CREATING A HYDROPONIC HERB GARDEN
Growing fresh hydroponic herbs is easy

OPTIMISING PHOTOSYNTHESIS
Benefits from improving the process

WINDERMERE BERRY FARM
One of NZ’s oldest berry fruit gardens

FINDING SEASONAL WORKERS
New government support program

CARIBBEAN FRESH: hydroponics in Anguilla
Powerplants are the exclusive Australian dealer for Priva. Call us today to discuss your climate control needs. Ph: +61 3 87957750

Control Your Climate  Grow Your Profits
www.powerplants.com.au
Welcome to this issue of Practical Hydroponics & Greenhouses. As usual, we have a great line-up of stories awaiting your reading pleasure.

How many of us have dreamed of escaping to an island paradise not only for a holiday but also perhaps to live a carefree, permanent existence? Tucked away in the Eastern Caribbean, Anguilla is the epitome of such a dream – beckoning visitors with spectacular beaches, breathtaking blue seas and a casual elegance. However, despite its idyllic lifestyle, Anguilla is relatively arid, with islanders relying on imported fresh fruit and vegetables.

One luxury resort, however, has solved this problem. Nestled in the heart of this paradise is CuisinArt Golf Resort & Spa, which boasts the claim of being the only Caribbean resort housing its own pesticide-free, hydroponic farm. In this issue we visit this innovative hydroponic operation set up and maintained by respected industry expert, Dr Howard Resh PhD.

Continuing on the same theme of self-sufficiency and sustainability, in Fair Play, Missouri USA, the Institute of Simplified Hydroponics has designed and built a hydroponic culinary herb garden. CEO of the Institute, Peggy Bradley describes the progress of the initiative and shares with readers tips on how to grow their own fresh hydroponic herbs to add zest, flavour and nutrition to any diet.

Elsewhere, Dr Mike Nichols profiles one of New Zealand’s oldest berry fruit gardens, which has recently implemented new technology improvements, including conversion from soil-based growing to hydroponic systems.

On a practical note, our article, Optimising photosynthesis examines the importance of photosynthesis and the possibilities its optimisation brings for food security, renewable energy and the reduction of CO2, while Helping find seasonal workers looks at how the Australian Government has announced a new program offering support for Australian horticultural growers seeking seasonal workers.

Do you have a story for us? We welcome stories for publication with a focus on hydroponics, greenhouse, IPM, crop management and horticulture lighting technology. Let’s hear your ideas.

Enjoy this issue!

Christine Brown-Paul
Full installation & maintenance service with our own experienced staff and machinery
Full Range of Greenhouse, Shadehouse and Netting Components
Specialist in Climate Control
Automated Thermo-Reflective Screens
Exhaust, Circulation & Twin Skin Fans
Auto vent and roll up wall motors and systems
ISSUE 182 :: AUGUST 2017 :: THE COMMERCIAL GROWERS’ MAGAZINE

Features

Caribbean fresh ...................... 28
How an Anguilla luxury resort is growing its own fresh hydroponic produce.

Creating a hydroponic culinary herb garden .................. 36
In the US, the institute of Simplified Hydroponics has designed and built a hydroponic culinary herb garden.

Windermere Berry Garden ........... 48
Dr Mike Nichols profiles one of New Zealand’s oldest berry fruit gardens.

Helping find seasonal workers .......... 54
New government support for Australian horticultural growers seeking seasonal workers.

Practical

Optimising photosynthesis ............. 56
Benefits for food security, renewable energy and the reduction of CO₂.

Protecting strawberry production biologically ............ 62
Lachlan Chilman from Biological Services explains the benefits of IPM for the greenhouse strawberry industry.

The final word .................. 66
Alternative solutions to using pesticides in the greenhouse.

Departments

From the Editor .................. 3
News & Products .................. 6
Reader Inquiries ................ 26

Cover: Hydroponics allows fresh produce to grow in a tropical island paradise.
THE WORLD’S MOST FAMOUS VERTICAL FARM

The ‘Growing Underground’ vertical farm has been featured on CNN, BBC, National Geographic, Al Jazeera and countless other worldwide media platforms. Located 33 m underneath central London in an abandoned WW2 shelter, it supplies local restaurants and retailers with 15 varieties of microgreens daily. Produce goes from seed to harvest in a matter of days and packs a flavour punch that even sunlight grown herbs do not.

The secret is a finely tuned light spectrum, optimised for vegetative development of the plant and accumulation of phenolics, which are responsible for flavor and nutrients buildup. The spectrum in question is AP673L by Valoya, the Finnish manufacturer of high-end LED grow lights.

Herbs are grown 100 per cent under artificial illumination. The entire farm is equipped with Valoya’s LED grow lights due to the high quality spectrum but also because of low energy consumption and...
negligible heat emission. In total, 1620 pieces of Valoya’s L-Series illuminate the growth area.

Valoya’s AP673L spectrum stimulates leaf development while delaying flowering. This makes it ideal for leafy green vegetables, herbs, microgreens and other plants harvested before flowering. The spectrum is a wide [also known as full or continuous] spectrum, which contains bits of all spectrum colors including outside the PAR area, just like the sun.

Unlike the sun, parts of the spectrum, which do not contribute to efficient plant development, have been reduced thus creating a light, which feeds the plant only with the information it needs resulting in optimal development.

Valoya is a provider of high end, energy efficient LED grow lights for use in crop science, vertical farming and medicinal plants cultivation. Valoya LED grow lights have been developed using Valoya’s proprietary LED technology and extensive plant photobiology research. Valoya’s customer base includes numerous vertical farms, greenhouses and research institutions all over the world [including eight out of ten of the world’s largest agricultural companies].

Vertical farms are one of Valoya’s three main market segments. For a quote for your project, contact: sales@valoya.com. More information at: www.valoya.com

INFORMATION ON SIDE EFFECTS OF PESTICIDES

As a leader in IPM, Biobest is well placed to understand that it is essential to take the effects of pesticides on beneficial organisms into full consideration. Growers can now consult the rich Biobest database even more easily through an updated webpage and smartphone app. The list is available in seven languages and can be easily consulted at: www.biobestgroup.com/en/side-effect-manual. You can download the new Biobest Side Effect Manual app for free in the AppStore and Google Play. Besides increasing the user friendliness, the new tool also offers another important innovation: the opportunity to enter into dialogue.

“The Side Effect Manual is an indispensable tool in Integrated Pest Management (IPM). We have a lot of available information that growers and advisors should be able to consult easily,” said Paco Lozano, Manager of Biobest Knowledge and Training Center.

“Communication technology is constantly evolving, so we are proud to provide this renewed and improved version. If the user clicks on a chemical, they immediately see that the font of the applicable beneficials is darker in colour, which means the effect on those beneficials is known. If not, the name of the beneficials is shown in a lighter font.

“Users will immediately recognise many useful features from the previous version as the layout is comparable and recognisable to the user. This also applies to the classification, ranking from harmless [1] to harmful [4] and to persistence, the time that the chemical continues to affect the beneficials. The search results are still available as a pdf from the website. Furthermore, the user can now choose to make an unlimited number of combinations, which is different than before,” he said.

“Our new tool also offers them a unique new possibility. We open the dialogue between growers and Biobest. For example, growers can share their experiences on certain combinations of pesticides and beneficials. This may allow us to further refine the available
information. Growers can also express their interest in a combination that has not yet been investigated. Through the icon (i), they simply send a message to Biobest. This feedback will help us to adapt our research to the field’s requirements. Sending a message can also be done via the “Help us” button”, said Mr Lozano.

Users of the old version of the Biobest Side Effect Manual on either smartphone or tablet should remove the old app and download the new from the AppStore or Google Play.

The new Side Effect Manual app automatically synchronises with Biobest’s database.


DR JO LUCK APPOINTED DIRECTOR OF NEW PLANT BIOSECURITY PUSH

A renowned Australian scientist with more than 25 years’ experience in plant disease, biosecurity and microbiology has been appointed the director of the national Plant Biosecurity Research Initiative (PBRI).

Dr Jo Luck will lead the development and delivery of plant biosecurity research for PBRI – a new partnership between seven plant Research and Development Corporations (RDCs).

Hort Innovation chief executive John Lloyd said Dr Luck is the ideal candidate for the PBRI director role. “Dr Luck has a strong track record of delivering results throughout her 30-odd year career in plant sciences,” he said.

“With exceptional leadership skills, valuable operational experience and abundant energy, Dr Luck is ideally positioned to work with all seven of the nation’s research and development corporations to propel Australia’s biosecurity offering to new heights.”

Dr Luck will be charged with helping unite biosecurity research efforts across the plant RDCs, stamping out any repetition in funding and making recommendations for new investment in consultation with producers and other stakeholders.

She will also work with key biosecurity stakeholders to identify research area priorities, engage funding partners and keep government and other stakeholders informed of activities.

Dr Luck is the former research director at Plant Biosecurity Cooperative Research Centre. Before that, she was the principal research scientist of microbiology at the Victorian Department of Primary Industries, and performed roles at NSW Agriculture, NSW Fisheries and La Trobe University.

Greg Fraser, PBRI chair and Plant Health Australia chief executive said Dr Luck has a detailed understanding of funding and research in biosecurity, and “is well known and well regarded by many of the key stakeholders that will be involved in the new research partnership”.

PBRI – comprising the wine, wood, cotton, grain, rural industry, sugar and horticulture research and development corporations – currently invests $55 million per year in research to manage pests and diseases that affect Australian plant crops.
FACELIFT FOR UGLY VEGETABLES

As part of an industry-led drive to reduce waste, Horticulture Innovation Australia and the CSIRO are working with growers to turn imperfect-looking vegetables into nutrient-rich snacks and supplements.

Hort Innovation chief executive John Lloyd said the project is investigating how good nutrients, or phytonutrients, can be drawn from carrots, broccoli, turnips and other vegetables.

“Limiting the amount of produce left in the field and offcuts cast aside during processing is a priority for the industry because there’s so much potential there. On top of this, Australians are not eating enough vegetables,” he said.

“This project is addressing both these issues by determining a way we can turn underutilised produce – such as ugly veggies that are not to specification – into high-value, super-high-nutrient ingredients and products.”

As part of the project, researchers are investigating the use of separation, extraction and stabilisation technologies to create products that can be sold as powders, concentrates or vegetable-dense snacks for children.

CSIRO chief research scientist Dr Mary Ann Augustin said research shows farms can lose up to 40 per cent of produce and growers are keen to see this stop. For that reason, and because it has great health benefits, fermentation of vegetables is also a significant area of focus of the project.

“Fermentation is a great natural way of delivering the good bacteria through food. We are investigating ways vegetables lost in the food supply can be processed and presented in a consumer-friendly manner because it has huge health benefits,” she said.

Dr Augustin also said feedback from growers is that processing plants need to be more accessible as many producers cannot justify the expense of freighting unused produce long distances.

“We are also looking into the interest in setting up processing hubs in key growing regions to make it easier for growers to process their underutilised produce and create these high-value, nutrient-dense tasty products.”

The desired outcome is also to encourage new industries and employment based on new edible food ingredients and products from the underutilised vegetables that will provide more returns to farmers.

John Said, the chief executive of one of the largest lettuce and brassica farmers in Australia, Fresh Select, said any project that arms industry with the tools it needs to minimise produce loss is positive.

“We are very excited by the potential of this research project and are proactively supporting this initiative to reduce food waste. It will not only benefit growers and the industry, it will also benefit the Australian population by providing high-nutrient products and improving the nation’s health.”

The project is due for completion late 2018.

This project has been funded by
According to Pat Hannan, CEO of Growcom – the peak representative body for Queensland horticulture – it would seems every week there is a new article highlighting the potential of the Queensland agricultural sector to be a powerhouse of our economy over coming decades.

“The horticulture industry is primed and ready to embrace these opportunities both locally and abroad as our sector continues to grow. This is why the Queensland Government should be commended for the State Budget’s $5.2 million commitment to supporting rural economic development through growing food exports over the next three years. Growcom looks forward to working constructively with government to develop the proposed Rural Economies Centre of Excellence and continuation of the One Stop Service that will benefit our diverse industry,” Mr Hannan said.

“However, there remain some major barriers to success. We need leadership from the Queensland Government to ensure horticulture can deliver upon its potential.

“Plant biosecurity requires a substantial and immediate increase in investment. While industry appreciates continued funding for the management and irradiation of the panama tropical race 4 disease affecting the state’s banana industry, we need new investment for all of horticulture to prevent incursions and establishment of plant pests before they become an issue,” he said.

“For example, the Tomato Potato Psyllid virus that has been found in Western Australia has potentially devastating consequences for the potato industry including affecting our capacity to export a wide range of horticulture products. We must do everything we can to prevent this pest from establishing in Queensland.

“The sector-wide issue of power prices also needs to be addressed. Our growers are reliant on cool rooms to ensure that consumers receive safe fresh produce. Spiralling power prices are making it increasingly difficult for growers who are seeing their margins squeezed. A robust cool chain is fundamental to our export success and there is no point developing...
markets for high quality produce if maintaining the cool chain is cost prohibitive,” Mr Hannan said.

“Growcom is eager to help the state government to develop a comprehensive strategy for Queensland agriculture to overcome these barriers and ensure that our industry meets its potential.”

AU IMPORT RESTRICTIONS ON CERTAIN GOODS TO CHANGE

Importers in Australia have been advised of the Biosecurity (Prohibited and Conditionally Non-Prohibited Goods) Determination 2016 (Goods Determination), which is currently under amendment. As a result, from 30 June 2017 certain commodities will have different import conditions. Once implemented, imported goods into Australia must comply with the new legislation and read this notice.

From 30 June 2017 fresh strawberries from the United States of America will require an import permit prior to the goods being imported into Australia.

Commodities that will not require an import permit include: Fresh grapes for human consumption from China; fresh mango for human consumption from Vietnam and all regions of India; fresh apricots and interspecific stone fruit hybrids for human consumption from the United States of America; fresh Agrocybe cylindracea mushrooms for human consumption from all Countries; dried Trametes versicolor mushrooms for human consumption from all countries; frozen Cantharellus cibarius and Craterellus cornucopioides mushrooms for human consumption from all countries.

All goods entering Australia must continue to meet the import conditions published in BICON.

For more information visit: agriculture.gov.au via www.freshplaza.com
### MAPPING OUT AUSTRALIA’S FOOD FUTURE

New technologies could see us eating algae-based sources of protein, developing allergenic-free nuts and tolerable varieties of lactose and gluten, and reducing environmental impact through edible packaging.

Speaking at the launch during the Australian Institute of Food Science and Technology’s (AIFST) 50th Anniversary Convention in Sydney, Assistant Minister for Industry, Innovation and Science, Craig Laundy, highlighted the importance of innovation and entrepreneurship in driving new economic growth in the industry.

Keeping a greater share of food processing onshore and better differentiating Australian food products are major themes across the Roadmap, which calls on businesses to act quickly or risk losing future revenue streams to the competitive global market.

Developed with widespread industry consultation and analysis, the Roadmap seeks to assist Australian food and agribusinesses with the desire to pursue growth and new markets.

Deputy Director of CSIRO Agriculture and Food, Dr Martin Cole said Australia was well positioned to act as a delicatessen of high-quality products that meet the needs of millions of informed and discerning customers both here and abroad.

“Australian businesses are among the most innovative in the world, and together with our world-class scientists, can deliver growth in the food and agribusiness sector amid unprecedented global change,” Dr Cole said.

“Less predictable growing conditions, increasingly global value chains and customers who demand healthier, more convenient and traceable foods are driving businesses to new ways of operating. Advances are already being made through the use of blockchain technology and the development of labels that change colour with temperature or time, or are programmed to release preservatives.

“This Roadmap will set us on the path to sustainable growth in the sector.”

The Roadmap was developed in collaboration with the government-funded food and agribusiness growth centre: Food Innovation Australia Limited (FIAL).

Recently, FIAL launched their Sector Competitiveness Plan, which outlines the over-arching industry vision to grow the share of Australian food in the global marketplace and the necessary strategy to achieve the vision.

“With the growing Asian middle class, Australia is in the box seat to take advantage of the many emerging export opportunities,” FIAL Chairman Peter Schutz said. “Consumers are looking for differentiated products that cater to their needs. This is especially exciting for Australian food and agribusinesses which have the capability to respond with customised and niche products.”

Australia exports over $40 billion worth of food and beverages each year with 63 per cent headed for Asia.

Dr Cole explained that Australia is a trusted supplier of sustainable, authentic, healthy, high quality and consistent products.

“We must focus on these strengths and enhance the level of value-adding to our products,” Dr Cole said.

“Recent Austrade analysis shows early signs of such a shift, as for the first time in Australia’s history value-added foods have accounted for the majority (60 per cent) of food export growth.”

The Roadmap outlines value-adding opportunities for Australian products in key growth areas, including health and wellbeing, premium convenience foods and sustainability-driven products that reduce waste or use fewer resources.

Five key enablers for these opportunities are explored in the Roadmap: traceability and provenance, food safety and...
Monitor, datalog and control.

Measure your growing conditions with our pH, conductivity and temperature meters, monitors, controllers, wireless data and automated dosing systems. We have a range of tools to help you gain the best growing environment for your plants.

What are your pH and conductivity values? Visit us online to find out more about our measuring instruments.
biosecurity, market intelligence and access, collaboration and knowledge sharing, and skills.

These enablers align with FIAL’s knowledge priority areas that are central in helping the food and agribusiness industry achieve its vision and deliver increased productivity, sustainable economic growth, job creation, and investment attraction for the sector.

The Roadmap calls for improved collaboration and knowledge sharing to generate scale, efficiency and agility across rapidly changing value chains and markets.

“To survive and grow, the challenge facing Australia’s 177,000 businesses in the food and agribusiness sector is to identify new products, services and business models that arise from the emerging needs of tomorrow’s global customers,” Dr Cole said.

Full report: Food and Agribusiness Roadmap: unlocking value-adding growth opportunities for Australia.

**CROPLOCUS PLANS AUD $8M IPO IN ASX LISTING**

CropLogic, the agricultural technology company, has launched its prospectus and is planning an A$8 million capital raising before listing on the ASX.

The Christchurch-based company is offering 40 million shares at 20 Australian cents each with a minimum subscription of 25 million shares, or A$5 million. The capital will be used to fund market development, research & development, ASX listing costs and working capital, it said. In May, it completed an A$2 million pre-initial public offering funding round.

CropLogic’s software models plant growth by gathering field data and making crop prescriptions and management recommendations. The company was incorporated in 2010 when it licensed the intellectual property for its software from the New Zealand Institute for Plant and Food Research, which had done 25 years of plant model research.

“The launch process brings about many opportunities for CropLogic to continue its development and expansion throughout the US, Australia, New Zealand, and into China,” chief executive Jamie Cairns said.

“Our strategy provides us with the opportunity to firstly use our technology to transform and optimise the business model of the acquired companies before then introducing additional services to their clients. It is a two-phase approach that we believe reduces the cost and risk of market entry.”

The company recently began its roadshow presentation showcase in Auckland and Wellington to be followed by further presentations in Melbourne and Sydney.

NEW CORTEX LIGHT CONTROL SOFTWARE FROM HELIOSPECTRA AB

Heliospectra AB, a world leader in intelligent lighting technology for greenhouse and controlled plant growth environments, introduces CORTEX – one of the market’s leading light control software.

“The new Heliospectra solution enables growers to significantly increase consistency and control of crop quality, harvest cycles and yields,” said a Heliospectra AB spokesperson.

“Integrating with Heliospectra’s intelligent LED lights and an array of plant sensors, the new platform ensures that greenhouse and indoor crops receive perfect light 365 days a year. CORTEX offers advanced controls and dynamic adjustments of supplemental light intensities, quality and schedules with real-time response to changes in local weather and other light-limiting factors.

The new solution was recently showcased at Cultivate 2017 in Columbus, Ohio with live demonstrations of how growers could standardise production and boost year-round yields using automated light schedules, sensor feedback and centralised controls.

“We understand that close collaboration with our customers is vital and that every grower wants to improve business performance,” said Ali Ahmadian, CEO of Heliospectra AB.

“The guiding principle in developing CORTEX is providing a customisable control system and metrics that improve profitability and operations for growers.”

“After years of working with our customers in the field, it’s clear that existing platforms do not provide growers with the controls required. The addition of CORTEX to Heliospectra’s product portfolio introduces an intuitive and unrivaled light control system that enables businesses to standardise production, reliably forecast yields and achieve negotiation advantages in the marketplace,” Mr Ahmadian said.

“CORTEX also brings a higher level of integration and light management capabilities to existing control software systems, enabling our customers to make the most of their other investments in greenhouse technologies.”

Heliospectra’s CORTEX introduces new features to the company’s current software and product portfolio to elevate the level of automation and control capabilities for growers. Centralised control components include:

Automated light response gives growers the ability to replicate preset light strategies across the plant growth cycle and ensures consistent light quality year-round.

Energy and power consumption monitoring increases visibility so growers can adapt and optimize light use and schedules based on peak hours, rising energy costs and potential dollar savings.

Repository of data logs, historical lighting strategies and instance isolations equips growers to make data-driven decisions for predictable, reliable and repeatable business forecasting and harvest results.

Multiple light zones and groupings standardise schedules and settings to allow growers to use their time and staff hours more efficiently.

Real-time management and remote notifications from any device – anytime, anywhere – enable growers to monitor hardware status across their facilities and quickly control light settings, intensities and spectrum strategies.

“Heliospectra remains focused on the company’s active biofeedback program patents as the CORTEX platform accelerates intelligent lighting software, dynamic response and automated controls that enable growers and business operations to achieve consistent crop quality with reliable future sustainable success,” Mr Ahmadian said.

More information at: www.heliospectra.com or call +46 31 40 67 10 (+1 888 942 GROW for Americas).
FIRING UP THE GREAT OUTDOORS

Most growers are proud of their own gardens and enjoy using the latest features to create attractive spaces. Backyard fire pits are becoming increasingly popular as we look to utilise the outdoor space in winter with functional landscaping features. Essentially, a fire pit is the new water feature; it’s a great addition to the backyard, transforming the outdoor area into a cozy and inviting space – perfect for those winter evenings.

“The ambience a fire pit brings is worth the investment alone, providing an enjoyable feature for the garden and a natural gathering spot for socialising and entertaining. It’s a great focal point, I like to describe it as nature’s TV and people are naturally drawn to the campfire-like atmosphere,” said Jason Hodges, Australia’s well-loved celebrity landscaper, most notably seen on the Channel Seven lifestyle TV show Better Homes and Gardens.

Jason is also a brand ambassador for Australia’s leading masonry manufacturer Adbri Masonry, Australia’s leading masonry manufacturer supplying quality concrete bricks, blocks, pavers, retaining walls, erosion control products, architectural masonry solutions and reconstituted stone veneers throughout Australia’s East Coast, South Australia and Tasmania.

Jason and his Greenart Gardens team won The Royal Horticultural Society’s prestigious Comeadow Award at the Melbourne International Flower and Garden Show (MIFGS 2013), with their entry of an inviting entertainment space, complete with an alfresco kitchen, dining area, and an edible landscape of vegetables and herbs.

Watch the video below to see how Jason Hodges offers a simple step-by-step DIY guide to building your very own fire pit.

To talk to an Adbri Masonry representative, call 1300 365 565 or for more information on backyard DIY projects, visit www.adbrimasonry.com.au

AU BERRY GROWERS TAKE ON CHEAPER IMPORTS

Australia’s berry growers are going head-to-head in the marketplace against imported frozen berries, after a hepatitis A food scare prompted the second national recall of berries grown and processed overseas in as many years.

“We’d been toying with the idea of
Are you interested in a commercial alternative to soil-based production?

Build your knowledge with the

Certificate III in Production Horticulture

Course Code: AHC30610

Topics covered include:

- Hydroponic systems, crops and media
- Hydroponic plant nutrition and maintenance
- Pest & disease management in protected cropping
- Hydroponic crop management
- Crop harvesting in protected cropping
- Hydroponic irrigation systems
- Keeping production records
- Weather and climate
- Workplace safety

Proudly supported by

www.gotafe.vic.edu.au | 1300 GOTA FE (468 233)

GOTA FE is a business name of Goulburn Ovens Institute of TAFE (RTO 3094). This training is delivered with Victorian and Commonwealth Government funding.

NEW ONLINE COURSE
frozen berries for many years ... when the hep A scare came out it became at the forefront of peoples’ minds and all of a sudden there was the opportunity,” grower Matt Gallace said.

The Gallace family started investing in new state of the art freezing machinery two years ago when 25 people contracted the hepatitis A virus after eating Nanna’s frozen fruit, which was grown and packed overseas.

“The thing with overseas grown fruit is there is no traceability, no accountability ... there’s different practices and standards all around the world,” Ruth Gallace said.

“The way the labelling laws are in Australia you can’t be confident about the origin of what you’re buying.”

That means fruit could be grown in one country and packed in another. The strawberries at the Gallace’s farms are all handpicked and graded, before being washed and individually snap frozen. It is the washing that this family believes sets its berries apart from the overseas-processed fruit.

“They come in from the field as whole fruit, when we hull them they are still whole fruit, they come through the washer, it goes through the blast freezer down to -60ºC there’s not a lot of time in between picking and blast freezing and it ensures that you get a product that is uncompromised,” Mr Gallace said.

The family has negotiated a trial with one of the big supermarkets to supply their frozen berries to 20 stores across Victoria. The big question is whether will customers pay more for locally grown, locally processed frozen berries?

“I think that people are more informed and concerned about the origins of their food these days for a whole host of reasons, food safety being one,” Ms Gallace said.

“There’s so many reasons to buy Australian and we have found that we have a really loyal customer base that has either gone off frozen fruit completely and they’ve returned to the category or, of course, have switched over.”

Read more at abc.net.au

---

**AUTOGROW ANNOUNCES GLOBAL FIRST API SOLUTION FOR INDOOR AGRICULTURE**

Autogrow has become the first of the established players to launch an API (Application Programming Interface) for indoor agricultural growers; greenhouses, vertical urban, containers, plant factories, offering access to data traditionally not available to them.

Called MyData (v0.2), this is the first release in a series of cloud-based solutions offering a universally accessible API to recent and historical growing data including light and relative humidity, wind speed, pH and EC. With a 24-hour data refresh and 180-day historical data available, growers will be able to utilise their information to discover operational insights or even custom-build or develop their own data solutions, services or apps without limitations.

“We believe the future of innovation for indoor agriculture is about exploring what is possible and then sharing those solutions. This first in a series of releases from our research and development team is part of Autogrow’s strategy to support growers with comprehensive tools that will get the best out of their businesses,” said Autogrow CEO Darryn Keiller.

“MyData has also been created for innovative technology developers who are looking to take it to the next level, build on our work and share it with the wider community. We believe that to advance innovation in indoor agriculture you have to take an ‘open source’ approach and get true collaboration happening across the industry.”

Autogrow has been working with a select group of growers to gain valuable feedback on the first iterations of the API and initial
Feedback has been positive. “It inspires confidence to see Autogrow move in this direction as it shows the application is continuing to be developed towards a more open standard where the user has more control and access. For me this direction is great because I like to access my data in my own format. I will be able to set up an app that shows me only what I want to focus on and access it immediately without having to navigate through a large application, configure a report and exit again,” said grower Craig Morris of The Berry Patch.

Future releases of MyData will include advanced analytics, prediction, real-time data, remote-control features and the ability to provide software developers the flexibility to develop custom functionality with Autogrow products.

- The current version of MyData (v.02) is available on a trial release for Autogrow customers using the latest MultiGrow product.
- Current key features (v.02):
  - 24-hour Data Refresh.
  - 34 Metrics.
  - Open Standard API format.
  - 180-day history.

- Current benefits (v.02):
  - Data insights to greenhouse/CEA operation.
  - Flexible data structure and model to shape and form the data any way best suited for the business.
  - Best-in-class interoperability (REST API), whether it’s Excel, SAS, R, Matlab, Tableau, Knime, or any other API-Enabled tools.
  - Accessible anywhere in the world, whether it’s PC, smartphone, or tablet.

More information available at: www.autogrow.com
BEST NEW PRODUCT 2017: APEX GREENHOUSES RETRAC™ RETRACTABLE ROOF SYSTEM

At the recent Protected Cropping Australia (PCA) conference in Adelaide Apex Greenhouses launched its RETRAC™ retractable roof and was awarded “Best New Product” for 2017.

“This product was developed after frustrating experiences with other products on the market,” said director Eddie Braaksma.

“The RETRAC™ system gets rid of wires, cables and other unnecessary parts that are common in other retractable systems. Cables and wires used on other systems mean long installation hours and high maintenance, as well as losing space around the structure.

Our system is clean and clear meaning low maintenance as well as being fast and safe to construct”.

Grower Stephen Hill from Tasmania had the RETRAC system built on his property eight months ago.

“I couldn’t think of anything better on the market. The RETRAC system provides the best of both worlds, being able to cover up when it’s raining and opening up to full light,” Mr Hill said.

The directors of Apex believe their system has a lot of applications in protected cropping both domestically and worldwide.

“More and more we see supermarkets demanding produce year round. We see in Australia with extreme weather events, more growers are looking to move under cover to protect their investment. A glasshouse is not always the right choice for climates with high humidity and temperature or the ROI might not be there depending on the value of the crop. This product can fill a big gap in that market,” said Folco Faber from Apex’s management team.

Director James Harris added: “A lot of time and investment has gone into the development of the RETRAC™. Were leveraging off our long history in the greenhouse industry and we are confident that this is going to bring some much needed competition to this sector.”

More information at: www.retracgreenhouse.com.au or email sales@retracgreenhouse.com.au
The greenhouse re-imagined

With a retractable roof system, Retrac provides growers with the ability to open up and access the best of nature, as well as the flexibility of covering up to protect against its worst. It's the perfect solution for those looking to have a higher level of control over weather conditions, crop production and yields.

Key features include:

- Easy to construct, fast build time
- Film can be replaced quickly, safely and at low cost
- Ability to customise film covering, multiple film types even within a single greenhouse
- Minimal moving parts = minimal maintenance
- Modular design maximising growing space - no messy bracing wires
- No wires under tension eliminating the risk of injury from damaged cables
- Unique design making retrofit of current greenhouses possible
- Robust greenhouse substructure
- Flexible truss widths and bay sizes. Customised to suit you
- Easily add bird, insect or shade mesh. Three layer function
- Suitable for both plant and animal operations

Retrac is an innovative new product from Apex Greenhouses - a company with a long and proud history of developing world-class products.

Retrac is the retractable greenhouse reimagined, offering growers the best that mother nature has to offer, with the ability to shut it out when the situation demands. Retrac’s modular design and customisable features enables growers to have full control over yield and profit potential.

Designed by decades of experience, Retrac™ overcomes many common issues with current retractable systems, including high build price, the use of poor quality materials and complex film replacement.

When it comes to your next retractable system, the choice is clear.

Cost effective, simple to use, easy to maintain - Retrac™ is the clear way to grow.
A group of Japanese entrepreneurs has unveiled plans for the largest single site advanced glass greenhouse project in Japan. On April 27, SARA Incorporated from Okoyama broke ground for the US$125 million glasshouse project on the 1,000 hectare Kasaoka bay reclaimed land area. The project will soon start with the construction of a first 11.16 hectare semi-closed greenhouse project for the production of tomatoes, bell peppers and lettuce.

SARA, which stands for 'Smart Agribusiness Research and Alliance', was founded by Japanese entrepreneurs Mr Kobayashi, Mr Sano, and Mr Wada in April 2016. Taizo Sano, the Chief Operating Officer at SARA, has been investigating modern horticulture technology and production practices during his extensive career in the Japanese fresh produce industry. Sano became acquainted with international suppliers, researchers and sustainable energy solutions in order to design a business plan that prepares the Japanese horticulture sector for the next generation of greenhouse farming.

The new Japanese venture will grow a combination of three high value crops to supply distributors, retailers, and consumers. Over a total of 11.16 ha, the company will grow 5.68 ha of tomatoes, 3.25 ha with bell peppers and 2.23 ha of lettuce. The produce will be marketed through supermarkets, CVS, home delivery and various other food service customers in Japan. The company also considers exports to Asian cosmopolitan consumers.

Hygroscopic Adiabatic Cooling
Sano’s SARA project takes advantages of the latest innovative technology in order to enable efficient production in the hot, humid day and night climate.

“The challenging climate makes it very difficult to grow greenhouse vegetables over the summer season in Japan and other semi tropical climate regions in Asia,” Mr Sano said.

“Therefore, we teamed up with Dutch greenhouse manufacturer Van der Hoeven and developed a new climate system for a semi-
closed greenhouse setting. This new and patented dehumidifying Hygroscopic Adiabatic Cooling (HACO) climate control system enables greenhouse production of healthy vegetables during the difficult hot and humid seasons.

Biomass Tri Generation

The SARA project phase 1 will be powered by a state-of-the-art Biomass Tri Generation (BTG) power plant jointly designed and manufactured by Japanese company Takuma Co., Ltd. The biomass power plant generates 10,000kW electricity and is directly connected to the grid to sell the surplus electricity to a local power company.

According to Sano, the steam from the boiler will be used to empower air conditioning, heating and de-humidification. SARA and Takuma also jointly developed an exhaust gas cleaning system to source clean CO\textsubscript{2} from the biomass power plant and use this to fertilise the crops inside the greenhouse.

Japanese tech company Hitachi Co., Ltd. and Dutch greenhouse automation company Hoogendoorn are contracted to jointly develop the IOT computer, monitoring and control system of the project. This system will also include both the greenhouse energy management and labour management system platforms.

The total investment of the SARA project is estimated at 125 million USD. This required capital has been granted from syndicated loans provided by several Japanese banks. The local greenhouse construction from foundation to mechanical installation is supervised and coordinated by a partnership between Van der Hoeven and Daisen Co., Ltd., one of the largest greenhouse builders in Japan.

“All together, this project will be the largest single site glass greenhouse project in Japan’s horticulture history. With the opportunity to expand, the Kasaoka reclaimed land area has the potential to become an important high-tech megafarm site in South East Asia”, Mr Sano said.

The project site is already prepared and finalised by Kasaoka city with construction work having started in May 2017. SARA plans to hire about 200 employees, with the first crop to be expected in April 2019.

Source: hortidaily.com
Van der Hoeven has announced that it has received its first large order from Japan for its greenhouses with the patented HACo system. The SARA horticultural project (see above) covers 128,269 m² and consists of three greenhouses where lettuce, tomatoes and peppers will be grown.

"HACo is the solution for cultivation in climates where there is high humidity. It is well known that cool summers in temperate zones can change from fresh and sunny to warm and sultry. This usually happens for just a few days each year, but in sub-tropical climates, with warm, humid summers, it is more often than not," said Peter Spaans, Director at Van der Hoeven.

"HACo, hygroscopic adiabatic cooling, now provides a solution for these climate zones. It can actively cool at any time of day, with minimal impact on its efficiency. In addition, thanks to energy retention, the system is more efficient than traditional chillers. This combination offers the possibility of capping the peaks in the middle of the day, despite sunshine, and helping to apply a rapid pre-night."

The external light that is absorbed in order to maintain the internal conditions, can be handled at several levels, thanks to its smart construction. This means that the system offers multiple levels, and therefore more control than a simple “on/off” option:

- ModulAIR with a single pad, excellent for relatively dry times
- ModulAIR with two single pads, optimum results for adiabatic cooling
- ModulAIR with HACo, actively extracting latent heat to move down to a third level.

"HACo is fully engaged when relatively moist air occurs and it achieves its high level of efficiency by not destroying the latent heat but capturing it, and where possible, re-using it. HACo really comes into its own in climates such as in Japan, where very high humidity represents a major challenge. Withdrawing latent energy is what every cooling system does, but not destroying it is how it can be achieved using less energy," said Mr Spaans.

“This introduction of HACo into the ModulAIR system delivers an expansion of the global footprint for semi-closed systems. Combined with our active support to achieve the best possible result, this means that Van der Hoeven delivers the most complete package on the market.

“We are proud to announce the initial project relying on the newly developed HACo-system. A system that uses hygroscopic fluids as a mean to provide an efficient method of cooling," he said.

“A few years ago, we started to develop this system in order to find a solution for high-value horticulture in tropical and sub-tropical climates. We have been constructing large projects for many years in very hot, but dry climates, using evaporative, or more common in our sector, adiabatic cooling. Sadly, this technique can’t provide a solution for use in tropical and sub-tropical humid climates.

“The traditional method of cooling used in those challenging climates is air conditioning. This is not a realistic option for horticulture, due to the very high investment required and the high-energy consumption," Mr Spaans said.

“With the HACo-system, we have now found an answer to these problems, and are able to provide a good climate in horticultural greenhouses in warm, humid tropical climates.”

For more information about the patented HACo system from Van der Hoeven, email: info@vanderhoeven.nl or call: (+31) 88 262 66 66.
INAPRO AQUAPONICS DEMONSTRATION SITE IN GERMANY RECEIVES OFFICIAL VISIT

On the 19th of July, a delegation of Members of the European Parliament visited the INAPRO demonstration site located in Waren (Germany) and discovered how the aquaponic system developed by the INAPRO project produces sustainable food with a low environmental impact.

The visit took place in the framework of a mission organised by the Committee of Fisheries to Mecklenburg-Western Pomerania in order to meet and exchange with several stakeholders from the region about fisheries and aquaculture related issues.

The delegation was composed of MEP Werner Kuhn (EPP, Germany), MEP Clara Aguilera Garcia (S&D, Spain), MEP Francisco José Millán Mon (EPP, Spain) and MEP Jens Gieseke (EPP, Germany) who are all prominent Members of the Committee on Fisheries and the Committee on Agriculture and Rural Development.

The delegation arrived on the premises of Müritzfischer, the company, which manages the INAPRO demonstration site and members were welcomed by Mr Ulrich Paetsch and Mr Ulf Rehberg. The Müritzfischer is the largest freshwater fishing company in Germany and deals with lake and river fisheries, aquaculture, fish processing and marketing.

The INAPRO demonstration site is located in the headquarters of the company and consists of a fish farm equipped with a recirculating aquaculture system (RAS), a broad-ship greenhouse, a technical room with a combined heat and power plant (CHP) and the computer control system, a feed storage room and an outside secondary clarifier. The whole facility covers an area of 573 m³ and produces tomatoes and catfish since last year.

During the visit, the MEPs were able to walk around the site and exchange ideas with Mr Rehberg who explained how the system works and presented the innovations developed by the INAPRO consortium with the aim of improving conventional aquaponics to save water, nutrients and energy.

The biggest innovation provided by INAPRO is the double water recirculation system. Indeed, in the Waren demonstration site there are two independent water recirculation systems: one for the plants and one for the fish. The two systems are linked together via a one-way valve that allows the transfer of the correct amount of nutrient-rich fish water to the hydroponically grown plants. Furthermore, in order to cut the freshwater demand, the evaporated water from the greenhouse, is collected through cooling traps, filtered and reinserted into the fish tanks. This feature allows to minimise the daily freshwater input to less than three per cent of the total amount of water circulating in the system.

INAPRO aquaponics can be adapted to different production facilities located in different regions of the world. The system can also be adjusted to produce different kinds of vegetables and different fish species, all free from pesticides and antibiotics. The MEPs agreed that further development of the INAPRO aquaponics would allow the production of local, sustainable and healthy food also in rural and remote areas, including those facing water scarcity issues.

More info at: www.inapro-project.eu/
QUESTION:
What is outgoing longwave radiation and what is its influence on plants?
I notice that there was a paper titled, “The underestimated effects of Longwave Outgoing Radiation on your greenhouse crop” at the recent Protected Cropping Australia Conference.
Would you please explain what this means.

ANSWER:
All I remember about glasshouses from science in high school was that they allowed in and captured the incoming radiation from the sun, but then didn’t transmit out the emitted heat radiation from within the glasshouse. Hence they could maintain higher air temperatures than cold outside temperatures.

Radiation
Radiation is universal. Known as electro-magnetic radiation, it all travels at the speed of light. However, there is an infinitely wide range of different wavelengths, going from extremely short gamma radiation at a fraction of a nanometre (1 billionth of a metre = 10 - 9 metre), to radio waves with wavelengths in kilometres. Also, the shorter the wavelength, the higher the frequency of the radiation and the more energy it contains.

All solid surfaces emit heat radiation. How much they emit is influenced by several factors, especially their temperature and also the emissivity of the surface. However, the wavelength of the radiation is directly determined by the surface temperature, the higher the temperature, the shorter the wavelength and vice versa.

Solar radiation
The radiation we are most familiar with is that from our sun, known as solar radiation. This is also the major impact upon a greenhouse and the plants within it. The range of radiation frequencies from the sun is known as its spectrum. This is graphed in Figure 1. The vertical axis is the energy strength of the radiation, termed irradiance and measured in Watts per square metre [w/m²]. The horizontal axis is the wavelength of the radiation given in nanometres.

The black line is a reference and is the spectrum emitted by an ideal black body at 5250ºC. The bright yellow zone is the solar spectrum before it reaches our atmosphere. The bright coloured zone is the spectrum once it has passed through the atmosphere and reached earth. Various gases in the atmosphere absorb portion of some wavelengths in the spectrum. The most important is ozone (O₃), which absorbs a high proportion of the dangerous ultra violet (UV) wavelengths. This is why astronauts in space require very strong UV protection. There is also some absorption by water (H₂O), and a little by oxygen (O₂) and CO₂.

The global spectrum is split into three bands, the UV (below 400nm), the visible (400 to 700nm), and the infrared (heat, 700 to 3000nm). About 50% to 55% of the energy contribution comes as heat. It is important to recognise that...
heat radiation does not heat air directly. It lands on surfaces and heats those surfaces. In a greenhouse, the heat from surfaces such as plants, floor, structure, covers, etc, heats up a boundary layer of air, which is then moved by convection to warm the air within the greenhouse.

Outgoing longwave radiation
Usually taken as wavelengths between 4,500 and 100,000 nanometre. These come from much lower temperature emitters such as plants. So, the plants are losing energy to cooler surfaces.

The loss is not usually noticeable during the day other than when incoming radiation is low, that is, cloudy winter days. However, at night when there is no incoming solar radiation the impact on plants can be severe.

Sky temperatures
As measured with an infrared thermometer, the temperature of a clear sky is around –50ºC. In outer space the surrounding temperature is absolute zero, that is, −273ºC. With cloud cover the temperature of the cloud is usually between -20 and -30ºC.

Greenhouse cladding properties
Greenhouses basically harvest light. Consequently, high light transmission is the fundamental requirement for greenhouse cladding material. Most common claddings, whether glass or plastic, sheet or film, transmit about 85 per cent to 90 per cent of incoming radiation.

Most claddings do not transmit UV, with the exception of low iron glass. Removing the iron gives slightly higher light transmission, but also enables crops such as coloured lettuce to develop deeper colour than under normal coverings.

Most coverings do not transmit longwave radiation, with the notable exception of plain polyethylene. This means that on a clear night the plants are losing heat energy to a sky temperature of −50ºC. An example of the potential impact came where I live on an abnormally cold clear night late in spring. There was plenty of soft spring growth in nursery pot plants and the energy loss in polyethylene tunnels was such that there were huge losses due to frost damage. The same damage can be sustained outdoors, however, in this case it was the soft indoor growth, which made those plants extra vulnerable. The addition of additives and/or coatings can change the properties of cladding materials.

Plant energy losses
The major surface to which plants lose longwave radiation energy is the greenhouse cover. The colder the cover, the greater the energy loss and consequently the lower the plant temperature will go. The extreme of frost damage is extremely rare, however, it is possible for plant temperatures to get below the greenhouse air dew point. In this case plants can suffer direct damage, but in particular they become vulnerable to attack by fungal diseases such as botrytis and mildews.

Plant energy losses can be significantly reduced by using an energy screen, the temperature of which will be much higher than the cladding. A shade screen will help to a lesser extent, and it is essential to close it at night, especially when the sky is clear. The inner cover of a twin skin greenhouse will be warmer and reduce plant energy losses, however the incoming light levels are also permanently reduced.

Figure 1. Solar radiation spectrum.
CARIBBEAN FRESH

On the tiny Caribbean island of Anguilla, one luxury resort uses freshly supplied produce grown in its own pesticide-free, hydroponic farm.

By Christine Brown-Paul
A British Overseas Territory in the Eastern Caribbean, Anguilla comprises a small main island and several offshore islets. Its beaches range from long sandy stretches like Rendezvous Bay, overlooking neighbouring Saint Martin island, to secluded coves reached by boat, such as at Little Bay. Protected areas include Big Spring Cave, known for its prehistoric petroglyphs, and East End Pond, a wildlife conservation site.

While consumerism continues to degrade the many beauty spots scattered throughout the Caribbean, Anguilla has managed to maintain both its historical and natural charm, while embracing traces of post-modernity in recent vacation properties. Although these recent developments have facilitated more convenient tourism, Anguilla remains an irresistible setting of genuine island life. While a blissful getaway, however, the island faces major challenges in obtaining accessibility of fresh food sources.

Relying on North America or Europe (via St. Maarten) for all of its food imports, for Anguilla, receiving processed and non-perishables is not the issue. Acquiring fresh fruits and veggies, however, is a little more complex, as their quality can become greatly reduced by long periods of shipment.

One island resort, however, has solved this problem. Nestled in the heart of this paradise is the luxury resort of CuisinArt Golf Resort & Spa, which boasts the claim of being the only Caribbean resort housing its own pesticide-free, hydroponic farm.

Beyond the resort’s pool and beach there is a championship golf course, tennis courts, bike rentals and cooking classes offered to all guests. A fitness trainer is on hand for yoga classes or an early morning boot camp session for guilt-free indulgence later in the day.

GOING HYDROPONIC IN ANGUILLA

The 18,000-square-foot hydroponic farm incorporates two lettuce ponds; vine crops like tomatoes, peppers, cucumbers and eggplant; and a large variety of herbs.
cucumbers and eggplant; and a large variety of herbs, all housed in a hurricane-proof greenhouse. Leaving nothing to waste, the nutrient-rich drainage water from the farm is recycled to feed the landscaped gardens ensuring year-round lush, vibrant flowers and tropical plants that complement the resort’s whitewashed buildings. The grounds of the 275-acre resort are spectacular, and lead to a pristine white sand beach that stretches for two miles.

The hydroponic operations at CuisinArt were first set up in 1999 by eminent hydroponic expert, Dr Howard Resh PhD whose interest in hydroponics goes back to the 1970s when he was a graduate student at the University of British Columbia in Canada. Following graduation, he taught at the university for three years, but left to pursue his interest in the commercial aspects of hydroponics.

Later, Dr Resh became involved in many international hydroponic projects in Canada, Saudi Arabia, Taiwan, Venezuela, United States, Tortola and Anguilla. He has designed outdoor and greenhouse hydroponic systems as well as developing new hydroponic concepts and systems. Author of Hydroponic Food Production, Dr Resh has been Hydroponic Farm Manager at CuisinArt since the project began.

“Nothing is left to chance at this soilless growing operation. Greenhouses are hurricane resistant, the water comes from a desalinisation plant, and the excess growth and greenery is composted when discarded while decontamination rooms keep unwanted bacteria and insects out of the greenhouses,” Dr Resh said.

“We use a greenhouse from Agra Tech, designed to withstand hurricanes, because that is an issue here in Anguilla.

“Some hydroponic crops grown include: beefsteak tomatoes, cherry tomatoes, picolino tomatoes, yellow tomatoes, red, orange and yellow peppers, bok choy, a variety of lettuces, basil, arugula, Italian and moss-curled parsley, chervil, watercress, chives, mint, oregano, dill, thyme, sweet marjoram, string beans and broccoli raab...
Staff member working on the tomato vines, which grow so high that he must work on stilts.
and even edible nasturtiums and violas. “Using CuisinArt Golf Resort & Spa as a model, I propose that other resorts throughout the world consider a hydroponic farm as a similar component of their operations. The concept is to provide resorts with very nutritious and flavourful vegetable crops that are clean and safe. With the implementation of Integrated Pest Management (IPM) the vegetables are pesticide free. This will overcome guests’ fear of getting ill during their vacation and overcome their avoidance of salads as is often the case in many areas where resorts exist,” Dr Resh said.

“The integration of a Hydroponic Farm into a resort permits chefs to emphasise nutritious salads on their menus. They may demonstrate in cooking classes many uses of these vegetables including natural juices and even cocktails.

“Health spas combining exercise and treatment programs with nutrition as a part of a ‘wellness’ program utilise the fresh salad crops. An example of this is a fresh tomato or cucumber facial and skin wrap. Herbs such as lavender are part of lotions for cleansing our skin. Healthful, nutritious diets upon which are based the menus of the restaurants are part of this overall wellness concept. As travellers become more aware of the source and quality of the food they eat in these resort areas, a deciding factor in their choice of a resort destination will be a healthful, safe diet,” he said.
Dr Howard Resh (R) explains the finer points of hydroponics to guests at the resort.

“Cukes in buckets”, a system for growing cucumbers.

Hydroponically grown violas are also used in the resort as edible flowers.

“At CuisinArt Golf Resort & Spa, our Hydroponic Farm is harvested at its optimum ripened stage to give the guests that distinguished ‘backyard garden’ flavour, making a lasting impression with them.

“The aim of the Hydroponic Farm is that it is one unique component of the resort that when combined with the beautiful landscape and beach surroundings, friendly and efficient service, healthful food, with the exercise/care programs of the spa, our guests will relax to experience an unforgettably pleasant vacation that will attract they and their friends to come again,” Dr Resh said.

The Hydroponic Farm at CuisinArt has also fuelled the food production at the resort’s sister property, The Reef,
which opened in November 2016. Just like CuisinArt, The Reef has complete access to the farm and all of its ingredients, fresh produce and a range of nutrient-dense fresh juices. A member of Small Luxury Hotels Of The World, The Reef boasts two restaurants that are delivered the farm fresh hydroponics daily.

“With tours of the Hydroponic Farm, the guests will realise a sense of security in eating salads made from the on-site farm,” Dr Resh said.

“On the tour guests can experience the methods of growing, they undergo a psychological impact assuring themselves of the quality and safety of the foods. This sets the resort apart from others and brings the guests and their friends back. The payback to the resort is not through savings in food costs, but in obtaining high occupancy rates. The profits are in the sale of rooms and attendance at the restaurants of the resort. This is what we are experiencing here at CuisinArt Golf Resort & Spa.”

For more information visit: www.howardresh.com
Watch Dr Resh’s tour of the Hydroponic Farm at CuisinArt Golf Resort & Spa, Anguilla at: https://www.youtube.com/watch?v=ohrvnol6PLc

Bok choy growing in cascading styrofoam boxes.

Fresh produce such as these hydroponically grown tomatoes are used in dishes at the resort.
The outdoor kitchen and hydroponic herb garden is located on the walkway between the home and the front entrance.
CREATING A HYDROPONIC CULINARY HERB GARDEN

IN FAIR PLAY, MISSOURI USA, THE INSTITUTE OF SIMPLIFIED HYDROPONICS HAS DESIGNED AND BUILT A HYDROPONIC CULINARY HERB GARDEN AT ITS TINY HOUSE PROJECT.

BY PEGGY BRADLEY
As dawn breaks, young sprigs of peppermint are selected for morning tea. At lunch, basil is selected for a pesto sauce. During the day, fresh rosemary is added to bread, and a teaspoon of tarragon is harvested for a supper dish. In the evening, sage leaves are brewed for a bedtime tea to aid in a good night’s sleep.

In today’s world of outdoor kitchens, a hydroponic herb garden can be easily added to the space, bringing aromas, flavours and a welcoming ambience to the space. Most culinary herbs are thought to have medicinal properties as well. A few studies have shown that the active phytochemicals in hydroponic herbs are as good or better than soil grown. Hydroponic herbs can be grown with organic or inorganic nutrients.

Quality of life can be improved with fresh picked herbs for teas and cooking. No chef anywhere in the world has access to higher quality herbs picked fresh as needed, growing within arm’s reach.

CULINARY HERB GARDEN

In Fair Play, Missouri, The Institute of Simplified Hydroponics has designed and built a hydroponic culinary herb garden. This garden is placed in a corner of an outdoor kitchen area is a huge success in increasing the comfort, aroma and flavour of food and beverages.

The first herb grown in the outdoor kitchen was a single 18” diameter container of peppermint. The pot is a commercially available pot with a 1” diameter hole in the bottom for drainage. For hydroponics, a circle of plastic screen was placed in the bottom of the pot, to retain substrate. The pot was filled with perlite, and a peppermint planted in the center of the pot.

The plant is watered once a day with hydroponic nutrient water sprinkled from watering can. Several commercially available hydroponic nutrients have been used with success. The plant uses about one quart of nutrient water a day. The two-year-old plant has produced about six fresh new peppermint sprigs a day, enough for two cups of tea. The single peppermint plant has so far supplied mint for over 600 cups of tea and may continue for years in the future.

Probably any culinary herb can be grown in a similar manner.

SELECTING THE HERBS

Different herbs are popular in different countries and different cuisines. There are also some universal favourites that we include in our garden. Herbs are harvested from fresh new growth and any flowers are
pinched back to inhibit going to seed.

**Mint**: we have two 18” diameter containers, one with peppermint and the other spearmint. Both are very productive providing for four cups of tea a day. The mint tea can be drunk hot or cold. Mint is thought to have antiviral and antibiotic components that help fight colds and flu.

**Genovese basil**: a variety of sweet basil used to make Italian Pesto for pasta. Basil also makes a tea that is slightly lemon flavoured, a favorite with children. We have four containers from 15” to 18” diameters. This produces enough basil to make a pesto every three days.

**Sage**: used as a seasoning for dressing and also a favorite tea in many cultures. We have two 12” square pots of sage that will eventually grow to be about two feet tall. This allows for two to four cups of sage tea a day.

**Rosemary**: a favorite herb used in breads and dishes. Skewer rosemary produces natural skewers for barbecue. Also used as a tea. We have three 12” pots in the garden, enough for about two sprigs a day.

**Chives**: used as a substitute for onion in some dishes, added as a garnish for salads. We have two 12” diameter containers of chives growing about a tablespoon a day.

**Fennel**: used as leaves and the root bulb. A flavouring for a tea, and used in dishes. Fennel tea is considered medicinal to treat colds, repertory issues and Alzheimer’s. The bulb end is used as a vegetable. The bulb ends are harvested every 60 days and new plants are planted. We have one 15” diameter pot in the garden allowing for about a tablespoon a day.

**Parsley**: used in dishes, as garnish and as a tea. Considered a medicinal tea to promote body cleansing. We have two pots growing about a tablespoon a day.

**Cilantro**: used in Mexican dishes such as salsa. We have two 18” diameter pots growing about ½ cup a day.

**Oregano**: we use Italian and Mexican oreganos. Used in pizza, Italian tomato sauces and as a herbal tea. We have two small pots of 9” diameter allowing for about a teaspoon a day.

**Stevia**: used as a natural sweetener. Sprigs can be added to teas instead of sugar. We have two 12” pot growing about a teaspoon a day.

**Tarragon**: used in soups and stews. Makes a great beverage sold as a commercial drink in many countries. We have one 12” pot growing about one tablespoon a week.

**Dill**: use seeds and fronds as a flavouring for pickles, on toast, in breads. Makes a great tea with calming properties. We have one 12” pot growing about a teaspoon a day.

---

**DAILY USE OF FRESH HERBS**

Several of the herbs can be used to brew in teas, served hot or cold. By brewing teas, the water is brought to a boiling point, likely to kill most bacterial disease and have added minerals from the herbs. The basic recipe is three 3” sprigs of herb, with honey, lemon or salvia to taste.

A 12-ounce can of Coca Cola has 9.33 teaspoons of sugar. If fresh herb teas are replacing sugar soft drinks, they can be help in improving daily diet.

**Pesto**

The Genovese basil in the herb garden is used to make pesto. This requires a cup of fresh basil, so it will use much of the growth from an 18” planter, each week. It does not require cooking, so it reduces need for energy used in a cooked sauce.

**Recipe**

1 cup basil leaves (125 grams)
1 garlic clove
1 tablespoon pine nuts
1 ounce parmesan cheese grated
¼ cup olive oil

The ingredients are placed in a food processor or a...
mortar and pestle and blended together. Pesto in blended into cooked pasta or used in meat dishes and stews. It offers outstanding flavour that is likely to be a family favorite. The cheese can be replaced by a grain product and the pine nuts with peanut.

**Salsa Cruda**
6-8 vine-ripened tomatoes
1/2 medium yellow onion
2-3 jalapeno chilies
1/2 cup chopped cilantro
Chop up ingredients and serve in bowl with chips, or on food. Two 12” containers of cilantro will supply enough to make this recipe every day.

**HAND WATERING**
Our herb garden is hand watered with a watering can of hydroponic nutrient. This helps establish the herbs, as over-pouring with nutrient water allows plant to obtain some nutrient from their leaves as well as the roots. This action alone should see a 40 per cent increase in growth rate as opposed to watering the roots only.

To hand water a garden of about 20 plants takes about four gallons of nutrient water a day, and about five minutes to mix the water and hand water the garden. With a simple system such as this, there are no parts to buy, and no systems to fail. So this is the most foolproof method of watering the plants.

However, the garden herbs should be hand watered once a day and there are times when this is difficult. Illnesses and family emergencies will happen. Family vacations require being gone a week or more. Unless there is a very kind neighbour or friend nearby, the garden can be automated to give a daily feeding of nutrient water.

**STRATEGIES FOR AUTOMATIC WATERING**
There are several hydroponic systems on the market that can be used to create an automatic watering system for the garden. Some of these require electricity and at least one, the AutoPot system, can be operated without any external source of energy. These systems are an excellent alternative to hand watering to keep your garden growing while you travel.

**Drip irrigation systems**
If you have a pressurised water system, such as a city water supply piped into your home, you can set up a drip irrigation system. Most of these systems require a pressure of 45 psi and so they will not work in areas where there is no pressurised system.

These drip systems are offered by a few different companies and can be set up to attach to an outside hose. The systems create a watering line that can be used to ensure water to the plants.

*Culinary herbs create a beautiful space loaded with flavour and aroma for teas and foods.*
GET THE CONSISTENCY AND QUALITY YOU WANT WITH PERFECT LIGHT 365 DAYS A YEAR

BETTER GROWTH THROUGH RESEARCH with the Heliospectra LED Lighting

CONTROL CONSISTENCY
Use automated light strategies with optimized light intensity and quality for consistent production and reliable forecasts.

IMPROVE QUALITY
Boost crop quality to produce plants that look and taste better, offer improved nutritional value and have a longer shelf life with an optimized light spectrum.

INCREASE YIELD
Achieve consistent, year-round yields by supplying perfect light 365 days a year to ensure optimal plant growth and crop quality.

ACCELERATE HARVEST
Scale operations and production by adding more harvest and revenue cycles.

heliospectra.com
sales@heliospectra.com
www.heliospectra.com
These drip irrigation systems are not designed to be used in hydroponics, and use small emitters that can easily clog when delivering nutrient water.

A second issue is a possible failure of the system that allows water to flow freely to the ground. Left unattended, this can lead to flooding of your property and costing money for a huge water bill. This happened to us at the Institute, and left us with an unexpected US$300 water bill.

**Gravity-fed drip irrigation**

Where there is no pressurised water, a drip irrigation system can be set up using gravity as the energy source. In this case a water container is placed at least three feet above the ground, and the drip system is used for plants below. At three feet high, the gravity-fed system has a zero to two psi water pressure.

**The water supply**

For our garden we use a 50-gallon water barrel on the ground and a 30-gallon barrel placed above that for the hydroponic nutrient. Both barrels are placed in a shade area to reduce the heat buildup from the sun, and both are tied to a tree to keep them from toppling on anyone.

The hydroponic barrels are food grade recycled barrel purchased for US$10 each. A plastic spigot with on and off shut off is placed on the barrel by drilling a hole and attaching to the barrel. When attaching the spigot, Teflon tape is used to make a tight seal.

**Drip system**

We use a system common to the drip industry of a backflow valve (to prevent liquid from siphoning back into a tank), a 200 mm filter (to collect large particles from the system) and a device to change from hose fittings to a ½ size polyethylene tubing.

**Timer**

A timer can be used to set a watering time for each day. Most drip irrigation timers need some water pressure to
work, so it is necessary to purchase a zero pressure timer for a gravity fed system.

Unfortunately, there are just a few zero pressure timers on the market and most have poor reviews on Amazon. We are using a Toro Zero gravity timer and it appears to be working but some Amazon reviews claim this timer might fail in a few months.

**Tubing line**

For gravity fed, we use a ½” diameter tubing from the timer, and use only one line through the garden. If the line is split into two lines, one may be slightly lower than the other and fail to get much water. That one line curls through the pots and ends on the ground. About every 12” the line is punched and a ¼” tubing fitting placed in the ½” line.

Tubing of ¼” is cut to length and placed in each pot with a spike to hold the tubing. In a pressurised system, emitters would now be placed at the end of the ¼” tubing.

**Emitters**

In our system, the pipe is placed near the center of the pot and no emitter is added. Nutrient water is allowed to flow freely from the ¼ inch tubing. This is to reduce cost, and to better ensure each plant gets its daily water.

Generally, the larger 18” pots require about a quart (one litre) of water a day and the smaller about ¼ of that. So lines are placed to the larger pots first. A line such as this usually works for about 10 to 20 pots before the water pressure is gone.

In debugging the system, you run the timer and see how the plants are getting their water. In a certain about of time, the plants will receive what they need. The timer is set for that time, usually about 10 or 20 minutes.

**Hydroponic added to the barrel**

When the system is set up the top barrel is filled with water and hydroponic nutrient is added to the water according to the instructions of the manufacturer. When the barrel is emptied, more water and nutrient are added.
Fresh water flush
No matter what watering system is used, the herb garden is watered with fresh water once a week to flush the system of excess minerals. This is done with the fresh water stored in the bottom barrel. Water is delivered through a hose and or a watering can to the garden.

Pop bottle-fed systems
There are some designs of irrigation systems that use repurposed pop bottles placed in the plant containers to deliver small amounts of water. A few of these use bottles just cut off at the top and nutrient water would be poured into the bottles as needed. A couple of holes are drilled on the bottle or in the cap to drip water onto the plant roots.

One issue for this system is the open container of water is an invitation for mosquitoes and needs to be protected. If using a method such as this, the top of the open bottle should be covered with an insect screen to prevent mosquitoes from entering.

This type of watering system can be useful to keep plants alive for a few days or as long as the water holds out. However, our 18” pots that require a litre of water a day only have a two-day supply of water in a two-litre bottle. For a 10-day stretch they would need a 10-litre bottle and that is getting very large.

CONCLUSION
If you are new to hydroponics, a culinary herb garden is a great place to start. Herbs, once established tend to grow well and are very welcome in the daily diet.

If herbal teas are used to replace soft drinks there should be a reduction in daily sugar. If herbs are used in cooking, they can replace most of the salt in the diet.

The real reward comes from serving a pesto on spaghetti and having guests tell you are a great cook. Your secret weapon was the outrageously great flavour and aroma of the hydroponic basil.

It is easy to start. The daily rewards are worth it.

For more information and kits to support this garden visit our website at www.carbon.org

A single 18” pot of peppermint has supplied leaf for 600 cups of tea over two-year span.

About the author
Peggy Bradley is the CEO of the Institute of Simplified Hydroponics, a non-profit organisation based in Fair Play, Missouri, USA. She has a Masters in Civil Engineering and has been active in hydroponics for over 50 years. Her work has been primarily in the field of Simplified Hydroponics and has visited over 16 countries working to establish the technology.

Contact: peggybradley1@hotmail.com, see website for more info at www.carbon.org
THE WORLD OF ORCHIDS

by JACK ROSS

A Practical Guide to Cultivating Orchids in Soilless Culture

With an estimated 25,000 species worldwide, orchids are loved for their exotic and mysterious habitat, from cloud-shrouded mountains and rainforests to mangrove swamps and semi-desert scrubs. They are perhaps the most challenging of all flowering plants to cultivate outside their natural habitat often taking many years before the first flower appears.

This book presents the results of the author’s many years of research into orchid cultivation using soilless culture techniques. This book is for orchid enthusiasts as well as commercial growers producing high quality orchid flowers.

If you love orchids, you’re going to love this book...

Get your copy here...

We and nature are one.
WINDERMERE BERRY FARM

IN NEW ZEALAND, ONE OF THE COUNTRY’S OLDEST BERRY FRUIT GARDENS HAS IMPLEMENTED NEW TECHNOLOGY IMPROVEMENTS, INCLUDING CONVERSION FROM SOIL-BASED GROWING TO HYDROPONIC SYSTEMS.

By Mike Nichols, Bruce Christie and Damian Duggan-Jones

Some 5km north of Wanganui – on the Wanganui-New Plymouth Highway – is one of the oldest berry fruit gardens in New Zealand. Established by the Forks family in the 1940s on the fertile Westmere loam, it then became the property of the Walker family for the next 40 years, until it went into receivership in 2011, and was purchased by the Boswell family. Windermere is currently managed by Tony Boswell who has a long and successful background in business management.

When the Boswells purchased the property all the berry fruit was being grown in the soil, without any irrigation. Production was doubled in the first season simply by irrigating the crop, but Tony was interested in much more development, and he invested in 1.5 ha of high tunnels from the British company Haygrove for just under $NZ1 million, along with the necessary table top system for the strawberries and the drip fertigation system. One hectare of strawberries and 0.5 ha of raspberries are now grown under high tunnels.

The difference in growth and productivity in the tunnels and outdoors is staggering. This points clearly to the importance of providing the plant’s environment with better light interception, warmer environment, good drainage, adequate nutrients and water, plus shelter from the wind and rain. An added advantage of tunnel production is that biological control of predators becomes a possible option while bird damage is minimised, simply by covering the ends of the tunnels with bird netting.

When we visited the property in early December the strawberries in the tunnels were only at the beginning of the harvest season, although the outdoor crop had been harvested for some weeks. This was because the ends of the houses had not been closed during the spring and the plants being on table-tops and not being in contact with the ground were cooler than those planted outside in the ground. The result was some very large fruit (perhaps even excessively large) on Aromas and Albion. (they were the king fruit, which is the more likely reason they were large). Yes, it is possible to get strawberries too large for the market, and at 40-50-g this means only five or six fruit to a punnet! This is something that we have not experienced at Massey, where our greenhouse strawberry crop is harvested from early September. We suspect that the lower light levels (and therefore lower photosynthesis) at that time results in smaller fruit due to light limitation in the growing conditions. Later in the year when growing conditions improve there are many more fruit trusses (and therefore fruit) on each plant, so the fruit still does not grow too large.

We are uncertain how much insect pollination is necessary for strawberries, but it is certainly critical for good raspberry crops also grown on the property. With this in mind along the southern windbreak on the property is a line of beehives, and about 10 m away are the entrances into the tunnel houses. Bird-proof netting over the ends of the houses keeps the birds out, but allows the bees easy access. The close proximity of the bees and the greenhouse enables the bees to be active when the temperature in the greenhouse is warm enough even when the temperature at the hive is lower than they would like to go out foraging.

Since the Boswells took over the property they have developed an all-in-one berry fruit/produce market, farm store and café overlooking the strawberry patch. The café is open seven days a week from 9.00am-5.30pm from October-May, and provides a valuable rest stop for travellers between the lower North Island and New Plymouth. Not only is fresh berry fruit available (in season) but pick-your-own and frozen berries are available. In fact, the recent problems with imported frozen berry fruit from Asia has meant that New Zealand frozen berry fruit now receives a considerable premium on the local market.

The main varieties of strawberries being grown in the tunnels are the day neutrals, Aromas and Albion, but the outdoor crop is short day type Camerosa, which peaks in the pre-Christmas period.

A planting of raspberries (grown from tissue cultured material) is being grown hydroponically in some tunnels. There are some problems with this crop (crumbly fruit), which suggests that tissue explant source or the in vitro growth environment may not have been ideal for bulking up high health raspberries, unless there is an excellent genetic base of the primary tissue cultured material the end result may be unsatisfactory. It is noted that each propagation method applicable to raspberries has its pluses and minuses and while root cuttings appear to be more in favour by some prominent industry
Tunnel strawberry crop (early December).

Raspberries (training method).

Further construction of Haygrove tunnel houses (Tony Boswell in foreground).
organisations as the bulking up mechanism they are by no means the only method that can be used. Nevertheless, the growth of raspberries in the tunnels is most impressive, with a good autumn (primocane) crop being present in the first season of growth from a spring planting of the very small tissue cultured plantlet material.

Raspberries appear to prefer better root aeration than strawberries, so the watering/feeding regime needs to be managed to provide a slightly drier root environment. Too much water and reduce oxygen availability in the root zone despite providing good nutrition can cut down the early development stage for a raspberry crop.

A significant area of Windermere is still growing berry fruit in the soil, but this is likely to change in the future, as the advantages of protected cultivation and hydroponics as resources become freed up. A small area of strawberries (according to manager, Tony Boswell) will always be grown outdoors near the main highway, because “customers expect strawberries to be grown in that manner”. However, the advantages of growing under high tunnels appears are undeniable, and we anticipate in the future that most of the berry fruit being grown at Windermere Farms in the future will be under protected cultivation.

Converting between soil-based production systems and protected cropping requires an adjustment in production practices. Essentially, the idea is to move a high valued crop, such as berries, into more ideal growing conditions. In a more controlled environment, uncertainty in supply is minimised and superior fruit quality makes exporting a viable option.

The initial investment costs include the covered structure, irrigation system and elevated gulleys with fittings (often provided as a package). Slabs of packaged compressed coir are placed on gulleys and uncompressed via irrigation before planting. These slabs come in different dimensions suited for different crops. Traditionally, slabs are replaced seasonally with strawberries and every three to four years in raspberries. Identifying correct plant growth and development is vital in developing a robust fertigation and pest management plan. Converting to protected cultivation is more affordable currently as demand has increased over recent years in Australia and New Zealand.

Deciding on technology improvements always involves an element of risk. Making a new system work with the burden of the capital investment deters many growers. Windermere Berry Farm took the risk, accepted the challenge and has not looked back.
Raspberries six months after planting.

Beehives adjoining south hedge.

Strawberry “pollination” by a bee swarm.
Outdoor strawberry crop, adjoining tunnels (early October).

Essential artificial shelter.
HELPING FIND SEASONAL WORKERS

The Seasonal Work Incentives Trial offers support for Australian horticultural growers to find seasonal workers.
Image courtesy of the Department of Employment.
The Australian Government has announced the Seasonal Work Incentives Trial, a program that offers support for Australian horticultural growers to find seasonal workers.

Attracting skilled and reliable seasonal workers has long been one of the biggest challenges facing Australia’s horticultural industries.

Australians do not want the work, which is the reason most of Australia’s seasonal farm labour comes from overseas, be it in the form of backpackers on a working holiday visa or the Seasonal Worker Program (SWP).

New Zealand has similar farm labour needs, yet Horticulture NZ, which represents 5,500 growers, estimates that 50 per cent of labour there is sourced locally.

Chief executive Mike Chapman said the sector employed 60,000 people.

“We’re always a bit short of workers and we have predicted that over the next few years we’re going to need 2,000 to 5,000 additional seasonal workers,” he said.

“We’re constantly looking at ways to increase our permanent and our seasonal workforce.”

Seasonal Work Incentives Trial

Now, growers in the horticultural industry who need workers on a short-term basis during peak times, can access the Australian Government’s new Seasonal Work Incentives Trial from 1 July 2017 to help meet their needs.

This two-year trial aims to encourage participants to take up short-term seasonal work opportunities in the horticultural industry by providing them with an opportunity to earn more income, without affecting their income support payment.

Participants placed under the trial can also receive a Living Away and Travel Allowance if the work they are placed in is located more than 120 km from their home.

The trial is being managed by jobactive, Transition to Work and Disability Employment Services providers.

Participants will work closely with growers and the participant to ensure they know what growers need and that they get the right person who is willing to work and understands the job to be done. Employment services providers will receive a weekly incentive payment for up to six weeks, depending on the duration of the job, to support growers and workers under the trial.

Growers should contact their nearest employment services provider to discuss their labour needs. Employment services providers are located across Australia, and their contact details are available at jobsearch.gov.au/providers.
Optimising photosynthesis has potential to bring benefits for food security, renewable energy and the reduction of CO₂.
A look at the importance of photosynthesis and the possibilities its optimisation brings for food security, renewable energy and the reduction of CO₂.

In the Dutch newspaper Trouw, a recent article was published about the importance of photosynthesis and the possibilities its optimisation brings for food security, renewable energy and the reduction of CO₂.

According to researchers at Wageningen University & Research University in The Netherlands, unlike humans, plants can use sunlight to produce their own nutrients and energy.

“This process is called photosynthesis and it runs the world. If we want to keep the planet and its growing population running in a sustainable way, we will need plants to produce far more food, energy and applicable biomass than they do now. Photosynthesis, the green engine of life on Earth, needs tuning,” said a Wageningen University researcher.

“This is something mankind has never done before. We have hybridised and bred plants for centuries to create the best varieties. Here and there we have genetically adapted crops to increase their yield. We have given plants water, good soil and artificial fertiliser. But we have never worked on the plant’s engine before. Until now.”

The first results are in, and they are spectacular. Dutch plant scientist Wanne Kromdijk, working under the supervision of Steve Long at the University of Illinois (US), recently published the results of experiments with tobacco plants in the magazine, Science.

“These scientists were able to increase the yield of the tobacco plant by 15 per cent. This is a huge step in breeding terms and was achieved by tweaking a component of the photosynthesis process of the plant,” said the researcher.

“Long had previously discovered how the gearbox of the photosynthesis engine works. The crux is that while light powers photosynthesis to the benefit of the plant, too much light can damage the machinery of photosynthesis. If a plant is in the blazing sun, part of the absorbed light energy is simply dumped instead of being used for photosynthesis.

“The process shifts photosynthesis down a gear, so to speak, and only goes up again when light intensity diminishes. This means that a plant standing in fluctuating light is constantly changing gears. And this is the case for most plants due to the moving leaves of neighbouring plants or overhanging trees that sometimes block sunlight but at other times let it shine through,” he said.

According to the Wageningen researchers, once the light intensity diminishes, it takes some time before the
plant changes to a more efficient gear. During this period photosynthesis is not as efficient as it could be and the gear change takes longer for some plants than for others.

“Steve Long’s team discovered the reason for this difference and built a faster gearbox into the tobacco plant. With spectacular results. Steve Long works in the US and UK, and is part of a large research consortium that is currently being established of scientists from 48 institutions in 17 countries. They are working hard to obtain finance for the Photosynthesis 2.0 research program in the next EU framework program, which starts in 2020,” the researcher said.

“The type of result achieved by Kromdijk and Long will certainly help,” said Dr René Klein Lankhorst from Wageningen University, one of the initiators.

“It shows how much progress can be achieved by playing with photosynthesis. And it’s not the only spectacular result. Our British colleague Christine Raines studied an enzyme complex in an entirely different part of the engine. She was able to accelerate its functioning, which resulted in a 30 per cent yield increase. And there are countless other parts of the engine that could be adjusted.”

However, Dr Lankhorst is keen to underline that this is not where the story ends.

“Examples of super-photosynthesis are not only found in recent science, but also in nature. The Formula 1 of photosynthesis involves desert plants, the seeds of which sometimes have to wait for years for rain. What’s more, when the rain finally comes they must do everything very quickly: seeding, rooting, developing stems, leaves and flowers, and distributing new seeds,” said Dr Lankhorst.

“It is incredible, you can almost see the plants grow. But for desert plants it is a necessity. And to focus everything on super-fast growth, they’ve abandoned other activities that are less important, such as disease resistance. This means you can’t just put genes from a desert plant into our crops. But although you have to be careful, it’s clear that photosynthesis can be accelerated.

“People often think that nature is very efficient. It is, but only in natural conditions. The crops we grow were not born for agriculture; we took them from the forests and placed them in fields. If they had completely adapted to these new conditions they would perform much better. A field of potatoes, for example, uses only 0.5 per cent of the incident solar energy. This could be 5 to 10 per cent,” he said.

“But we don’t even have to get that far. A doubling of production would already resolve the food demand of the growing global population and the demand for biomass for a green economy. And this doubling would also make a world of difference to the climate. The Paris Climate Agreement states that global CO₂ emissions must be reduced by 20 gigatons per year. Photosynthesis in
agricultural crops uses 14 gigatons of CO₂ a year worldwide. The CO₂ the crops absorb is obviously partly released again as we consume or burn them. But if photosynthesis was accelerated, part of the extra CO₂ absorbed could be stored in some way, in the soil for example, and this could make a considerable contribution to the climate agreement goals – a difference of some 4 gigatons CO₂ a year,” Dr Lankhorst said.

“This is all possible. And it would have guaranteed results, leading to more economic activity and growth. And yet it isn’t easy to obtain financing for research into accelerating photosynthesis. Thankfully, opinions in Brussels are shifting: the European Commission has declared yield improvement in agriculture a priority in view of the major world problems (food, energy, climate). Research into photosynthesis fits right in. But in The Netherlands itself, it remains difficult to get things moving quickly.”

Over recent years Klein Lankhorst led a national research program called Biosolar Cells, which studied both the acceleration of photosynthesis in plants and algae, and the mimicking of nature: artificial photosynthesis for the production of, for example, hydrogen, which is a fuel, or methanol, a raw material for the chemical industry.

However, Biosolar Cells was financed by the Natural Gas Funds, which were at that time partly used for knowledge development and scientific research. The Dutch Government closed down this source of funding, however, bringing to an end programs such as Biosolar Cells and many more.

Wageningen University and Utrecht University may receive an investment subsidy for lab facilities in both cities for accurate experimental research into photosynthesis.

“This would allow us to see exactly what happens in the plant, above and below ground,” Dr Lankhorst said.

“I haven’t been able to persuade the obvious candidates, such as energy companies. They show an interest in a few wind turbines, perhaps a field of solar cells here or there, but that’s it. The chemical sector will require much more biomass to move towards green chemistry, but doesn’t want to compete with food production as that is a fight they’d lose. We can make sure that the biomass will be available. Yet, they’re not interested. Reducing climate risks is of the essence to insurers, but they aren’t interested in investing in research into reducing those risks either.”

Companies that will definitely benefit from adjustments to the engine of photosynthesis are those involved in breeding and seed production; a global sector in The Netherlands. But to date, they aren’t jumping at the chance to invest although many do see opportunities
on the horizon but beyond their timeline.

This is a typically Dutch problem Klein Lankhorst as explains: the gap between fundamental research and innovation.

“We know that we will make significant progress, but we need 10 to 15 years to realise applicable and responsible applications. For instance, when accelerating photosynthesis, you don’t want the crop to need any more water or artificial fertiliser than is absolutely necessary because climate change will reduce the amount of water available to agriculture,” he said.

“This means you have to look carefully at how to develop such plants. It will take time to ensure that the extra productivity goes to where it is needed, such as the fruit or grain. And there are many other preconditions we need to take into account. But we will be successful. And we don’t need that much money, especially compared to other branches of science like particle physics or nuclear fusion. An international research program into photosynthesis would require approximately one billion for 10 years.”

“Over the same period, a multinational would spend the same amount on their Friday socials alone.”

What is photosynthesis?

Plants, algae and some bacteria produce from carbon dioxide CO₂ and water (H₂O) sugars (C₆H₁₂O₆), which can be used for many purposes, including as a building block for cell material, as an energy source or as a nutrient. These sugars are the result of photosynthesis.

Judging by the end product, photosynthesis might be thought to be a simple process. But appearances can be deceiving as the underlying machinery is extremely complex. Photosynthesis is a combination of many biophysical processes and chemical reactions, which are catalysed by various enzymes. The mechanism is so complicated that the last of these enzymes was only identified several years ago. And it’s still unknown how many genes regulate the photosynthesis process; it could be hundreds or even thousands.

The photosynthesis engine consists of two large blocks. In the first, sunlight is used to make energy-rich substances that can be stored in the cell. This block is
known as the light reaction. In the second, the dark reaction, the stored energy is used to make glucose from carbon dioxide and water.

Unravelling photosynthesis is a story that started in the mid-seventeenth century, when Jan van Helmont, a physician and scientist from Brussels, showed that as plants became larger the soil in which they grew did not become lighter. Helmont concluded that water was the source of their growth, not the soil.

It took a century and a half before it became clear this was only half the story, and that plants also needed CO2 to grow. This discovery was the result of an observation by the versatile British scientist Joseph Priestley, who saw that a candle under a bell jar would go out long before it was burnt to the stump, but that this didn’t happen when a plant was under the same jar. Priestley spoke of ‘injured air’ that was healed by the plant.

The Dutch physician Jan Ingenhousz then showed that plants needed sunlight to do so. Not long after, Swiss scientists Jean Senebier and Nicolas-Théodore de Saussure discovered that ‘injured air’ is actually CO2 absorbed by the plant. In exchange, the plant emits oxygen, which allows the candle to burn.

Oxygen is a waste product of photosynthesis, which is emitted into the atmosphere by the plant. This emission is one of the largest environmental disasters in the history of the Earth. Oxygen is an aggressive and destructive substance, which the plant isn’t able to process. It wasn’t part of the Earth’s original atmosphere, but currently takes up some 20 per cent.

With their emissions, plants created their own potential destruction and they had to adapt significantly to survive. But on the other hand, via photosynthesis oxygen has made possible the existence all life forms which are not self-sufficient, including mankind.

Source: www.trouw.nl
PROTECTING STRAWBERRY PRODUCTION BIOLOGICALLY
Over the last few years, the greenhouse strawberry industry has seen great benefits from Biological Services IPM programs.

The first commercial insectary established in Australia, Biological Services offers a range of IPM services to growers nationwide. Through a combination of experience, passion, innovation and ongoing research and development, Biological Services has developed rearing techniques for a range of biological control agents, which target many of the key pests in horticulture today.

"Biological Services provides viable alternatives to regular broad spectrum insecticide programs in a range of horticultural crops, and have staff to provide the technical backup and support to enable growers to effectively manage IPM programs on their properties," said Managing Director Lachlan Chilman.

"A key problem at present is insecticide resistance to many major pests such as mites, aphids, whiteflies and thrips. Biocontrol and IPM programs are intelligent options to protect crops and reduce pesticide usage.

"Over the last few years, the greenhouse strawberry industry has seen great benefits from Biological Services IPM programs. The single biggest factor in this success has been the addition of Orius for extra thrips control to complement the longtime favourite beneficials of Neoseiulus cucumeris, Phytoseiulus persimilis, and Hypoaspis," he said.

"When strawberry production moves from open field growing to covered structures, the environment is changed. Covers are an advantage to reduce spoilage from rain and for Botrytis control, but the conditions are generally warmer and drier. This increases the breeding of Western Flower Thrips (WFT). The inclusion of Orius released at flowering (alongside Cucumeris) under the covers has made control of WFT much easier.

"The timing of releases is paramount to success. Orius should be released throughout the crop when the first flowers start to open, and they will begin to breed immediately. Once well established, a healthy Orius population will control WFT for the entire season – usually with no WFT sprays required at all."
However, it is imperative that toxic pesticides that may harm *Orius* and other beneficials are kept to a minimum,” Mr Chilman said.

“Controlling secondary pests such as mirids, caterpillars and aphids can be challenging. For this reason, it is important for growers to work closely with our consultants, only spraying products and rates that are compatible. Toxic products must only be applied as advised. This can be done occasionally when *Orius* populations are well established with plenty of eggs laid for fast recovery of beneficials once toxic residues subside.

“Powdery mildew was difficult to keep under control this season, particularly in the cooler regions such as Tasmania. While most fungicides are compatible with the program, caution must be taken when applying Flint®. It should also only be used several weeks prior to release of *Orius*, or after *Orius* is well established,” he said.

“Using *Cucumeris* in conjunction with *Orius* helps to control WFT larvae under the calyx [as this is where *Cucumeris* live and breed]. Good numbers of both predators are essential to reduce bronzing damage from WFT. If there are prolonged periods of low flowers, it may be necessary to re-apply both predators. Cyclamen mite is another pest, which *Cucumeris* will help to control. Plants with visible symptoms should be targeted with extra *Cucumeris* to ensure control.

“As in open field strawberry crops, *Persimilis* is still the best biocontrol agent for Two-Spotted Mite (TSM). Once again the timing of releases is critical. Certain miticides are still available for use, but TSM are becoming resistant to most of these, and others are toxic to *Orius* or predatory mites. For this reason, releasing *Persimilis* early, and in sufficient quantities is imperative for season long TSM control,” Mr Chilman said.

“*Hypoaspis* continue to be an important part of the strawberry IPM program. These should be released at time of planting. Not only will they prevent fungus gnats from building up, (which damage new roots on runners and spread disease), but will also aid control of WFT that pupate in the soil. *Hypoaspis* has been shown by research to control up to 30 per cent of resident thrips populations, so in conjunction with *Cucumeris* and *Orius* help to form a formidable program for WFT suppression.”

For more information contact:
Lachlan Chilman, Managing Director
Biological Services 0403 727-252
lachlan@biologicalservices.com.au
info@biologicalservices.com.au www.biologicalservices.com.au
THE FINAL WORD:

THE DIRTY DOZEN

DR MIKE NICHOLS LOOKS AT ALTERNATIVE SOLUTIONS TO USING PESTICIDES IN THE GREENHOUSE.
In the USA every year the Environmental Working Group (EWG) looks at the results of the US Department of Agriculture’s testing and ranks the “dirtiest” and “cleanest” fruit and vegetables in the supermarket in relation to the amount of pesticide residue they contain, both within, and on the outside.

The “bad” produce includes: apples, celery, peaches, strawberries, spinach, blueberries, and lettuce, while the “good” produce includes: onions, sweet corn, avocado, asparagus, cantaloupe, kiwifruit, cabbage, watermelon, and kumara.

The purpose of this survey appears to be to suggest that only organic produce is safe, and this appears to be a continuation of a misconception. It is necessary in many cases to spray organic crops with pesticides in order to grow a crop of acceptable quality and yield, and not all organic sprays are safe for the consumer.

For example, copper is a heavy metal and should always be used sparingly to avoid residues on the crop and also in the soil.

I do not, however, have too many problems with the inclusion of strawberries on the bad list, because in any country (such as New Zealand) when it can rain during the harvest season, it is absolutely necessary to spray with pesticides regularly in order to protect against fungal problems such a *botrytis* fruit rot.

However, as strawberries (and other berry fruit such as raspberries and blackberries) must be harvested sequentially as they ripen, there is no way that spray residues are not on the fruit, and washing this type of fruit is not an option.

Of course, it can be argued that using pesticides with a short withholding period will cover this, but no pesticide is absolutely safe for everyone, and it would be preferable to use pesticides.
(whether approved for organic or conventional production) as little as possible, particularly during the fruit harvesting period. Last year, in a very wet summer some outdoor strawberry growers were found to have excessive pesticide residues on their fruit.

Fortunately, the solution is relatively straightforward, as we discovered in our greenhouse strawberry studies that by putting a roof over the crop (a rain shelter) immediately changes the situation. This can be further improved by growing the crop above the ground hydroponically (using the so called a tabletop system). *Botrytis cinerea* (the fungus, which causes grey mould on strawberry fruit) does not initially infect fruit, as it predominantly gains entry via the dead flower petals, so that as a further precaution a single spray with a fungicide at flowering would act as an additional insurance, although we have never done this. I should add that in our greenhouse (tabletop) strawberries, we have harvested only a handful of rotten fruit from several hundreds of kilos of ripe fruit, without applying any fungicides or pesticides.

We have used the regular applications of biologicals (supplied by Bioforce) to control two-spotted mites, cyclamen mites and thrips. *Phytoseiulus persimilis* for two-spotted mites, *Neoseiulus cucumeris* for thrips and cyclamen mites. Although what we are doing cannot be classified as organic, as we are growing hydroponically using conventional nutrients, it certainly could be described as pesticide free. This is (apparently) the main reason why people who buy organic choose organic rather than conventionally produced fruit and vegetables.

**About the author**

Dr Mike Nichols is a retired lecturer from Massey University and a regular contributor to *Practical Hydroponics & Greenhouses* magazine. He has travelled around the world consulting on horticulture and is one of only 25 honorary members of the International Society for Horticultural Science (ISHS).  

*Email: oxbridge@inspire.net.nz*
Step by step
Conversion from soil to soilless
Commercial growers guide

A new manual has been released to help growers thinking about converting to hydroponics.

For many growers, investing hundreds of thousands of dollars in new high-tech greenhouses is not an option.

However a step-by-step conversion of their existing structures may be feasible.

Converting to hydroponics' takes growers through the decision making process of converting to hydroponics, making sure growers understand both the benefits and limitations of hydroponic systems.

Book / DVD Special Features
- Existing structure conversion examples
- Yield Improvements
- Return Improvements
- Benefits & Limitations
- Dispelling common myths surrounding hydroponic systems

DVD Bonus - Videos of conversion sites.

Converting to hydroponics

Kay Ferguson, Jeremy Batley-Parker, Barbara Hall

This commercial hydroponic growers manual was produced by researchers from South Australia R&D Institute (SARDI) and the NSW Department of Primary Industries in collaboration with growers and consultants.

The project was funded by the vegetable levy through Horticulture Australia Limited.

Book - hard copy $54.95
170 pages plus bonus videos
$41.55 + $13.40 post & handling

Book - DVD form $21.50
PDF of book plus bonus videos
Suit computer or TV
$15 + 6.50 post & handling

PRACTICAL HYDROPONICS & GREENHOUSES
The Commercial Growers’ Magazine

DEDICATED TO DELIVERING NEWS, REVIEWS, PRODUCTS, ‘HOW-TO’ ARTICLES, FARM AND INDUSTRY PROFILES ON HYDROPONICS, GREENHOUSE, AQUAPONIC, IRRIGATION, INTEGRATED PEST MANAGEMENT AND HORTICULTURE LIGHTING TECHNOLOGIES.

Now in its 25th year of publication, Practical Hydroponics & Greenhouses has established itself among the world’s most authoritative publications on protected cropping technology.

www.hydroponics.com.au

- Read original content enriched with links.
- Get immediate access to your magazine, including back issues anytime and anywhere.
- Print or download your magazine for offline reading.
- Create a greener planet by reducing paper.

Free Digital Online Magazine