Dixon, University of Guelph, Ontario Agricultural College, School of Environmental Sciences, Controlled Environment Systems Research Facility, Guelph, Ontario, Canada N1G 2W1; (519) 824-4120, Ext. 52555; mdixon@uoguelph.ca; http://www.ces.uoguelph.ca.

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

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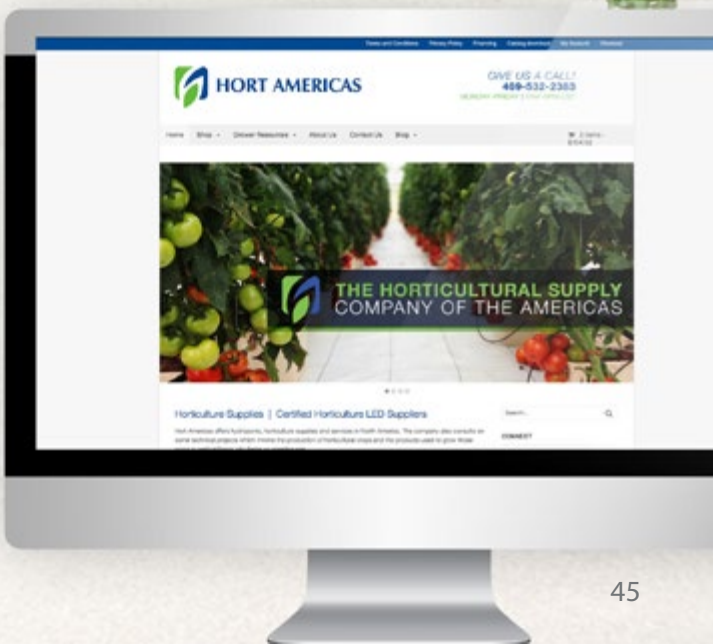

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Urban Ag News & CEAC would like to THANK Dr Rorabaugh

Thank you for contributing to the industry of controlled environment ag!
Thank you for 18 years of educating nearly 500 students!

From the CEAC:

"The CEAC would like to congratulate Dr. Pat Rorabaugh on her well-earned decision to retire in the summer of 2016. Anyone that is familiar with the CEAC knows that Pat is the engine that keeps us running full speed ahead. Whether you visited the CEAC as a student, a short course attendee, or to take a greenhouse tour, Pat was always there going the extra mile to make sure every last question was answered. We will miss her, but will also cherish the time she is still here at the CEAC. The CEAC and the ag industry will not be the same without her hard work and passion!" *Click here for more>>*

ORGANIC CROPS GROWN IN A GREENHOUSE USING HYDROPONICS

FARMER TYLER TALKS WITH BRETT ELLIOTT, FARM MANAGER AT ELLIOTT GARDENS

FARMER TYLER

SPECIAL REPORTS:
INNOVATIVE GROWERS
BY FARMER TYLER
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Proper HVAC Maintenance Delivers Savings and Reliability

By John Zimmerman

Learn what preventive maintenance should be done on a controlled environment agriculture heating, ventilation and air conditioning system and what it can cost you if it's not.

In Urban Ag News Issue 11, I introduced Jeffrey Orkin, CEO at Greener Roots Farm, a hydroponic controlled environment agriculture operation in Nashville, Tenn. I was monitoring the power consumption of Greener Roots Farm's heating, ventilation and air conditioning (HVAC) system as part of a case study, when one of the compressors in the system failed. Because I had a power monitor on the system before and after the compressor was replaced, I was able to determine how much energy and money the HVAC system was wasting as a result of the problems that led to the compressor failure.

Preventive maintenance schedule

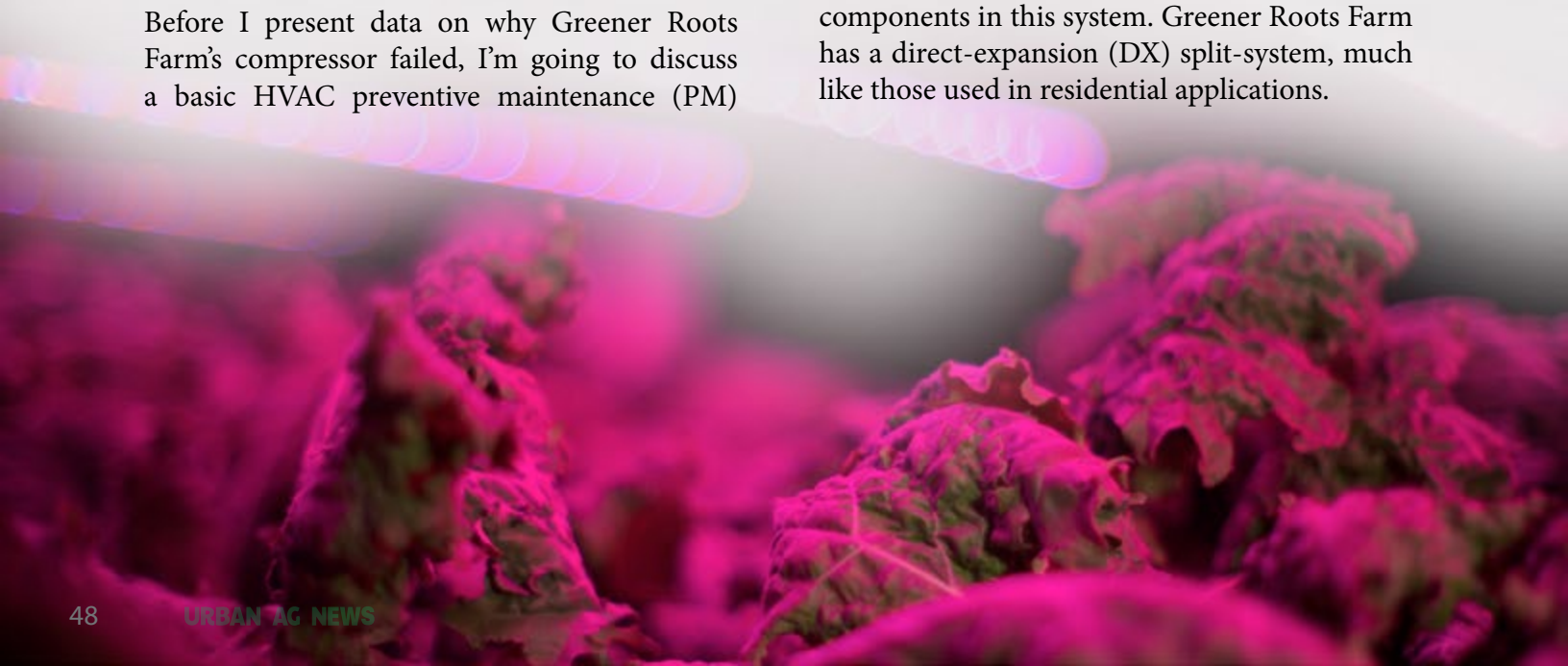
Before I present data on why Greener Roots Farm's compressor failed, I'm going to discuss a basic HVAC preventive maintenance (PM) schedule. I'll also highlight the importance of each maintenance activity and provide variations to the schedule that make sense for indoor growing applications.

HVAC preventive maintenance basics

Three common factors that determine the makeup of an effective PM schedule are:

1. The type of HVAC system.
2. The application the system is serving.
3. The ambient conditions within which the system operates.

These factors determine the type of activities that are required as part of the PM schedule and the frequency with which they need to be performed. The type of HVAC system used determines the components that require PM. For example, a chilled water system requires a relatively elaborate PM schedule because of the number of complex components in this system. Greener Roots Farm has a direct-expansion (DX) split-system, much like those used in residential applications.



Chilled water system components

Chiller(s)
Pump(s)
Cooling tower(s)
Air handler(s)

DX split-system components

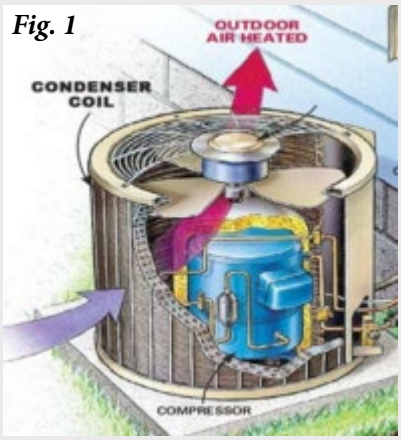
Air handler
Condenser

Based on the number of components that require PM, a DX split-system has a much less complex PM schedule than a chilled water system. However, the PM schedule for Greener Roots Farm's DX split-system differs greatly from a residential application, primarily due to the difference in operation.

The HVAC system for an indoor growing operation needs to operate 24 hours a day and treats a very high latent load (very moist air). Compare that to a residential HVAC system that cycles on and off based on the relative comfort of the space and treats a much lower latent load, thereby reducing wear and tear on the components. Additionally, the high moisture content of the air in indoor growing operations opens the door for issues that residential systems rarely encounter. These include corrosion of metal parts including linkages and drain pans, clogged condensate lines and mold.

The ambient conditions in which a system operates can greatly impact the wear and tear of the system's components. Greener Roots Farm's case highlights this fact. The term ambient conditions refer to the immediate surroundings of the system or components of the system. For the purpose of this article, the focus is on the impact ambient conditions have on outdoor components. However, as described above, moist air indoors can negatively impact indoor components as well. For most systems, components located outdoors are designed to reject the indoor heat to the outside air. In a DX split-system, like at Greener Roots Farm, the outdoor (and heat-rejecting) component is the condenser. In order to reject the heat, the condenser uses a fan to force air across the coil, allowing the heat from the refrigerant inside the coil to be transferred to the cooler outside air (See Figure 1).

Fig. 1



When creating a PM schedule for a condenser, the surrounding dirt, dust and debris that can reduce the component's ability to properly reject the heat must be taken into consideration.

Figure 2 shows how dirt, dust and debris can impact a condenser. Ambient conditions including annual rainfall, direct sunlight and wind have an impact on the life of outdoor components and must be considered when creating a PM schedule.

Fig. 2

Sample PM schedule for a DX split-system

	FREQUENCY (TIMES/YEAR)	
OUTDOOR UNIT (CONDENSER)	**RESIDENTIAL**	**INDOOR GROWING**
Inspect for proper refrigerant level; adjust if necessary.	1	2
Clean dirt, leaves and debris from inside of cabinet.	1	4
Inspect coil and cabinet; clean as needed.	1	4
Inspect fan motor and fan blades for wear and damage.	1	4
Inspect control box, associated components, wiring and connections; check for damage.	1	4
Inspect compressor and associated tubing for damage.	1	4
INDOOR UNIT (AIR HANDLER)		
Inspect and clean blower assembly.	2	4
Inspect blower assembly for corrosion or water damage.		4
Inspect and replace fan belt if needed.	2	4
Check combustion blower housing for lint and debris; clean as necessary.	1	1
Check combustion blower housing for corrosion.		2
Inspect evaporator coil, drain pan and condensate line; clean as necessary.	1	4
Inspect evaporator coil, drain pan and condensate line for corrosion.	1	4
Inspect for gas leaks in gas furnaces.	1	1
Inspect burner assembly; clean and adjust as needed.	1	1
Inspect ignition system and safety controls; clean and adjust as needed.	1	1
Inspect heating elements; replace as necessary.	1	1
Inspect heating elements for corrosion; replace as necessary.		2
Inspect flue system; replace parts as necessary.	1	1
Inspect control box, associated controls, wiring and connections.	2	4
Clean or replace filters.	4	12
Inspect conditioned airflow system (ductwork) for leaks.	1	4
Inspect conditioned airflow system (ductwork) for mold or corrosion.	1	4
WHILE SYSTEM IS OPERATING		
Monitor system starting characteristics and capabilities.	2	4
Listen for abnormal noise.	2	4
Search for source of unusual odors.	2	4
Monitor air conditioning and heat pump systems for correct refrigerant charge.	1	2
Measure outdoor dry bulb temperature.	1	4
Measure indoor dry and wet bulb temperatures.	1	4
Measure high and low side system pressures.	1	2
Check vent system for proper operation.	1	1
Monitor system for correct line and load volts/amps.	1	2
Monitor system operation per manufacturer's specifications.	1	4
Provide system operation report and recommend repairs or replacement as necessary.	2	4

Greener Roots Farm case study

There were two reasons that the compressor failed at Greener Roots Farm, both of which are directly related to the system's ability to reject heat.

1. The outdoor condenser coil was extremely dirty. A dirty condenser coil reduces the airflow across the coil, subsequently reducing the amount of heat that the forced air can remove.
2. The indoor air handler had a loose belt. A loose belt reduces the airflow to the indoor growing space, causing the overall heat content of the return air to rise.

To further complicate things, the condenser at Greener Roots Farm had a two-row coil. This means that even if the perimeter coil (the visible coil) was clean, there is still a possibility that the interior coil was dirty. This is what happened with the Greener Roots Farm condenser (See Figures 3 and 4). The perimeter coil is clean, but the interior coil had not been cleaned for a long time.

Fig. 3

Greener Roots Farm was paying a local contractor to do PM on its HVAC system twice a year.

While the sample PM schedule above suggests PM should be done on an HVAC system in an indoor growing setting on a quarterly basis, the coil on the Greener Roots Farm condenser should not have gotten this dirty. Although the hired contractor may have cleaned the perimeter (visible) coil twice a year, it was obvious that that the interior coil had not been cleaned.

Some costs that result from poor PM on an HVAC system are easy to quantify, including the cost of a new compressor, the money wasted for a PM contractor and the downtime associated with fixing the problem. However, the increase in energy cost over time as a result of a slow degrading system is very hard to quantify. Luckily for Greener Roots Farm, a power monitor was placed on the system for three days (spanning four calendar days) before the compressor failed.

We continued to monitor the power for 27 days after the compressor was replaced, the coil was cleaned and the belt was replaced The power monitor took readings in 10 minute intervals. Below is a summary of the results.

	Before	**After**	**Delta**
Total power (kW) used	2,498	1,857	(641)
Total energy cost ($0.11)	$274.78	$204.27	($70.51)
Cost per day			($23.50)

Fig. 4

Greener Roots Farm power monitor data

Before presenting Greener Roots Farm power monitor information, there a few disclaimers about the data.

1. In a deliberate, controlled experiment, three days would not be an adequate time sample, especially to determine the increase in degradation over time. However, three days was the amount of time available.
2. Since the power was being monitored for the last three days before the compressor failed, it can be assumed that these were the most inefficient days and that every day before this three day period would have been incrementally more efficient.
3. Furthermore, the assumption was made that this indoor growing facility was operated the same for both time samples.
4. In order to make an accurate comparison, a four calendar-day sample of the post repair time period was chosen that had approximately the same outside air conditions.

Here is a summary of those conditions:

Temperature comparison (Fahrenheit)

BEFORE	LOW	MEAN	HIGH	AFTER	LOW	MEAN	HIGH
7/23/2015	73	79	85	8/9/2015	68	81	94
7/24/2015	70	81	91	8/10/2015	73	83	92
7/25/2015	68	80	92	8/11/2015	75	83	90
7/26/2015	70	81	92	8/12/2015	68	78	88
AVERAGE	70.25	80.25	90	AVERAGE	71	81.25	91

Looking at the outside air temperature comparison, temperatures during the time sample after repairs were made were slightly higher, but the power usage was still less.

Lessons learned

The Greener Roots Farm HVAC case study is not a complex, scientific experiment. However, it is a simple example of how poor preventive maintenance can cost growers money in the long run. This case study should also serve as a reminder to ensure that contractors are performing the work they were hired to do.

Many of the preventive maintenance activities for HVAC systems, including cleaning coils, can be done by most employees with materials available at local hardware stores. I recommend growers do some of these activities. This will allow them to become familiar with the results should a professional HVAC technician be hired to do the maintenance.

About Harvest Air

www.harvestairllc.com

Harvest Air was founded by Chris Whaley and John Zimmerman in July 2015. Both Chris and John are registered professional engineers with a combined 30+ years of experience designing, estimating and managing the installation of large-scale commercial heating, ventilating and air conditioning (HVAC) systems for a wide range of industries.

Controlled environment agriculture (CEA) requires a sophisticated farming process to ensure that crops receive the proper amount of water and nutrients in order to optimize yield. While it might appear that the farming techniques used in CEA are well designed and sophisticated, Chris and John discovered that many of the HVAC systems used in CEA are not adequate. By applying proven principles and knowledge gained from their experience, Harvest Air's HVAC solutions are extremely efficient and reliable, allowing farmers to focus on their crops and not the infrastructure that supports them.

John Zimmerman, PE

Co-Founder and President
john.zimmerman@harvestairllc.com

John Zimmerman obtained a bachelor's degree in mechanical engineering from the University of Texas-Austin and a master's degree in building construction management from Purdue University. He is a registered professional engineer in Texas.

Chris Whaley, PE

Co-Founder and CEO
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Chris Whaley obtained a bachelor's degree in mechanical engineering from the University of Oklahoma and is a registered professional engineer in Texas.

Both John and Chris have spent their careers designing, selling and managing the installation of mechanical systems for large-scale commercial buildings for some of the largest mechanical design-build companies in the United States.

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Intensive Berry Production

Using Greenhouses, Substrates and Hydroponics
Is this the way forward?
By NICKY MANN, 2014 Australian Nuffield Farming Scholar

First of all, this whole study topic couldn't have been undertaken without the wonderful and generous support of my investors Horticulture Innovation Australia and Nuffield Australia.

Therefore, I am eternally grateful and indebted. I would also really like to encourage other growers in the Protected Cropping Industry to seriously consider applying for a Nuffield Scholarship as it is a life-changing experience and adds so much value to agriculture here in Australia and across the globe.

Not only do you get to travel to some amazing countries which will force you completely out of your comfort zone but you get to meet truly extraordinary people, learn phenomenal things, see mind-blowing farms / research / businesses, but you get to share and collaborate with other likeminded people around the world which only adds benefit and substance to relationships which are crucial in this fast changing world we live in and will assist humanity to adapt and to progress.

Why did I undertake this study?

As hydroponic rose growers based on the Central Coast, we have managed to cushion ourselves from market pressures by opening our own retail outlets, being vertically integrated and have added agritourism to the mix in order to survive as a small grower in the protected cropping industry.

However, with the continued surge in imported roses from both South America and Africa landing on Australia's shores increasing the squeeze on prices.

Wade and I decided to diversify and spread our risk even further from just being rose growers.

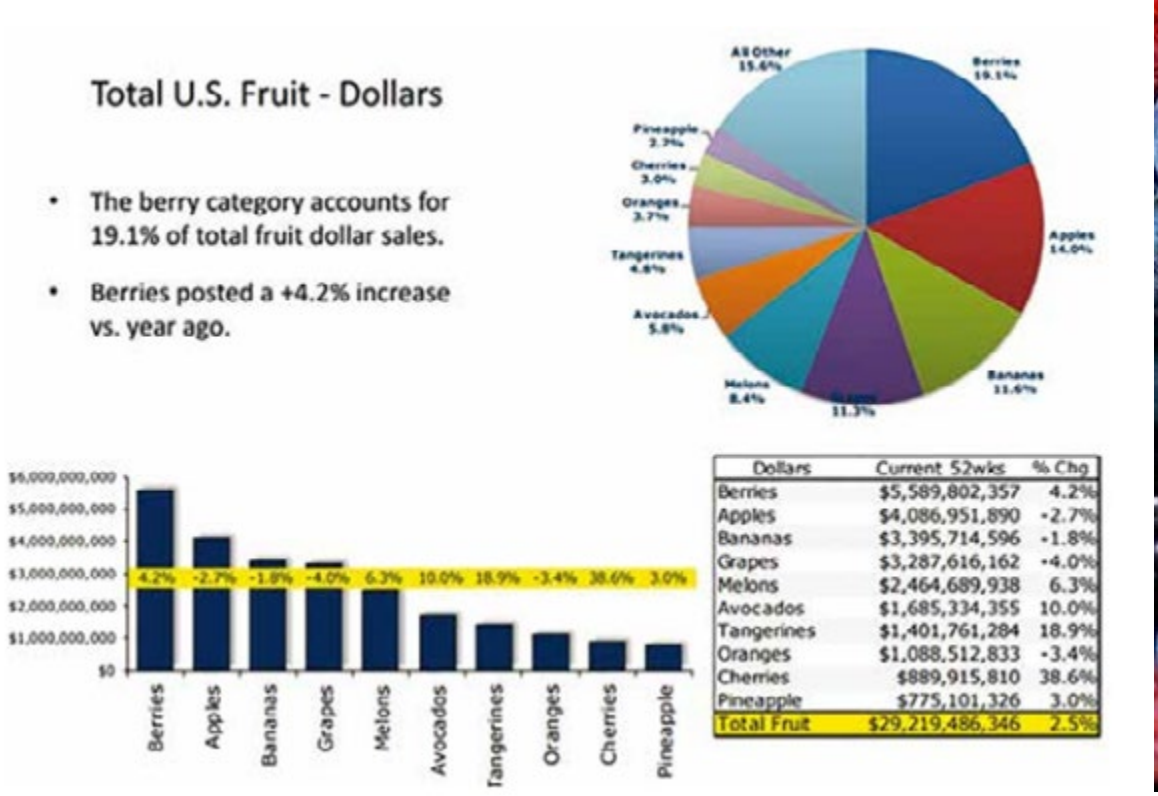
We needed to grow a high value crop in our multi-span twin-skin greenhouses and felt we had to consider growing "food/fruit" as opposed to decorative fun-fair as consumers are more concerned about what they eat and where it is grown than where their flowers are grown which will sit on a vase in their home and not be consumed.

Enter the Nuffield Scholarship – which I decided to use to learn / study all the ins-andouts of intensive production of berries using greenhouses, substrates and hydroponics.

I need to add here it was a case of learning by doing too as we received our first raspberry plants in November 2013 a mere two months after I received my scholarship. The blueberries arrived six months later.

What were my objectives of this study?

- Overview the berry industry in Australia and abroad, looking at;
- Protected Cropping Structures
- Containers and Substrates
- Hydroponic systems
- Compare the pros and cons of protected cropping vs traditional growing methods
- Analyse the major berry crops like strawberries, blueberries, raspberries and blackberries
- Formulate a recommendation to growers in the Australian industry considering intensive berry production in greenhouses with substrates and hydroponics



Dollars	Current 52wks	% Chg
Berries	$5,589,802,357	4.2%
Apples	$4,086,951,890	-2.7%
Bananas	$3,395,714,596	-1.8%
Grapes	$3,287,616,162	-4.0%
Melons	$2,464,689,938	6.3%
Avocados	$1,685,334,355	10.0%
Tangerines	$1,401,761,284	18.9%
Oranges	$1,088,512,833	-3.4%
Cherries	$889,915,810	38.6%
Pineapple	$775,101,326	3.0%
Total Fruit	$29,219,486,346	2.5%

Overview of the Berry Industry

The above graph gives a fairly accurate overview as to where berries stand on the global market becoming the number one fruit category by value in the USA and having 4.2% growth year on year.

Here in Australia Rubus (Raspberries, Blackberries, Boysenberries, etc) have grown in production and consumption from less than 500 tonnes in 2008 and will exceed 4500 tonnes in 2015 as shown in the graph below.

Blueberry production and consumption in Australia like the rest of the world has seen incredible growth with no signal of demand or production plateauing or slowing plus the saturation point is not looking like it is anywhere in sight in the near future – shown in Cort Brazelton's graph below.

Therefore, with the trends in berry consumption and demand continuing to rise – it feels right to consider all options available to growers to increase production to meet the continued demand.

Protected Cropping Structures

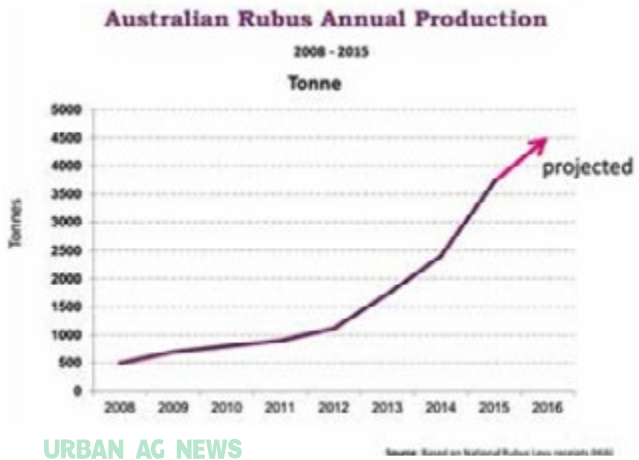
I was lucky enough to travel to 11 countries and managed to see all sorts of berry production from wild low-bush blueberry production in Nova Scotia, Canada to high tech glass venlo strawberry production in The Netherlands.

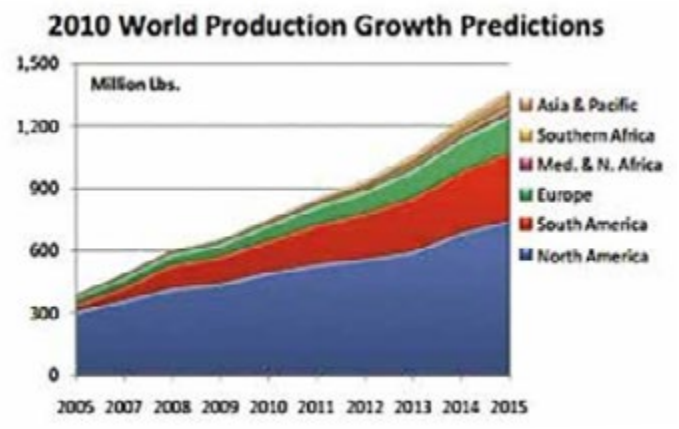
When it came to putting protection over berries the range was vast and included basic bird-netting, hail netting, low-tech "Spanish-style" tunnels, higher tech tunnels, multi-span greenhouses, venlo glasshouses as well as retractable plastic, glass and polycarbonate structures.

Obviously the more protection and sophistication reflected in better climate control but so too price.

The growers and projects I visited all had very good reasons why they had selected the particular structure they were growing the berries in and were in most cases getting the best results for the money invested.

Yes there are pro's and con's for every structure but in most cases the decisions were purely economic.





Substrates

Being a fan of coco-peat from years of growing roses in this media, it was encouraging to see how widely this media was being adopted by hydroponic berry growers with much success and I would hasten to say this was by far the most popular.

However, again I saw growers using sawdust, sand, bark, potting mixes and then combinations of the aforementioned – some with great success.

However, my concern would be in a couple of years when the sawdust and bark particularly breaks down and how this will impact the plant health and fertigation feeds.

It was exciting to see growers starting to experiment with blends like coco-peat, peat moss and mycorrhizae for blueberries and coco-peat with Trichoderma for raspberries.

It is important to have a low pH for blueberries and to have good aeration for raspberries as these plants are prone to root diseases.

My preference for berry crops is coco-peat as it is organic in nature and therefore biodegradable, has high water retention capacity, high air porosity and is a renewable source of growing media.

I was lucky to be shown extensively around Legro in The Netherlands and learnt so much about coco-peat, peat moss, buffering and blends.

After growing in coir for nearly 12 years it was refreshing to be put straight on some of the myths I have been lead to believe with regard to coir.

The following table demonstrates clearly the advantage of using substrate as a growing media for blueberries and leaves little doubt in one's mind to difference in production between the two methods of cultivation.

Basically, after 5 years 8.25 Tonnes vs 37.5 Tonnes which equates to 450% increase in yield by using substrates.

Comparative Results with "Aurora" (Northern Highbush

Blueberry Variety) by Peter van Dijk, Blueberry Consultant – The Netherlands, March 2015

Containers

I discovered as most people know farmers and growers are extremely innovative and resourceful especially when it comes to hydroponic production and using different types, shapes and forms of containers to grow in.

Grow bags/pillows of coir are extremely popular and regularly used especially by hydroponic strawberry growers on table tops.

YEAR	Conventional Yield (kg/ha)	Substrate Yield (kg/ha)
1	1,650	7,500
2	2,200	15,000
3	4,950	22,500
4	6,600	30,000
5	8,250	37,500

** Bumblebees are not available on mainland Australia unfortunately & not allowed to be commercially reared in Tasmania.*

The real downside to bags is getting rid of all the plastic after it's use – this is a tedious process and expensive to do.

I saw the best results for strawberries in long-shallow white troughs really heaped high with coco-peat so that the strawberries could be planted at a slight angle to present the fruit for easy picking.

Square 10l pots with excellent aeration for raspberries and large 40l poly-weave grow bags (Garden City Plastics) for blueberries seemed to me like the best options.

I think the new range of pots from PlantLogic have some exciting potential for the hydroponic berry production and should be investigated by growers considering this type of production.

Protected Cropping Berry Pro's

1. Increase plant density
2. Improved and effective use of IPM in a confined environment
3. Increased first class saleable fruit
4. Protection against birds and pests which means less damaged or spoilt fruit
5. Protection against rain, hail, wind means less disease and less sprays
6. More efficient and effective use of labour as labour can work in all weather conditions
7. Higher yields and sooner
8. Less RISK of crop loss due to disease, rain, birds, wind, pests
9. Faster growth and faster production of fruit – multiple fruiting cycles per season/year
10. Change varieties more regularly – keep up-to-date with latest genetics
11. More control of the plants can change feeds quickly to be generative or vegetative or stress plants to induce flowering. Substrate is very even compared to soil in large areas
12. Close irrigation systems – recycle water/nutrients

Protected Cropping Berry Con's

1. High cost – and the better the structure the more investment involved
2. Air movement – heat in tunnels can be too hot not good for plants, labour or pollination
3. Wind and hail damage to the plastic covers or glass can be disastrous
4. Plants have to be replaced more regularly
5. Machinery harvesting is limited as machines cannot fit inside structures easily
6. Substrate is less forgiving than soil as a media for growing anything in therefore irrigation and fertigation must be precise
7. Plastic film can be inhibiting for the best performance of pollinators
8. Dust and spray residue can accumulate on the leaves of plants in tunnels which slows down rate of photosynthesis which affects plants performance
9. Need relatively level land to build greenhouses and tunnels substrates

Greenhouse strawberries

High tech production of strawberries seen in The Netherlands, Belgium and Ireland using the latest glass venlo glasshouse structures was extremely impressive and matched some of the finest high tech tomato, capsicum and cucumber projects I have seen around the world.

I think it is only a matter of time before the majority of strawberry production comes into high tech protection as it produces consistent quality and supply which the supermarket and consumers LOVE.

Strawberry Wish List

- High – tech glasshouse
- Using bumblebees * in conjunction with honey bees for ultimate pollination
- Costs = A$450 per m^2
- 15 year return on investment
- 15kg per m^2
- Closed irrigation system
- Vents
- Shade-screens
- Energy screens
- Pipe and rail system
- Hydronic heating and buffer tanks
- CO_2 injection
- Hanging gutters/suspended single table tops
- Troughs filled and mounded with coco-peat
- 2 support wires
- Foggers and misters

Greenhouse Blueberries

Although most greenhouse blueberry production currently being done around the globe is in low tech "Spanish-style" tunnels like the ones sold by Haygrove.

This type of protection is effective but does have it's drawbacks like trapping heat and slowing airmovement, but it is economically viable.

However, there is a slight trend to use a more sophisticated multi-span greenhouse with more climate control features.

It is still early stages and the profitability of this slightly more expensive infrastructure has not been established yet.

Blueberry Wish List

- Retractable roof and side vents for climate control i.e. exhaust heat and humidity and to assist the pollinators
- 40 ltr poly weave bags
- Coco-peat, Irish peat moss, perlite and Mycorrhizae
- A$100 per m^2
- Yields:- 1kg per plant 1st year 3kg per plant 2nd year, 5kg per plant 3nd year 10kg per plant thereafter
- Bending, pinching and pruning system
- Closed irrigation system
- Shade-screens
- Bumble bees* and honey bees for pollination
- T-system support wires – 30cm interval
- Foggers and misters

Greenhouse Raspberries (Rubus)

High tech production of raspberries seen in The Netherlands, Belgium and Ireland using the latest glass venlo glasshouse structures was extremely impressive and advanced.

I would love to see this type of production undertaken in Australia but remain doubtful it will happen anytime soon as there is fairly good production and quality of raspberries coming out of tunnel production currently and uncertain whether growers will undertake the huge investment required for what is a relatively small market in Australia. However, my wish list would be:-

Raspberry Wish List

- Coco-peat blend with Trichoderma
- 10 ltr pots with good aeration at base like a Plant Logic 10l raspberry pot; black square pots for cold climates and white pots for warm climates.
- Costs - A$100 per m^2
- Double cropping of primo-canes in 1st year
- Yields of 2kg per plant
- 20 tonnes first class fruit
- 3 stem system in linear trellising
- Multi-span plastic structure
- Closed irrigation system
- Retractable roof and side vents for ultimate pollination by bees and to exhaust heat and humidity
- Shade-screens
- Bumble bees* and honey bees for pollination
- Potential to adopt high-wire greenhouse cucumber
- and capsicum growing system

Nuffield Key Findings

- Timing – everyone using protected cropping and hydroponics was totally focused on particular timings of their crops either early, late or without interruption; or very particular supply gaps
- Minimising risk – ensuring all fruit was reaped and no losses were incurred from disease, pests, climate or labour not being able to work
- Consistency of supply and quality
- Efficient and effective use of labour
- Water and nutrient saving
- Farming land is limited and this method means berries can be grown anywhere due to the use of substrate and protective structures i.e. roof tops

Unexpected Findings

• Methyl bromide is still used in USA as a soil fumigant for soil grown strawberries, blackberries and raspberries – this is being phased out and growers will have to find alternative methods to sterilize their soil OR move to substrates

• Spotted Wing Drosophila (SWD) – this is the plague of USA, South America and Europe – this pest is literally wiping out entire crops of berries. Protection helps especially the more sophisticated the crop protection.

• Control of genetics by a few powerful breeders and marketing companies

• Honey bees as pollinators were used in conjunction with bumble bees in high tech greenhouses – growers found that when they were effective there was nothing better than honey bees. Plus they were cheaper as there are more bees in a honey-bee hive and they are gentle and highly effective CROSS pollinators. Honey bees don't like to work when temperatures fall below 15°C and when humidity climbs above 71%, which creates a distinct window.

• How well raspberries travel from South Africa to United Kingdom – yes, if Australian Rubus growers think they are safe from imported soft fruit like raspberries being imported into Australia – think again. South Africa air freights raspberries to Europe with much success and without loss of quality or shelf-life. So if market access changes Australian producers can be under pressure. This could also be an opportunity for our growers to export our fruit to foreign markets.

Controlled Atmosphere (CA) Storage – bulk refrigerated containers of controlled atmosphere storage of blueberries is already being done from South America to Europe – again this is a threat to Australian growers but so too a huge opportunity for our blueberry growers to export our "clean-green" Australian produce abroad.

Recommendations

• Protected cropping minimises the risk from crop loss due to birds, pests, disease, rain, wind, hail, and not being able to work on the berry crop

• Diverse berry crops for the health of the pollinators

• Invest in knowledge - learn, share and collaborate as one united Australian berry industry

• Market access can change overnight and Australia must be prepared for this and should be establishing alternate or export markets now

Finally, a big thank-you to the numerous growers/farmers, researchers and fellow Nuffield scholars for your time, help and inspiration for this study – I am truly indebted to you all and hope the berry and protected cropping industries will find benefit from my study topic.

Lastly to my family and employees at Roses 2 Go Pty Ltd thank-you for your continued support throughout this journey.

If you would like to read the in depth findings and details of my study – my Nuffield report is pending publishing and will be available to read from the Australian Nuffield website.

For more: Nicky Mann, nickymann125@gmail.com

Tomatoes grown with light-emitting diodes or high-pressure sodium supplemental lights have similar fruit-quality attributes

Michael P. Dzakovich, Celina Gómez and Cary A. Mitchell

Greenhouse growers have been gradually adopting light emitting diodes (LEDs) as an alternative to high pressure sodium (HPS) fixtures. Long lifespans and high energy conversion ratios are among the main reasons why growers are attracted to LEDs, but many are left wondering how LEDs might affect the taste of their produce.

A recent study from Purdue University published in the October 2015 issue of HortScience examined how LEDs affected the flavor and composition of tomato fruits grown in a production setup. In three separate 4-5 month studies, the researchers compared greenhouse tomatoes supplemented with LEDs to those supplemented with HPS lamps as well as unsupplemented controls. Tomatoes were measured for color, sugar, and acidity while a consumer sensory panelists rated the fruits for attributes like color, aroma, texture, sweetness, acidity, aftertaste, and overall approval. Each study revealed that supplemental lighting had minor effects on fruit composition. However, sensory panelists indicated that tomatoes from all treatments tasted equally as good.

The findings from this study indicate that LEDs, used at the same wavelengths and intensities, will not negatively impact the quality of greenhouse tomatoes. With the potential energy savings associated with LEDs, greenhouse tomato growers using similar lighting systems can produce the same wholesome tomatoes that consumers want.

Taken by Rob Eddy

The complete work is available from ASHS for a fee.
Click here.

The curtains between rows were opened in order to show the entire experimental setup. Normally, curtains separate the rows to avoid "light pollution."

THANK YOU

Urban Ag News loves to partner with the universities that are leading the way in research. Often we ask you to help us do that through surveys. Along with the Ohio State University, we would like to thank you for participating in a survey on bioproducts used in the greenhouse production of ornamental and vegetable plants. This survey will provide valuable feedback to set research priorities and assist in the development of educational materials on bioproducts for the industry.

Beth Scheckelhoff, OSU Extension Educator for Greenhouse Systems
419-592-0806 | scheckelhoff.11@osu.edu

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The 15th annual Greenhouse Crop Production & Engineering Design Short Course will be held from March 20–25, 2016 at the beautiful Westward Look Resort in Tucson, Ariz. New to the 2016 course are specific half-day sessions on "Indoor Growing" and "Lighting for Growing Crops in CEA." In addition to the new sessions, the short course will feature a comprehensive program that will help you successfully grow crops within controlled environments and ensure those crops thrive and are marketable.

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