SAVING OUR SEEDS: world seed market surges!

SIMPLIFIED HYDROPONICS
Using hydroponics to help end hunger

BUGS TO THE RESCUE
Insects to feed the global population?

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By 2050, the world’s population is projected to rise to 9.6 billion people and sustainably growing enough food for a hungry world will be one of the greatest challenges facing humankind. A recurring theme in a number of our stories for this issue is the question of what measures need to be taken to feed this growing global population and what will be the challenges along the way.

Seeds are invaluable resources. In our feature, *Saving our seeds* we look at how exponential growth in the world seed market is being driven by this seemingly insatiable demand for food by the global population. A recent report describes how global seed market vendors have had to adapt to the combined economic pressures of global population growth, climate change, scarcer land resources and shifting agricultural policy dynamics brought about as a result of increasingly stringent regulation. The report also traces how, as the demand for organic products increases, so does the demand for organic seed in all sectors, including the corn, soybean and sorghum sectors.

The first so-called ‘Green Revolution’ used hybrid seeds, modern crop management and chemical fertilisers and pesticides to save millions of lives. However, the World Resources Institute said it came at a cost: Agriculture has become the “dominant driver” of tropical deforestation, accounts for 70 per cent of all freshwater withdrawals from rivers, lakes and aquifers and emits much of world’s greenhouse gases.

Many industry experts agree that industrial agriculture has led to a dramatic erosion of the world’s seed diversity. According to the United Nations Food and Agriculture Organisation (FAO), in the century leading up to the year 2000, the world lost 75 per cent of the genetic diversity of its agricultural crops.

It is sobering to think that 10 companies now control more than two-thirds of global proprietary seed sales. As some big corporations move to consolidate their stranglehold on seed proprietorship by patenting more and more seeds, and with the advent of GM crops, a groundswell movement is fighting back, notably with its advocacy of heirloom seeds and ‘Open Source’ seed saving networks.

Still on the theme of food security, respected industry expert Peggy Bradley looks at Simplified Hydroponics and how it may hold the key to ending world hunger while our story on French insect breeding innovator Ynsect shows how the company has raised a total of $37m over the last three years to tackle the issue of food security through mass-scaling the breeding of insects for global animal feed markets.

*Enjoy this issue!*

Christine Brown-Paul
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Cover: With a growing global population driving unprecedented demand for food, seeds are becoming an increasingly precious commodity.
NEW AUSTRALIAN WEBSITE FOR SEASONAL WORKERS

Fruit Growers Tasmania (FGT) has released a new online campaign with the goal of attracting more seasonal workers, using their new website: www.tasagjobs.com.au - is an initiative of Fruit Growers Tasmania and was made possible by a grant of $10,000 from the State Government and support from industry, 10 regional councils and Regional Development Australia.

FGT business development manager Phil Pyke said the website would be a hub for seasonal jobs in all sectors, including both visitors to Tasmania and locals.

Farmers will be able to post job openings, which it is hoped will increase their visibility for seasonal workers. The website will also provide Tasmanian agricultural news and information for workers, including work health and safety, work readiness and application advice.

“Growers can place adverts for two months free. [Filling] jobs in the sector is a challenge for everyone,” Mr Pyke said.

“The State Government understands that agriculture and tourism are competitive strengths for Tasmania.

“With industry concern over the backpacker tax on Tasmania’s agricultural and tourism sectors, the State Government is pleased to fund Fruit Growers Tasmania to co-ordinate an industry-run, online campaign, including targeted social media, to promote harvest jobs,” he said.

source: themercury.com.au

PLANT-BASED DIET RANKED BEST FOR 2017

In a recent look into the healthiest diets run by the US News and World Report, the DASH diet was ranked first among all the categories.

They asked for the expert opinion and feedback of a panel of nutritionists, dieticians, and doctors specialising in diabetes, heart function, and weight loss who ran
over 38 separate diet plans and ranked them on various categories. The categories included how easy the diets were to stay on, weight loss, heart function, long-term and short-term results and the ability to fight off heart diseases and diabetes.

For the seventh time in a row, the plant-based eating plan has been named as the best choice overall. It is followed by the Mediterranean diet, which came up from fourth place last year.

DASH stands for Dietary Approaches to Stop Hypertension. However, it is clear that its benefits go beyond combating high blood pressure, the US News says.

DASH includes the Mediterranean diets plus most recommended diets such as focusing on whole grains, fruit, vegetables, low- or no-fat diet, lean meat cuts, chicken, and fish. It also includes daily consumption of nuts, seeds, and legumes or beans to better round out the diet.

source: itechpost.com

AUSSIE ACAI BERRIES: UNPROVEN HEALTH CLAIMS

Professor Christine Parker, a legal expert from the University of Melbourne says around 33 per cent of açai berry products on sale in Australia list untested claims about the health benefits of the fruit. The benefits claimed on marketing material include anti-ageing properties, and prevention of serious conditions like cancer and heart disease.

In a paper published in the Federal Law Review, Professor Parker says Australian consumers have far less protection from misleading or false food claims than Europeans.

“With obesity and diabetes on the rise, consumers are increasingly anxious to make healthy food choices,” Professor Parker said.

“Consumers are at risk of making expensive or unnecessary choices because our regulations fail to cover many health claims, and are inadequately enforced.”

Unlike EU regulators, which check all food health claims by manufacturers and retailers, Australia only regulates a list of specific health claims, under the revised Standard 1.2.7 of the Australia New Zealand Food Standards Code, which came into force in April.

Any claims not on this list can be "self-substantiated" by industry.

source: medicalxpress.com

JAPANESE-AUSTRALIAN TIES STRENGTHENED

Chief Minister of the Northern Territory (NT) in Australia, Michael Gunner recently met with Mr Katsuo Yakura, Parliamentary Vice Minister for Agriculture, Forestry and Fisheries, to discuss future cooperation in agriculture and aquaculture.

“The NT Government and the Japanese Ministry of Agriculture Forestry and Fisheries moved an important step closer to an official Memorandum of Cooperation and to
foster closer ties,” said a NT Government spokesperson.

“The Memorandum of Cooperation will promote and progress research and development in agriculture and aquaculture production in the Northern Territory and supply chain logistics into South East Asia.

“This aligns with Japan’s Global Food Supply Chain strategy and with the Northern Territory Government’s focus on agriculture and aquaculture developments,” he said.

At the meeting it was agreed that this work would build mutually beneficial trade and investment linkages into the future between Japan and Australia particularly in soybean, barramundi and asparagus.

“The Northern Territory is uniquely positioned to grow and supply premium markets into the future and welcomes Japanese agribusiness and supply chain investment,” Mr Gunner said.

“Japan is very serious about the potential for agribusiness in the NT when it comes to asparagus, soya beans and the mighty barramundi. “They are very keen also to be part of our summit process and they have very strong ideas about infrastructure investment in the NT that could unlock private sector investment and especially targeting the agribusiness sector.”

**PLANT PROTECTION MINUS RESIDUE**

Ozone (O₃) is a natural gas that is characterised by its oxidising and devitalising effect, depending on the amount used. The key advantage is that after it kills pathogens, there is no residue, because the gas is converted into oxygen.

Low concentrations of ozone dissolved in water can be sprayed to eliminate many kinds of harmful organisms that live on plants, including fungi, bacteria or viruses. However, this does not lead to the emergence of resistant strains.

A new sprayer made by Italian-based company Mowat looks to help with this. According to the company it combines a low volume sprayer with an air-assisted boom and a patented generator for ozonised water. Mowat claims the movement of air ensures even distribution on plants for optimum coverage and protection with zero residue. Mowat is designed for use in orchards and vineyards.

**MULBERRIES: KEY TO WEIGHT LOSS?**

New hope for treating obesity may have been found with the mulberry compound, rutin, according to new scientific data published in the official journal of the Federation of the American Society for Experimental Biology.

Results from a recent clinical trial showed that rutin treatment significantly reduced adiposity, increased energy expenditure and improved glucose homeostasis in both genetically obese, and diet-induced obesity mice.

Interestingly, rutin also induced brown-like adipocyte formation in the subcutaneous adipose tissue in both obesity mouse models. It is understood that brown adipose tissue is a key thermogenic tissue in rodents and other small mammals, including newborn humans that defends core body temperature in cold weather.

It is widely suggested that a therapy for weight loss must involve a decrease in food intake and/or an increase in energy expenditure. Energy expenditure, through activation of brown adipose tissue may prove to be a key approach.
Rutin is a natural compound extracted from the mulberry, which is widely used as a capillary stabiliser, with little to no side effects. It also appears to have an effect on regulating whole-body energy metabolism by enhancing brown adipose tissue activity.

Recent studies, including reports in the *New England Journal of Medicine* unambiguously demonstrate that healthy adult humans have significant deposits of metabolically active brown adipose tissue in their bodies.

In this study, researchers found that rutin directly bound to and stabilised sirtuin 1 – which is thought to be linked to insulin resistance in humans and to play a key role in response to stresses (such as heat or starvation) and to be responsible for the lifespan-extending effects of calorie restriction.

Methods of delivering UCP1 to cells (e.g. by gene transfer therapy) or methods of its upregulation have been an important line of enquiry in research into the treatment of obesity, due to their ability to dissipate excess metabolic stores.

The researchers concluded that their findings reveal that rutin is a novel small molecule that activates brown adipose tissue activity and may provide a novel therapeutic approach to the treatment of metabolic disorders.

**COSTA GROUP SHARES SOAR**

The stock of Costa Group Holdings reached an all time high on 4 January 2017, aiming for a target of $3.60 by the end of the day, or 4.00 per cent above the starting share.

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price. Unfortunately, the shares never reached the target, which would have been worth $44.00 million more.

Costa Group Holdings stock has risen 11.25 per cent since June 8, 2016 and is trending upward and has even outperformed the S&P500 by 3.58 per cent.

Costa Group Holdings Limited is a horticulture company. The company has a market cap of $1.10 billion. The company is principally engaged in the growing of mushrooms, blueberries, raspberries, glasshouse grown tomatoes, citrus and other selected fruits within Australia and provides packing and marketing solutions for Australian exports.

source: friscofastball.com

IMPROVING FOOD SAFETY

The Active and Intelligent Packaging Industry Association (AIPIA) has been formally accepted as a partner organisation of the EU-funded NanoPack project, which will develop and introduce nanotechnology-based antimicrobial packaging to enhance food safety and reduce food waste. The project is funded with €7.7 million under the Horizon 2020 EU Framework Programme for Research and Innovation.

The project aims to develop and demonstrate state-of-the-art antimicrobial packaging solutions for perishable foods based on natural nano-materials that will prevent food-borne illness outbreaks and reduce food waste caused by early spoilage.

The three-year project is aimed at demonstrating, validating and testing food-packaging products with antimicrobial surfaces based upon natural materials. NanoPack will address scientific, technological, economic, safety and regulatory challenges to ensure that consumers eventually will be able to benefit from this novel packaging.

NanoPack is led by the Technion Israel Institute of Technology.

“NanoPack will demonstrate a solution for extending food shelf life by using novel smart antimicrobial surfaces, applied in active food packaging products,” said Dr Ester Segal, NanoPack’s coordinator and associate professor at the Technion. She added that NanoPack would help reduce the 1.3 billion tonnes of food wasted each year, which cause major economic loss and significant harm to the entire world’s natural resources.

“We intend to present better performing, safer and smarter products that will position Europe as the leader in food nanotechnology and smart antimicrobial packaging while increasing competitiveness and growth,” Dr Segal added.

BIOLOGICAL CROP PROTECTION HELPS REDUCE PESTICIDE USE

Thanks to the introduction of biological crop protection with predatory wasps and mites, bacteria and fungi, among others, the use of pesticides and other chemical agents in horticulture has dropped by between 50 and 90 per cent over the past 50 years.

The increasing importance of food safety and sustainable agriculture has also led to the growing use of biological crop protection in outdoor cultivation, according to Dutch family company, Koppert Biological Systems, which celebrates its 50th anniversary this year. In the past five decades, Koppert has developed from a small pioneering concern with four employees, into a multinational with an annual turnover of 190 million euro and 1200 employees in 26 different countries, including China, Brazil, the US and Russia. The company exports to more than 90 countries.

Its founder, Jan Koppert, started with just one insect in 1967; a predatory mite to control an infestation in his cucumber crop. Today, Koppert is a market leader in

Predatory mite - Koppert Biological Systems
Alstroemerias to Flower with Philips LED Lights

Philips Lighting, a global leader in lighting, has announced that the Dutch alstroemeria grower Hoogenboom Alstroemeria is moving to hybrid lighting in its 1.5-hectare greenhouse with Philips GreenPower LED toplighting. By using Philips GreenPower LED, grower Dick Hoogenboom will shorten growth cycles, increase quantity and quality of yields while reducing energy consumption up to 42 per cent.

Ries Neuteboom, Key Account Manager for Philips Horticulture LED Systems said: “More and more alstroemeria growers are choosing hybrid lighting as growing alstroemerias require both light and heat at the same time. Hybrid lighting systems with a combination of LED and Philips SON-T lighting answers the need to control heat and light separately allowing the grower to grow better crops, year-round with greater control over growing conditions while reducing energy costs.”

Grower Dick Hoogenboom opted for 50-□mol LED lamps providing him better climate management as well as flexibility to manage lights and heat independently.

“Our 100-umol Philips SON-T installation was already quite powerful, but I wanted to be able to provide even more light so that I can improve quality even more. The initial results appear to be positive.”

The crop is growing well and the production also looks excellent, said Dick Hoogenboom.

“Hoogenboom Alstroemeria will use light recipes specially designed by Philips Lighting to support its growing strategy. Philips Lighting has invented specific light recipes for specific crops to help growers further enhance their crop results. Using a recipe, a grower can steer specific plant characteristics, from compactness, color intensity and branch development to flowering to improve results. The company’s light recipe knowledge has been developed over many years of cooperation with growers, university, and research sites to enhance growth.”

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biological crop protection in horticulture and produces mites, insects, microorganisms, plant extracts, bacteria and fungi. These natural solutions for pests and diseases in horticulture are used worldwide against whitefly, aphids and spider mite, and all sorts of diseases. The use of pesticides has dropped sharply especially in tomato, cucumber and sweet pepper cultivation. In the last few years, biological solutions have also been increasingly used in seed treatments, food crops, fruit and ornamental plant cultivation.

Another important company cornerstone is natural pollination by bumblebees, which Koppert has produced since 1988. Koppert has developed various innovative hives for this purpose. The use of bumblebees cannot be combined with several types of chemical crop protection and this too has led to a drop in the use of chemical agents.

Recently, Koppert started to produce microbiological organisms such as fungi and bacteria for outdoor cultivation, which increase crop resilience and enrich the biodiversity and nutrient content of the soil. The company sees this as a huge growth market.

The company says the use of chemical crop protection can be reduced considerably in outdoor cultivation.

“There is an increasing demand for quality and safe food worldwide,” said Executive Board Member, Henri Oosthoek.

“We need to move towards agriculture and horticulture that does not work against nature but in harmony with nature. Resulting in more, better and safer food with less pressure on the environment. This is what we try to contribute towards each day.”

**IT’S NOT ALWAYS EASY BEING GREEN**

A Melbourne woman received a surprise while preparing a salad. Opening her bag of Coles mixed salad she found a little frog she assumed was dead.

“As I was washing my lettuce earlier for dinner, I noticed at the bottom of my strainer there was a frog, I was a little shocked and concerned that the frog was dead,” Ms Latinaa said.

“To my surprise the frog was alive as per the video attached. I’m very appalled with the situation after the recent break out of (salmonella) from packaged lettuce, you would think that the produce would be triple checked prior to being released to the store.”

Coles responded to Linda asking to discuss the matter privately. According to Ms Latinaa the frog is still healthy and was unharmed.

**NEW SMARTPHONE DETECTS STRAWBERRY SWEETNESS**

A new sensor called the SCiO can detect the sweetness of strawberries before you even eat them. Using a miniaturised near-infrared spectrometer, the sensor detects the molecular signature of things. The sensor is included in the new smartphone, the Changhong H2 that offers developers the tools to create different apps with one even detecting body fat.

The sensor was crowd-funded on Kickstarter a few years ago and is now heading into full retail, now that it has shrunk enough to fit into smartphones. A writer at The Verge tested the new smartphone sensor – while at first skeptical, he found that it had accurately detected the sweetest strawberries out of the bunch. The phone will first be released in China and then in the United States.

Source: heraldsun.com.au

**PLANTS SENSE GRAVITY**

Researchers from Japan’s Tohoku University have discovered that plants can sense gravity. Published in Nature Microgravity journal, the study used samples grown on board the International Space Station, the research team highlighting the...
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valuable contribution of the gravity-sensitive CsPIN1 protein to this process.

The team of researchers from Japan’s Tohoku University discovered how a protein helps plants sense gravity to boost their chances of survival, after cucumber seedlings germinated under the very weak gravity—or microgravity—conditions of the International Space Station.

Plants are experts in survival and can control the direction of their roots to maximise the use of resources around them. Using specialised cells, they can sense gravity and redistribute hormones, called auxins, to stimulate growth and allow vital features of the plant to develop.

The report also states that the role of the protein in facilitating the transport of BSE 0.63 per cent the growth hormones had first been suggested in previous experiments conducted on Earth.

To gain further insight, the researchers loaded cucumber seeds into specially designed canisters, which were sent up to the space station.

Cucumbers were chosen for the study as, like other “cucurbitaceous” seedlings such as melons, pumpkins and squash, they feature specialised protuberances, or pegs, whose formation is regulated by gravity. These pegs form during the plant’s early growth stage to help the seedlings emerge from their hard seed coat and anchor the developing plant in the soil while its roots form.

The experiment showed that CsPIN1 protein could relocalise under the influence of gravity.

Specifically, this change in the position of protein was found to occur in the so-called transition zone of the cucumber seedling where the pegs develop.

This behaviour stimulates the formation of a cellular canal capable of transporting growth hormones from one side of this zone to the other, the study said.

These findings point towards the mechanism by which the seeds are able to turn on and off the growth of their anchoring pegs in relation to their orientation with respect to gravity. And, as result, boost their chances of survival.

Source: IANS, Zeenews.india.com
HYDROPONIC GREENHOUSE: EXPECTATIONS SURPASSED SINCE APRIL 2016

Swiss company Migros Aare has obtained oak leaf lettuce and a three-lettuce combo from Forster Salatgarten, who cultivate the lettuce in a carbon-neutral hydroponic greenhouse in Oftringen. Migros has already sold about 800,000 of these lettuce varieties. Due to the year-round production, the import of oak leaf lettuce has been reduced by 13 per cent. It is hoped that by the end of March 2017, a CO2 reduction of 46 metric ton could be achieved.

The hydroponic greenhouse in Oftringen (about 60 km west of Zurich) was designed and built by Patrick Forster, the managing director of Trachsel in Pfaffnau. Migros Aare was convinced by the advantages and supported the project by committing to a purchase of two million lettuces per year.

Thanks to the hydroponic greenhouse, the entire lettuce production and supply chain stays in the Aargau region the whole year round. Migros Aare reduced the import of lettuce by 13 per cent; that is about 200,000 heads of lettuce.

The greenhouse is carbon-neutral and heated by the surplus heat of the neighbouring incinerator. This system will lead to a reduction of about 46 metric tons of CO2, compared to a greenhouse heated with fossil fuel, in the period of December 2016 to March 2017. According to the calculations of "myclimate", a Swiss climate protection foundation, this corresponds to a 180,000 km car journey.
ITALY: VEGETABLES IN THE SITTING ROOM WITH TOMATO+

A clever mini-greenhouse to grow over 30 types of vegetables at home throughout the year. This is what a company from Brescia has introduced with their new invention that enables easy-to-grow vegetables with no chance of them being affected by weather or parasites.

Tomato+ is a start-up established by 28-year-old Daniele Rossi, who is about to launch a truly unique tool onto the market. “We have patented Tomato+ in 160 countries and we believe it is revolutionary. It is more precise and technologically advanced than similar products available on the market, especially abroad. The grow-box measures 60x60x200 cm and it could work as a furnishing as well,” explains 29-year-old Claudio Guerrini, sales manager.

According to the developers, growing vegetables has never been so easy. You just need to place the pod with the seed inside the box, select the crop on the display, fill the 20-litre tank with water and add mineral salts. The software will set the temperature, humidity, hydroponic management and light cycle automatically. The grow-box is made up of 4 cells and each can hold one tray with up to 81 (biodegradable) pods. Lettuce needs more room, though, so each tray can hold around 20 pods.

But what is truly new, according to the promoters, are the LEDs and management program. At the moment you can choose from among 30 products, but the team’s agronomist and IT expert are working to widen the range. Among the products that can be grown there are: basil, parsley, rocket, valerian, spinach and lettuce.

The grow-box is also perfect for restaurants who want to amaze their customers with closer-than-local ingredients.

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GET MORE LIGHT WITH LESS ENERGY

US company LumiGrow Inc. has announced the worldwide release of the Pro Series E, a horticultural lighting product line that combines the best in optimised spectrum LED technology with cloud-based wireless control. Each Pro Series E fixture comes with a wireless control module included, so you can manage your lights from any phone, tablet, or computer via the SmartPARTM Wireless Control System. You can get up and running with the most modern lighting strategies available quickly and securely, backed by a five-year warranty and the industry’s best research operating for the last 10 years.

“We’ve engineered our lighting solution with our customers’ needs in mind. Our energy-efficient and intuitive design, utilises industry leading-highest efficacy LED’s, increased light output (PPF/W), robust and highly reliable components-drivers, and a user-friendly cloud-based software interface, boosting the bottom-line and overall performance,” said LumiGrow’s Executive VP of Operations and Engineering, David Littleton.

“Our new product line empowers our users with ease-of-use and nimble response to changing conditions. Cloud-based wireless controllability allows for real-time adjustment of output intensity and spectral ratios for optimising photosynthesis, achieving high yields, and improving commercial quality, all from your wireless device.”

The Pro Series E product line takes advantage of some of the newest enhancements in LED technology, to provide more light.
output than our previous Pro Series, all while keeping energy-usage low. "We’re happy to announce that when compared to HPS standard lamps, the Pro Series E typically pays itself off in electricity-usage savings within three years, with additional savings accrued each additional year of the fixture’s life," said VP of Sales and Marketing, Jay Albere II.

The new fixture delivers 50 per cent energy-savings versus HID, runs up to 50 per cent cooler than HID lighting, and maintains light output.

LumiGrow also enables its devices with spectral controllability so that you can achieve specific plant responses for higher quality. To learn more about what’s possible with LumiGrow lighting solutions and to read their spectral control guides and research papers, visit www.lumigrow.com.

NEW HORTICULTURE LIGHTING CALCULATOR
Lumileds has introduced an online calculator that fixture manufacturers can use to more quickly optimise the design of their grow lights. The calculator allows the user to input various LED combinations and operating conditions to generate the spectral power distribution, photosynthetic photon flux (PPF), and power usage of a fixture using Lumileds LUXEON SunPlus Series LEDs.

Designed to allow easy modifications of LEDs and operating conditions, the calculator facilitates fixture design by generating real-time feedback on spectral power distribution. Lumileds LUXEON SunPlus Series of LEDs are the only horticulture LEDs on the market that are binned by PPF and wavelength to ensure ease of system design and enable wavelength tuning for maximum crop yield in both greenhouse and vertical farming environments.

"With the Horticulture Lighting Calculator, fixture manufacturers can test many lighting scenarios in a short period of time, so that their optimum designs can be brought to market much more quickly and efficiently than if each potential fixture were built and tested individually,” said Jennifer Holland, Product Manager of the LUXEON SunPlus Series LEDs and Horticulture Lighting Calculator.

The LUXEON SunPlus 20 Line of LEDs is optimised for commercial greenhouses and uses 2.0 x 2.0 mm LEDs in Royal Blue (445 -455 nm), Deep Red (655-670 nm), Far Red (720-750 nm), Lime (broad spectra) and Cool White. The LUXEON SunPlus 35 Line is optimised for vertical farming, using Royal Blue, Lime, and three shades of Purple LEDs in 3.5 x 3.5 mm format.

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CREDIT CARD SIZED LOGGER TRACKS SHIPMENT TEMPERATURE
An extremely small NFC data logger to monitor temperature-sensitive products during transport has been announced by Polish-French company, Blulog. No larger than a credit card, this logger can be inserted directly into the packaging and features customisable temperature limits of 15-25°C, 2-8°C or any other user-defined limits. A push button starts and stops recording. A red light-emitting diode alerts the receiver if the temperature range is breached. The receiver can monitor the entire temperature profile, and in particular any breaches, via a smartphone or other handheld device equipped with NFC technology. This data is then automatically uploaded to a secure cloud-based database that can be accessed via an online web portal. The logger can also be programmed with any shipping or product information. The new device will be on show in February at Fruit Logistica in Berlin at: hall B, booth E-19.

NEW STACKABLE PET BEAKERS
Spanish-based company Veripack Embalajes has unveiled a new line of PET packaging named Distripack. “It is compact and easy to stack, secure, transport, store, and shelve. The container is suitable for a greater variety of fresh ready-to-eat products like loose berries or fresh-cut produce,” a Veripack spokesperson said.

The Spanish exhibitor also discussed their range of new beakers with hinged lids, which are designed for stacking thanks to the rounded edges on their bases and lids.

Six different volumes are available: 125, 150, 175, 200, 225 and 250-gram beakers. The 250-gram version has a double-hinged lid and a spout. The packaging material consists of clear PET and is also recyclable. The top and sides are available for labelling and the lid and base are ventilated with drainage holes on the bottom. The stackable PET containers will be shown at Fruit Logistica in February 2017 at hall 5.2, booth D-04.

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SWARMBOTS: FUTURE OF FARMING?
According to Central Queensland agronomist and a director of robotic farm equipment innovator SwarmFarm, Neville Crook, farmers are wasting too much money and effort by putting their faith in big, heavy and complicated equipment for little productivity gain, says “If we’re going to lift productivity we must get farmers out of the tractor cab and back down at ground level to focus on individual plant management. Let the machinery work itself.”

The SwarmFarm business at Emerald in Queensland has been a driving force in developing box trailer-sized robotic platforms to work in paddocks around the clock without needing a farmer nearby. While the current generation of “Swarmbots” has been initially built...
with weed spraying capabilities, Mr Crook said the technology would soon be adapted for tillage, precision planting and mowing.

Mr Crook said Swambots did not need to operate at 20 kilometres an hour like the big rigs because farmers would use several working at about eight km/hour to do the same job – and the machines could work all night if necessary.

The current custom-built generation of Swarmbot platforms cost about $150,000 to make and include weed-seeking gear worth $40,000, but SwarmFarm wants to get a commercial price for its autonomous units down to a cost equivalent to its competition.

source: goodfruitandvegetables.com.au

**THE ART OF RECYCLING**

Nothing in nature is lost, everything is transformed. French company, Idyl claims that Nature was the inspiration for the development of their “Tribu Ecolo” brand of cardboard packaging for tomatoes, which are made from recycled tomato plant fibres. The company sees this as one way to reduce the resources required for production, packaging and consumption.

After harvesting, the stems and the leaves of the tomato plants are collected and shredded. The resulting fibres are mixed with recycled paper and used to manufacture the cardboard material. It is hoped that by using the green waste from tomato plants the company can greatly help reduce deforestation.

Idyl plans to display the 100 per cent recyclable packaging at Fruit Logistica in February 2017 at hall 21, booth E-01.

For more information contact: Brigitte Sénéchal - Idyl FR-Châteaurenard - Tel: +33 4 9024 2001 marketing@idyl.fr - www.idyl.fr

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The new Winterlight Greenhouse of Bom Group, at Wageningen UR Greenhouse Horticulture in Bleiswijk, The Netherlands has seen its second planting of cucumbers. The first planting took place on September 19 last year and was mainly intended to test all systems and to align. The second planting is better matched with traditional high-wire cucumber crops and will provide more comparison information in the coming period.

The Bom Group Winterlight Greenhouse was developed in collaboration with Wageningen UR, Ludvig Svensson, Bayer CropScience and Glascom Horticulture. The project has been made possible by the Greenhouse program Kas als Energiebron, the innovation and action program of LTO Glaskracht and the Ministry of Economic Affairs.

The Winterlight Greenhouse features a new type of screen system, new screen cloth and light-diffusing glass, with more than 10 per cent light gain. The newly designed greenhouse structure is fully equipped with powder coated steel parts with an increased reflection factor of 90 per cent and is glazed with SmartGlass, a new type of diffuse with a large glass size. Even if the glass is wet or condensed, the light transmittance does not decrease.

The cucumbers (High-Power by Nunhems/Bayer) were planted on 27 December. According to the Supervision Commission Research (BCO), the crop does already very well and all BCO members are curious to see the developments between now and the end of the crop around July.

The integrated Iso ++ screen system is mounted in a W-shape for optimal light transmission at closed screen and features a new highly transparent screen fabric of Ludvig Svensson with an even better light transmission. The new greenhouse concept is also equipped with Air in Control, an active ventilation system with heat recovery.
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SMARTGLASS: MORE LIGHT IN AUTUMN AND WINTER

Manufacturers of SmartGlass, Dutch company Glascom Tuinbouw is one of the consortium-partners in the Winterlight Greenhouse, a research project of Wageningen UR. The goal of this project is to develop a greenhouse that has maximum light transition during the period between October and April. To put it in another perspective, the goal is to build a greenhouse with low investment costs and energy consumption that can realise high crop yield.

A number of other large greenhouses in Europe and the United States have been also built using SmartGlass, which boasts some intelligent properties compared to traditional greenhouse glass. For example, the glass has a very smooth surface structure. Dirt hardly attaches to the surface. Likewise, the glass is hydrophilic: condensed water doesn’t form droplets (which can fall down), but forms a thin film flowing to the drain (and also drains some remaining dirt).

The biggest innovation of SmartGlass is its ‘adaptive haze’ property. A patented modification to the basic glass causes diffuse light distribution. The haze (the amount that the light scatters) drops if the glass is moist, at the same time the glass becomes clearer and the light transition increases with several percent points.

When the glass is condensed or wet, the haze will drop, but light transmission will go up, especially in the angles of incidence between 40° and 70°. The glass becomes transparent if wet and after the glass dries again, it will return to its dry properties.

SmartGlass from Glascom Tuinbouw is also available in large quantities and comes in three different types: low haze, mid-haze and high haze, with or without antireflection treatment. You can also choose an antireflection treatment for the glass for specialised horticultural purposes.

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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...

Question: Why are my tomatoes and capsicum turning black?
I have a small greenhouse in which I grow 12 tomato and six capsicum (sweet pepper) plants. They are growing in bags of dripper fed coco peat. I use a standard “bloom” liquid fertiliser at the recommended strength (4 ml each of A and B per litre water). The older fruit of both the tomato and capsicum have turned black on the bottom. The tomato plants generally look OK, but the capsicum plants are looking poorly.
Can you suggest what is wrong and what I can do to fix the problem?

Answer: Blossom End Rot
The problem you have is called blossom end rot. It is a physiological disorder due to a lack of calcium in the fruit. It is rarely caused by insufficient calcium in the hydroponic solution, but rather because the calcium ions cannot get to the fruit, especially to the end furthest from the stem. This is usually caused by adverse climatic conditions, possibly aggravated by poor hydroponic management. Another point is that the symptoms take about two weeks to show up from when the problem occurred. In your case it seems to be an ongoing problem, so unfortunately, your younger fruit are also probably going to be damaged.

Possible causes
I expect that you have had many days of high temperatures, which result in the plants transpiring as much water as they can. The classic conditions for blossom end rot are a hot sunny day following a few days of dull weather. This results in a surge in growth and the fruit grow without being able to get enough calcium to meet their needs because it is being locked into the leaves due to the high water demand there.

I suspect that there may have also been a very strong influence from your root zone solution management.

Root zone conditions
The important solution to consider when managing hydroponic systems is the solution around the root zone. This especially applies to EC (electrical conductivity), which is the measure of solution strength, as much as to other properties such as pH, aeration, etc. Good hydroponic management requires regular checking of the root zone solution pH and especially EC. Water demand upon the plant is primarily transpiration, which in turn is mainly driven by the radiation received by the plant leaves. Other significant factors are temperature, humidity and movement of the air.

Water uptake – osmosis
Water uptake by plant roots works through the natural process of osmosis. Osmosis is the process of water movement through a semi-permeable membrane, driven by a concentration difference across the membrane. A semi-permeable membrane is one, which allows the passage of water, but prevents the passage of virtually all other ions, molecules, and particles such as bacteria. Water flows from the weaker solution into the stronger one.

The root cells work so they are effectively a type of semi-permeable membrane. In hydroponics, the root zone solution normally has a strength that is lower than the solutions within the plant. Therefore the water transfer is...
from the root zone solution into the plant. If the root zone solution has a very low EC (close to zero) the osmotic pressure difference will be quite high and the water transfer will be high. As the root zone solution EC is increased the osmotic pressure difference is reduced and therefore the water uptake is also reduced.

**Your probable cause**

Depending upon your fertiliser brand you would usually have an EC of your nutrient solution of about 2.5 mS/cm. You probably don’t have an EC meter, or if you do you don’t measure the EC of the run-off. In summer conditions the plant uses more water (trying to keep itself cool) than nutrient, hence the EC of the root zone solution rises. Typically, if there is 30 per cent run-off, an input of EC 2.5 mS/cm would rise to about 3.5 mS/cm in the run-off solution.

If the percentage run-off is significantly lower, the EC of the run-off solution will be substantially higher. I have measured the run-off from systems where the run-off was never checked and found ECs of over 10 mS/cm, the limit of my meter.

Very high ECs will severely inhibit the plant’s water uptake. At the same time the water demand is very high, but can’t be satisfied, so the plant temperature rises and damages the plant. I think this has happened in your case.

Specifically, concerning blossom end rot, the water flow, containing the calcium ions, gets dragged to the leaf to be used for transpiration. What calcium is in the water is locked into the leaves (known as a calcium sink) leaving none for the fruit. The end result is blossom end rot in both tomatoes and capsicum.

Tomato is a plant unusually tolerant of high levels of EC in the root zone. However, capsicum is much less tolerant and suffers severely with high EC. This has been the case with your plants and unfortunately your capsicum plants are unlikely to recover.

**What to do?**

**My suggestions are as follows:**

Permanently reduce the strength of your feed to about EC 2 mS/cm by adding only 3 ml each of A and B concentrate per litre. Immediately use this solution to flush through all your bags and displace the current high EC solution. Thereafter continue to use this feed solution, but regularly measure the volume of the feed and run-off and keep the percentage run-off to at least 30 per cent. If you have an EC meter, keep the run-off EC under 3, especially for capsicum.

To reduce the heat load on the plants cover the top of your greenhouse with shade cloth or whitewash and maximise any venting.
SAVING OUR SEEDS

The global fruit and vegetable seeds market is projected to grow at a CAGR of 8.10 per cent from 2016 and reach USD 14.00 billion by 2022. With a growing world population driving unprecedented demand for food, seeds are becoming an increasingly precious commodity.

BY CHRISTINE BROWN-PAUL
Burgeoning global population is driving seed market growth.
Across the world, a rise in need for food for growing populations, together with factors such as demand for nutritional food, environment friendliness, innovative production practices, new product offerings, and advent of modernisation of agriculture has lead to the growth of the market for seed industry. The seed market is primarily driven by the consumption of its end products and is gaining awareness among farmers.

Fruit and vegetable seeds are used for high-quality crop yield for the increasing population and its growing food demand. Hence, over the next few years, fruit and vegetable seeds will be viewed as a business opportunity. As a result, many multinational players have entered into the production of various types of fruit and vegetable seeds, which can be used for crops.

**WORLD SEED MARKET ANALYSIS**

The global seed market is marked with intense competition due to the presence of a large number of both, big and small firms. Research and development activities from the seed companies have provided new technologies in order to expand the global seed market reach to achieve efficiency of crop production through the improved seeds or planting materials.

Top 10 companies accounted for major share in the global seed market revenue in 2014. New product launches, mergers and acquisitions, and partnerships and expansions are the key strategies adopted by market players to ensure their growth in the market. The market is dominated by players such as Monsanto (U.S.), E. I. Du Pont De Nemours and Company (U.S.), Syngenta AG (Switzerland), KWS SAAT SE (Germany), and Bayer CropScience AG (Germany).

According to leading market analyst, marketsandmarkets, the fruit and vegetable seeds market is projected to grow at a Compound Annual Growth Rate (CAGR) of 8.10 per cent to reach USD 14.00 billion by 2022.

Seed is considered to be one of the most important parts of agriculture crop production on which the use of other agri-inputs efficiency depends. Biotech seeds are consequently seen as those products, which can improve the return on investment and to respond to consumer demands for economical agricultural production by increasing per unit seed production and per hectare production.

High growth potential in emerging markets and untapped regions, provide new growth opportunities for
market players. The growth of this market is also driven by changing composition of diet and other industrial demand for the crop produce, which is leading to commercial crop area expansion.

**SIGNIFICANT GROWTH IS PREDICTED IN THE SOLANACEAE SEGMENT IN PARTICULAR.**

Solanaceae belongs to the family of the flowering plants. Solanaceae includes plants, such as potato, eggplants, pepper, tomato, belladonna, nightshade, and others. The growth in this family of fruit and vegetable seeds has resulted in the development of active field of research for farmers globally. Leafy fruit and vegetable seed are projected to be the fastest-growing types in the next six years.

The conventional seeds segment projected to be the fastest-growing market during the forecast period. In 2015, the conventional trait segment dominated the fruit and vegetable seeds market; it is projected to grow at the highest CAGR from 2016 to 2022. As consumer demands and expectations from the food industry continue to evolve, the opportunities for conventional seeds are also increasing. The use of conventional seeds is on rise following bans imposed on GM seeds by the European countries.

With an increase in consumption of fruits and vegetables and growth in demand for tropical and exotic fruits and vegetables in the developing countries, globally; this segment is likely to witness a growth by 2022.

Increase in need for food demand, high investment in R&D, and change in farming practices key to success in the Asia-Pacific region. Asia-Pacific is one of the largest contributors to the global fruit and vegetable seeds due to an increase in the usage of fruit and vegetable seeds through advanced agricultural techniques and rise in need for food demand in the countries.

In 2015, India, China, and Indonesia constituted the largest country-level markets in the Asia-Pacific region. High market penetration by the leading fruit and vegetable seeds companies, for enhancing the agricultural growth and productivity are the main factors influencing the growth of the fruit and vegetable seeds market in Asia-Pacific.

**STRENGTHENING FOOD SECURITY**

Nations must unite in order to ensure crop diversity and safeguard global food supplies for a growing global
HUGE GROWTH FOR ORGANIC SEED MARKET

Dutch vegetable-breeding company Bejo Zaden says that it is convinced that more growers will use organic seed in the not-too-distant future.

“We’re seeing that organic seed is a huge growth market, both in and outside the Netherlands,” said Robert Schilder from Bejo.

“Led, in fact, by supermarkets and government, which both encourage it. They want plant protection product residues to be as low as possible.”

Organic cultivation nowadays more and more takes place on a large scale, by specialised companies. Bejo also has a wide range for smaller growers that can be ordered through the webshop.

Bejo has a wide range of organic seeds available. Bejo invested here because the organic sector prefers a fully comprehensive chain, even if organic seeds aren’t yet available for all breeds.

“Fortunately, we saw a future here 20 years ago and have developed an extensive range since. Currently, we have 150 breeds in 40 crops and are the market leader in organic vegetable seeds of biennial crops, including herbs.”

Across the globe, many continue to campaign about their right to save seeds.

“It’s not a huge movement but it is important,” said Clive Blazey.

“It’s important for the big companies as well as the small ones because this is where our genetic future lies.”

ORGANIC BREEDS HAVE TO DEVELOP A STRONG ROOT SYSTEM.

“Deep roots ensures more stable growth, which makes plants less susceptible to disease and stress due to drought or nutrition. The breeds are naturally stronger. The Hylander onion breed that we’ve developed is mildew resistant and has caused a revolution in organic onion cultivation,” Mr Schilder said.

Bejo believes in organic hybrids. A hybrid is created by crossing pure parent breeds. Inbreeding first establishes the desired breed, after which the positive properties are combined in the hybrid. This produces a breed with high yield and a high degree of uniformity (for example, all plants are ready to harvest at the same time). Seed grown from a hybrid, however, results in a breakdown of properties and plants that all have different characteristics.

Mr Schilder believes that their organic hybrids have many advantages: a more uniform product, better yields, less susceptibility to diseases.

“In the organic sector, the idea exists that non-hybrid breeds have more flavour. However, scientific test panels in Wageningen indicate that hybrid brassicas taste better.”

BEJO ALSO BENEFITS FROM ITS 20-YEAR INVESTMENT IN ORGANIC SEEDS IN A DIFFERENT WAY.

“Some cultivation techniques that we developed in organic cultivation, like soil management, can also be used in conventional cultivation so that it becomes more sustainable, a very positive side effect.”

Bejo Seeds Pty Ltd has also been operating in Australia since 1993.

More information at: www.bejo.nl and www.bejo.com.au
population. That was the message from the International Seed Federation (ISF) to representatives of governments, multilateral institutions, gene banks and foundations at the Crop Trust Pledging Conference in Washington DC in April last year.

ISF Secretary General Michael Keller warned that without their support, the world is in danger of losing crop diversity and limiting food supplies for future generations.

"Central to this endeavour is the work of our plant breeders who depend on plant genetic resources to create new varieties," said Mr Keller who highlighted the need for a specialised global system to collect and store plant genetic resources to maintain crop diversity and strengthen global food security.

"The Crop Trust and the Access and Benefit Sharing Fund of the International Treaty are equally important and equally necessary in the global management and exchange of plant genetic resources from international gene banks," said Mr Keller.

"ISF has a key role to play in uniting the many voices of the global seed industry and establishing common ground to facilitate the movement of seed around the world."

Calling on stakeholders and parties to support the conservation of genetic resources, ISF led the way with a symbolic financial contribution to be split between both funds, and emphasised the importance of ongoing cooperation.

"The seed industry continues to strive for improved and accessible seed with increased resistance to disease and pests, and an increased ability to withstand environmental extremes, in order to strengthen food security in the future," Mr Keller said.

The Crop Trust, an international organisation working to safeguard crop diversity, is an essential funding element of the United Nation’s International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), an agreement that includes 135 countries.

SEED SCARCITY

Countless varieties of vegetables and plants are lost due to climate change, natural disasters, war, outbreak of disease and poor agricultural management.

Projects such as the Millennium Seed Bank at London’s Royal Botanic Gardens in Kew and the Svalbard Global Seed Vault (see PH&G issue 102) on the Norwegian island of Spitsbergen aim at preserving the world’s food supplies and native vegetation as a means of protecting biodiversity.
Opened in 2008, the Svalbard vault is hidden beneath the ice and is the ultimate safety net for the world’s seed collections, storing food staples such as maize, rice and wheat.

In the 1980s, the practice of patenting seeds as inventions was legalised. With a patent, saving the seeds becomes a crime. Breeders are stopped from making continued improvements while patents, intended to reward and thus foster innovation, instead become an impediment to farmers and plant breeders alike. Together with seed industry consolidation, intellectual property restrictions have led to fewer choices for growers. A company can buy, and remove from production, a line that might compete with its profitable line. The control farmers once had has declined rapidly. Once an integral part of an independent society, the farmer is now at risk of becoming a small part in someone else’s food system.

It is a sobering thought that out of thousands of seed companies and public breeding institutions three decades ago, 10 companies now control more than two-thirds of global proprietary seed sales.

Traditionally, gardeners and farmers have assumed that the primary sources of seed will always be available as raw material for the food production system. Yet increasingly this assumption is unsustainable.

In its 2008 report, *Who Owns Nature?* the ETC Group – an international farmers’ rights and environmental organisation – described how buyouts had led to Monsanto claiming almost a quarter of proprietary seed sales worldwide.

The report pointed to an alarming concentration of power in the hands of a few corporations, which were increasingly forming alliances that turned them into a “tech cartel”.

“From dozens of pesticide companies three decades ago, 10 now control almost 90 per cent of agrochemical sales worldwide... and six of the leaders in seeds are also six of the leaders in pesticides and biotech,” says the report.

In the US, the genetic reservoir and uniqueness of vegetable seed heritage resides principally in three places: [1] the USDA seed bank, [2] small specialised seed companies, and [3] small family farms, especially those in ethnic communities.

Unfortunately, all are facing challenges. Federally sponsored government institutions such as the USDA seed bank are subject to periodic funding crises. Small, specialised seed companies (which offer many unique varieties) have low market penetration, are labor intensive, and are subject to market pressures, which put them at risk. Small family farms are at risk from urbanisation, rural outmigration, and economic change. In addition, multinational corporations are replacing multi-crop fields with monocultures, replacing traditional varieties with hybrids, and polluting open-pollinated varieties with genetically modified crops.

Writing in the Australian publication, the Organic Gardener, author Simon Webster describes how industrial agriculture has led to a dramatic erosion of the world’s seed diversity.

“Seeds are disappearing. In the century leading up to the year 2000, the world lost 75 per cent of the genetic diversity of its agricultural crops, the United Nations Food and Agriculture Organisation (FAO) estimates.

“Lack of diversity isn’t just a problem for people who would like the opportunity to buy yellow carrots and purple broccoli. Seeds are invaluable resources,” he said.

“For plant breeders, today’s seeds are the basis of tomorrow’s new varieties. And as we bid to grow food in a rapidly changing climate, we may need as much raw material as we can get.”

John Torgrimson, executive director of the US Seed Savers Exchange, which conserves heirloom seeds, says every crop variety is potentially of vital importance.

“Humankind has been cultivating plants for thousands of years,” Mr Torgrimson said.

“Over this time, our ancestors have selected and grown thousands of fruits and vegetables and passed them on to others in an age-old tradition of gardening, seed saving and plant breeding.

“We need to consider this premise: what if that one variety we lose today is the ace in the hole we need 100 years from now because of its adaptability to conditions we cannot envisage at this time?”

**THE IMPACT OF GM**

Founder of Melbourne’s Safe Food Foundation, Scott Kinnear says that multinationals can use two approaches to narrow the range of products on the market.

“You can buy the seed companies and take seed off the market. And you can take research dollars away from non-GM research and give them to GM research,” Mr Kinnear said.

Mr Kinnear is among numerous organic campaigners critical of the strong commitments to GM research made by state governments and the CSIRO. This research is often backed by funding from agritech companies.

Meanwhile, public funding for seed development and conservation around the world continues to steadily fall.
Produced by the International Commission on the Future of Food and Agriculture, the Manifesto on the Future of Seeds describes how this public funding has reached such low levels “that even major seed collections are under threat and increasingly depend upon so-called public-private partnerships”.

“Every new step of corporate concentration of seed stocks comes with a reduction of seed varieties as well as a reduction of the number of breeders and scientists maintaining these seed stocks,” the manifesto says.

GM crops draw criticism from many quarters. Anti-GM campaigners say they pose untested risks to human and environmental health, lead to increased pesticide use, and come with fiercely defended patents and licences, locking farmers into a system that perennially makes them buy more seed and more chemicals.

Critics also point out that GM crops also threaten seed diversity with countries, such as the United States, now planting only a small number of corn, soy and cotton varieties, most of them GM. And the threat of contamination by GM pollen means farmers can find it difficult to avoid GM crops even if they want to.

Currently, there is a backlash in India against GM crops and companies seeking to use traditional crops as the basis for new GM varieties. Farmers are fighting not just to hold onto their seeds and the control of their crops, but also to resist the escalation of chemical agriculture.

SEEDS OF CHANGE

In recent years, companies selling open-pollinated varieties have been enjoying a renaissance in heirloom seeds.

Clive Blazey from Diggers Seeds knows the importance of preserving heirloom fruit and vegetable seeds, and offers members of his Diggers Club 400 varieties from the American Seed Savers Exchange, which has preserved 25,000 varieties from around the world.

“Even Monsanto and other big companies are trying to hybridise what most people regard as heirloom varieties, such as black tomatoes. The big companies want to control the small packet market as well,” Mr Blazey said.

Spearheading grassroots seed-saving movements are initiatives such as Australia’s Seed Savers’ Network and the US Seed Savers Exchange, formed in 1975 with two people and two seeds and now has 13,000 members with 25,000 types of seeds. These seeds are being grown and shared, and are evolving as they adapt to their local conditions.
The groups’ focus is on saving heirloom, heritage or traditional seeds. They are open-pollinated varieties, meaning they are pollinated naturally in the field, by insects, birds or wind.

Unlike hybrid varieties, open-pollinated varieties reliably grow true to type if the seed is saved and planted the following season.

“Consequently, heirlooms offer the best hope for genetic diversity in the years to come,” said US Seed Savers Exchange’s John Torgrimson.

Seed groups and aid organisations have been working over decades in many developing countries to preserve traditional seeds. One organisation is Seeds of Survival (seedsofsurvival.org), a program started in Ethiopia that works with local farmers and traditional knowledge to develop better and more reliable seeds and crops.

Increasingly, however, there is concern that legislation written for industrial agricultural systems can make seed saving difficult. In Portugal, seed savers are campaigning against EU directives that prohibit the trading of seeds from one region to another while in New Zealand, campaigners are fighting a food safety bill that could potentially put restrictions on seed savers.
Published by The American Phytopathological Society (APS), the highly anticipated second edition of the Compendium of Blueberry, Cranberry, and Lingonberry Diseases and Pests is now available for commercial growing operations, nurseries, advisors, university staff, and diagnosticians.

This comprehensive new diagnostic and management guide collectively covers nearly 150 diseases, pests, and disorders of blueberry, cranberry, and lingonberry crops. It is ideal for large and small commercial growing operations, nurseries, as well as the advisors that serve them, including universities, extension offices, independent consultants, & diagnostic labs.

This important new title helps users confidently scout, identify, and manage problems in the field before they become economically devastating, offering more than 400 images and the latest diagnostic and management information for nearly 150 diseases, pests, and disorders of blueberry, cranberry, and lingonberry plants.

The Compendium of Blueberry, Cranberry, and Lingonberry Diseases and Pests, Second Edition is organised into four major sections on:

Infectious diseases, such as anthracnose fruit rot, bacterial canker, fairy ring, and leaf mottle virus.

Non-infectious disorders like cold injury, nutritional disorders, and oxygen deficiency.

Insect pests, such as aphids, blueberry blossom weevils, cranberry fruitworms, and leaf rollers.

Blueberry certification to facilitate compliance with blueberry plant certification standards and practices.

This new edition also offers a useful glossary, plus an index of key terms and an appendix to help readers identify common names of diseases and the pathogens that cause them.

The Blueberry Certification section offers current and comprehensive information to help users develop and comply with blueberry plant certification standards and practices. The certification program helps ensure that only high-quality plant material, free of targeted plant pathogens, passes through the blueberry production chain.

In addition to a useful glossary and index of key terms, this new edition offers an appendix that identifies common names of diseases of blueberry, cranberry, and lingonberry, along with the pathogens that cause them.

Visit www.shopapspress.org to learn more about the Compendium of Blueberry, Cranberry, and Lingonberry Diseases and Pests, Second Edition and other important crop health titles from APS PRESS.

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Changing our world one step at a time.
Insect breeding innovator Ynsect has raised $15.2m to help build a sustainable global food system that uses robotics and A.I.-enhanced vertical farming tech to develop insect protein essential to feed a growing global population.
Insect protein could be the answer to the growing global food crisis.
By 2030, over nine billion people worldwide will need to be fed, 4.5 billion of whom are part of the growing middle class, which increasingly is adopting meat- and fish-heavy diets. On top of that, it takes a lot of protein to grow a full-sized chicken, cow, pig or fish—producing more animal protein ironically means more protein is needed to feed them while they grow. As a result, demand for protein is expected to rise by up to 70 per cent in the next 15 years.

Offering a solution to this critical issue is French-based company Ynsect, which advocates insects as food to feed the demand of the growing global population. Billing itself as the global leader in the mass-scale breeding of insects for the animal feed markets, Ynsect was founded in 2011 by Alexis Angot, Fabrice Berro, Antoine Hubert and Jean Gabriel Levon.

“The world is on the cusp of a food crisis, and our need for high-quality protein is increasing day by day. Ynsect is working to harness the power of insect protein to solve this problem,” Mr Hubert said.

“At Ynsect, we believe insects have tremendous potential to help us deal with some of the most challenging issues humanity is currently facing. Insects are the most abundant organisms on Earth (excluding microorganisms), and are essential components of the ecosystem.

“They are the basis of the food chain for many birds, fish and mammals. In the wild, the diet of a trout, a chicken and a pig will naturally be composed partly of insects – up to 80 per cent in some cases. However, no fish, chicken or pigs raised on farms currently have the opportunity to eat insects. Thanks to Ynsect, however, this is changing,” he said.

Cultivating insects for food is not new; cricket hamburgers are available in London, and of course, insects have been part of the diet of many Indigenous peoples from Africa to Australia. With dwindling ocean fish catches – a major source of protein – growing and harvesting insects for fish food is a great application.

Ynsect prides itself on being an innovation company, which farms and transforms insects into a high-quality natural diet to meet the needs of the (farmed and domestic) animal feed markets, and potentially, in the longer term, human nutrition markets. With cutting-edge R&D, patented technologies and a world-leading multidisciplinary team, Ynsect was founded on a visionary idea: placing insect-derived protein at the heart of the agri-food system to sustainably address the growing global demand for meat and fish.

Recently, the company announced that it has closed a $15.2m Series B round led by Future Positive Capital and Bpifrance Ecotechnologies, with participation from existing investors Emertec, Demeter, Vis Vires New Protein Capital and Business Angels. This latest round brings the cumulative amount Ynsect has raised, from private and public sources, to $37m over the last three years – the largest-ever investment in the sector.

The announcement comes as EU member states recently endorsed a European Commission proposal to allow the wider use of insect proteins in animal feed. A vote taken during a session of the EU Standing Committee on Plants, Animals, Food and Feed (SCoPAFF), clears the way for insect proteins to be used in fish feed in Europe from July 2017. An industry game-changer, the decision was brought about in large part thanks to the advocacy work of the International Platform for Insects for Food and Feed (IPIFF), of which Ynsect’s CEO Antoine Hubert is President.
Ynsect farms and transforms insects into a high-quality natural diet for livestock and pet nutrition. With cutting-edge R&D, patented technologies and a world-leading multidisciplinary team, whose skills range from physiological entomology to biochemistry through robotics and IT, Ynsect was founded on a single visionary idea: placing insect-derived protein at the heart of the agri-food system to sustainably address the growing global demand for meat and fish.

“Few people today are aware of how the animals they eat have been fed,” explains Ynsect CEO Antoine Hubert, who cofounded the company in September 2011 alongside Alexis Angot, Jean-Gabriel Levon and Fabrice Berro.

“In fact, farmed animals mostly consume GM soya, grains, and sometimes poultry feather meal, as well as fish meal. It was fishmeal, in particular, which caught our attention.

“Fish meal is derived from catches of small fish, the global supply of which is under duress due to overfishing. In turn, that’s causing severe depletion of ocean biodiversity, and leading to food safety concerns due to the high content of heavy metals which bio-accumulate within dwindling fish stocks,” Mr Hubert said.

While insects account for a significant share of the diets of fish, birds and mammals in the wild, the same isn’t true of their farmed equivalents said Mr Hubert.

“At Ynsect, we produce insect proteins that can change this unnatural and unsustainable situation. We can now feed animals with a higher quality and more nutritious diet, while reducing the amount of fishmeal they consume. Crucially, we can also combine this with far greater sustainability.”

DISRUPTIVE TECHNOLOGY

Ynsect’s main product, Tenebrio molitor protein (TMP) is a de-fatted protein meal made of farmed mealworm larvae. To date, TMP is the only insect protein that shows considerable benefits to animal growth and health, when fishmeal is substituted with TMP in their diets.

After an extensive screening of several of the most popular insect species, Ynsect decided to focus first on TMP. This choice was guided by several criteria, among them the fact that the mealworm is gregarious (the larvae live naturally in high population densities), nocturnal (no need to expend any energy to light up the farm), has a high protein content (nearly 55 per cent in dry matter), and has a long farming history around the world due to its use in food for exotic pets, with no history of illness. In addition, it is already being consumed directly by humans in certain countries.

The company has designed proprietary technology to farm mealworm larvae, as well as other insects. Automation and machine-learning software are connected to sensors embedded in the farm, to ensure the highest-possible welfare standards for the insects,
while promoting animal growth and safeguarding operators’ health. As well as owning the leading patent portfolio in the sector globally, Ynstitute – as Ynsect’s headquarters and R&D centre is known – is the largest private research facility in this field worldwide.

Antoine Hubert and the team will use the investment to increase capacity at Ynsite, Ynsect’s pilot centre in Jura, France, and to begin preparatory engineering work on the world’s largest insect unit that will have the capacity to produce at least 20,000 metric tons of insect protein a year.

The company’s initial focus has been on early-adopter fish feed and pet food companies, for whom the superior quality and 72 per cent protein content of Ynsect’s TMP – which is the same protein level as that of the highest-grade fish meal – is a major selling point. Once Ynsect’s new unit begins production, the team expects several large animal feed players to become customers.

“The four of us started the company because we wanted to improve a global food system that is unsustainable and leading to a host of undesired impacts, including growing greenhouse gas emissions, the collapse in oceanic biodiversity and anxieties over food safety and security,” said Mr Hubert.

“That’s why we’re so delighted that some of the most renowned and innovative investors in the food tech and clean tech sectors, Future Positive Capital and Bpifrance Ecotechnologies, are joining us to help make our vision of insects playing the same leading role in the global food system as they occupy in the wild, a reality.”

Sofia Hmich, founder of Future Positive Capital, said: “This investment shows our long-term commitment to finding and supporting companies who are tackling intractable global challenges head on, with world-beating IP and flawless execution. We’re so excited for Antoine and his team, and looking forward to seeing Ynsect grow into a major global agro-food player.”

Gilles Schang, Deputy Managing Director Ecotechnology Investments at Bpifrance Investment, said: “Ynsect is a true pioneer in breeding insects for animal feed and has established itself as the frontrunner in the rapid development of this market. We are delighted to be positioning ourselves alongside the company’s founders and management in order to make Ynsect the global leader of disruptive agro-food technologies and to deploy worldwide the expertise they have developed in France.”

More information at: www.ynsect.com – watch the video below
The Ynsect team advocates growing insects as food to feed the demand of the growing global population.

Ynsect’s main product, Tenebrio molitor protein (TMP) is a de-fatted protein meal made of farmed mealworm larvae.
Be like water... go with the flow
DIY RESEARCH ON-FARM

According to research scientist Sophie Parks and statistician Lorraine Spohr from the NSW Department of Primary Industries, doing your own research is a low-risk approach to improving practices on your farm, as you can test a new treatment on a small part of your crop.
Crops and their environments are highly complex systems with a multitude of variables that change from location to location to different degrees and on various time scales. Due to this complexity, practices optimised for a research station might not be so successful when transferred to another location.

Though the new location may appear similar to the research station, there may be an undefined key limitation or combination of minor but different limitations that constrain production. In many cases, carrying out a small-scale trial, actually at the new location, will lead to an optimal local farming practice more rapidly than trying additional sub-treatments at the research station.

Doing your own research on-farm is a low-risk approach to improving practices as you can test a new treatment on a small part of your crop. These improved practices can achieve reduced crop losses, more production, greater quality produce or an earlier crop as a few examples. The results are relevant to your growing system and the process of doing an experiment allows you to get to know your crop better.

Treatments you may be interested in testing include a new variety, plant density, growing medium, foliar spray, or root drench which may improve the marketable yield and/or help to prevent pests and diseases. Using a simple experiment, the DIY trial compares plants receiving the treatment (e.g. a new variety) to ‘control’ plants that are left untreated (i.e. the current variety).

**HOW TO DO AN EXPERIMENT USING A HYPOTHETICAL EXAMPLE**

1. **Decide on the aim of your experiment.**
   In our hypothetical experiment our aim is to determine if growing cucumber plants in previously used growing media is as productive as growing them in fresh growing media. Our specific research question is: Is total production of cucumbers different for plants grown in used media bags compared to those grown in fresh media bags?

2. **Design your experiment**
   a) **Replicate your treatments (used media)**
      In our hypothetical experiment we included five grow bags containing media, which had been used in a previous cucumber crop. Each of these bags is a replicate making the total of five replicates for the treatment. Use a minimum of three replicates but more if you can manage it. Repeating the experiment also provides replication. In particular, this allows you to observe how the treatments perform in different seasons or for different varieties.
   b) **Replicate your control (fresh media)**
      In our hypothetical example, there were five control replicates. The five unused grow bags containing fresh media (the control) were used as a comparison to the five used grow bags (the treatment).
   c) **Randomise your treatments and controls**
      In our hypothetical experiment, fresh and used grow bags were allocated side-by-side in five pairs to 10 positions using the template below. To obtain a random allocation a coin was tossed, with ‘tails’ representing the used media grow bag.
      The first coin toss produced a ‘head’; meaning that a fresh media bag was placed in position 1 and a used bag was placed in position 2. This process was repeated until all bags were allocated.
   d) **Limit bias**
      In our hypothetical experiment, the experimental bags were placed within the most uniform part of the crop in the centre of an established cucumber crop, avoiding the edge row and other sources of influence like fans, heaters or walkways.
   e) **Decide on what data to collect**
      What you measure depends on the aim of your trial. For example, if you want to see if yield has increased, you can count or weigh the product at harvest, or measuring plant height may be appropriate for some crops. If you want to evaluate the incidence of disease following preventative treatments you can count the number of affected plants or leaves with symptoms. Have clear disease definitions and take photos. In our hypothetical experiment we weighed and recorded the fruit picked from the 10 experimental bags (single plants) for five harvests. Supporting information is also good to collect such as growing conditions during the experiment (temperature, humidity, feed and drain EC and pH), crop management activities and when they were conducted (e.g. pruning, training, release of biocontrols) and other important events (e.g. blackouts).
f) Pre-plan everything before you begin
Have recording sheets or a book dedicated to the experiment for collection of data and other information. Ensure that the data you collect is traceable. In our hypothetical experiment, each experimental grow bag and picking bucket was labelled with a unique number [from one to 10] to avoid any confusion in the crop or when weighing the fruit.

3. Collect, process and interpret your data
In our hypothetical experiment the cucumber weights from five harvests were added to obtain a total weight for each bag. The total weights were then plotted in a graph giving a visual picture of how the treatment yield compared to the control yield. You can create a graph (scatter plot) to see the data within an Excel spreadsheet. Enter the data as shown in Figure 1, with the individual position number in Column A. Column B is included to describe the treatments in words. The yields from each harvest are placed in the next few columns. Column F shows the numerical code for the treatment that each plant received.

Fruit weights from the used media treatment are represented by the number 1 and the fresh media treatments are represented by a 2. Entries in column F must be numbers (not words). The total weights for each bag are in Column G. Select rows 2 to 11 in column F and column G at the same time. Select the Insert tab, then select Scatter, then Scatter with only Markers as shown in Figure 1.

Figure 1. Steps to create a scatter plot in Microsoft Excel 2010
The horizontal axis in the resulting graph is a bit messy. To make it look better place the cursor over any number on the horizontal axis. When the message Horizontal Value (Axis) appears, double click the mouse. The Format Axis box should then appear.

Change the Axis Options to match the picture below, then press Close.

Figure 2. Modifying the axis options
The final graph is shown in Figure 3.

Figure 3: Total cucumber weight per plant (kg). On the horizontal axis 1=Used Media and 2=Fresh Media
The graph highlights the importance of replication. Reliability of conclusions is based on having sufficient replication. If only one bag had been compared from the fresh and used treatments, each with a result around 14kg, our conclusion would be less representative. Yet with 5 replicates the data is more representative. In general the fresh media appears to have performed better than the used media treatment. Further, the plants growing in the used media have more variable yields compared with the fresh media, which in itself may be valuable information. This graph alone may be enough to help you make decisions about using a particular treatment that you have tested in your experiment. However, if desired, and since the experiment was designed with randomisation and replication, a formal statistical method could be used to help confirm if the treatment was more effective than the control.

Difficult DIY treatments
Not all potential treatments are appropriate to test in
your own research. Pesticides must only be used according to the label instructions and must be registered for the crop you are growing in a greenhouse setting. So modifying the method of application of a pesticide or testing it on an unregistered crop, or testing in the greenhouse when it is registered only for field use is not possible. Also, treatment evaluation can be difficult in hydroponics if you want to test a solution additive or a new nutrient recipe, particularly if only one tank supplies the crop as replication is not possible. However, if the plants are in bags of media, some treatments could be applied to individual plants by manually applying the treatment solution (e.g. potassium silicate solution) with a watering can and the control solution (i.e. water) supplied to other plants in the same manner. Other treatments difficult to replicate include greenhouse coverings and climate control regimes. Do not be tempted to overlay another treatment onto your planned experiment. If you get for example an increase in yield, you will not know which treatment was the effective one.

In conclusion, DIY research is a valuable tool in plant production to gather information about how your crop responds to new treatments. Following these guidelines will ensure that you produce reliable results.

For more information, the Organic Farming Research Foundation has an excellent guide for on-farm research.

Using plant height as a measure of growth for a coriander experiment.
A TALE OF THREE ENTERPRISES

BIGGER DOESN’T ALWAYS MEAN BETTER. DEPENDING ON YOUR PERSONAL OBJECTIVES IT IS POSSIBLE TO HAVE A PROFITABLE ENTERPRISE THAT IS AT THE SMALLER END OF THE SCALE.

BY MIKE NICHOLS & DAMIAN DUGGAN-JONES

You do not have to be a huge enterprise to make a satisfactory income. In this article, we examine three distinct berryfruit enterprises, namely:

• A small pick your own blueberry enterprise near Palmerston North in New Zealand
• A huge blueberry enterprise in Queensland
• A family berryfruit enterprise near Masterton, New Zealand.

Each enterprise has its strengths and weaknesses, but essentially it shows that depending on your personal objectives it is possible to have a profitable enterprise with a wide range of different sizes.
POHANGINA BLUEBERRIES, PALMERSTON

Situated just 1km over the Pohangina River Bridge near Palmerston North, the 2.4ha blueberry block is run by Tim and Gloria Hall in partnership with Andrew MacDonald. The property was established in 1983, using mainly the varieties Bluecrop and Earliblue, along with a small number of Ivanhoe, Darragh and Berkeley. Prior to planting a heavy application of sulphur was applied in order to lower the pH of the soil to about 5.0. No further sulphur has been applied in the intervening period, and the only nitrogen fertiliser applied is in the form of the acidifying ammonium sulphate, so the pH has remained reasonable stabilised.

The whole block is maintained from a pruning point of view by cutting the bushes down to about 0.5m every seven years. Thus, the cropping is always on fairly new wood, and the plants never get too tall. Initially, they used to sell into the market and also export, but in recent years they have developed a pick your own operation, and with 70,000 Palmerston North inhabitants only a few kilometres away there is a ready supply of interested harvesters. In fact, PYO harvesters come from as far away as Wellington (160km) for a day out, for the opportunity to pick fresh fruit at well below retail prices, as well as to get a day in the country. When we visited the block in early January it was difficult to get any parking, and there were family groups busily harvesting the fruit, which was then weighed in the shed by the Tim and Gloria. Of course, PYO requires some form of organisation, and plastic bags in buckets are supplied to each picker, who can then easily take the plastic bag filled with ripe blueberries home after weighing (and paying). A large area of an adjoining paddock is set aside for parking, and when we visited, there were about 100 cars already present. ☝️
WEE RED BARN, MASTERTON

We have previously written about the Wee Red Barn (near Masterton), but the purpose of this is to emphasise that if you do not move forward, then you move back in relation to your competitors. Alan and Dot Bissett would be among the very best strawberry growers in New Zealand. They grow the bulk of their crop under Haygrove Tunnels (Alan is the Australasian Agent), but they are also interested in what other crops might successfully (and profitably) be grown under this form of protected cultivation. A key factor in their crop production is the use of Galuku coir, along with a hydroponic system controlled by Autogrow equipment.

Other crops currently grown at the Wee Red Barn include blackberries, raspberries, blueberries and gooseberries, although the strawberries take pride of place. School parties regularly visit the property from nearby Masterton, and this has posed the question of whether to develop a wider range of crops under Haygrove tunnels with the objective of providing an opportunity to develop some form of agritourism, and to stimulate the local economy with alternative crops to the very high quality wine grapes produced in near by Martinborough.

Crops, which may have some potential include high value stone fruit such as cherries, peaches, nectarines and plums, along with Tamarillos and passion fruit, dessert grapes, figs etc.

Alan has already made a start in sourcing some older cherry trees on colt rootstock, which have been grown in special bags to reduce root growth, but eventually he will aim to grow cherries hydroponically on the very dwarfing rootstock, Gisella 6, when it becomes readily available in New Zealand.

Cherries lend themselves to protected cultivation as they suffer from two major problems, bird damage and rain when ripening, and high tunnels provide the ideal solution. No rain gets to the plants, and the tunnels can easily be covered in bird proof netting over the harvest period. Picking is also much cheaper than from conventional trees, because most (all?) of it can be done from the ground. ☞
COSTAS BLUEBERRIES NEAR ATHERTON

In late November 2016, (MAN) attended the ISHS International Conference on Tropical Fruit held at Cairns in tropical (very tropical) Queensland. This provided me with the opportunity of visiting the Atherton Tablelands, and the Costas blueberry farm, near Atherton.

A mere 62ha of hydroponic blueberries all grown under Haygrove high tunnels. Surprisingly, none of the fruit are exported, because there is still an unsaturated demand for the berries in Australia! In fact, Costa are already expanding the blueberry operation at Atherton, and who would not, with an unsaturated domestic market at the time of the year that his crop is harvested?

The whole operation is very streamlined, with only two rows of blueberries planted in each tunnel, so that spraying is by tractor, which makes it a very efficient operation. The growth in this climate is phenomenal when adequate water and nutrients are provided via the hydroponic system, and after harvest the plants are “pruned” to a height of about 20 cm. Training the plants consists of the removal of the growing point on the young stems every few weeks. At the end of the harvest season the plants are up to 2m tall, and are then pruned back to 20cm.

Weed control in the pots (filled with coir) is by a coir fibre weed mat, which seems to perform extremely well.

Of course, an operation of this nature requires considerable start up capital, as well as a knowledgeable management team if it is to succeed, but the rewards can be extremely high. Naturally, growing in North Queensland has risks, chief among them being cyclones, which can occur as frequently as every five years, but this risk can be factored into the budget, and the basic structure of the greenhouse is unlikely to be damaged, although the plastic film will be at high risk!
The Medfly is a species of fruit fly capable of causing extensive damage to a wide range of fruit crops.
An imported fruit fly from the United Kingdom has shown great potential to biologically control the damaging horticultural pest Mediterranean fruit fly (Medfly).

In a series of glasshouse trials in Western Australia, research jointly funded by the WA Department of Agriculture and Food (WA DAF) and Horticulture Innovation Australia has tested an imported fruit fly’s mating performance and found it stacks up against current control techniques using sterile radiation-treated flies.

The department sourced the new Medfly strain from UK-based company Oxitec and reared a colony of 2400 flies at a specialised facility in South Perth.

WA DAF horticulture director David Windsor said the research was examining whether the Oxitec fly offered an improved option for industry to control Medfly, which costs the State producers millions of dollars each year.

Ceratitis capitata, the Mediterranean fruit fly, or Medfly for short, is a species of fruit fly capable of causing extensive damage to a wide range of fruit crops. It is native to the Mediterranean area, but has spread invasively to many parts of the world, including Australasia and North and South America.

Adult medflies lay their eggs under the skins of fruit, particularly where the skin is already broken. The eggs hatch within three days, and the larvae develop inside the fruit. Maggots may stay from five to 10 days (depending on temperature and food availability by fruit size).

Once the larvae reach the next development stage, it will dig its way out of the fruit, making a small hole and then falling to the ground where it starts to dig and then pupates centimetres underground. Depending on temperature adult emergence may occur in as short as seven days. The adults have a limited ability to disperse, but the global fruit trade can transport infected fruit over thousands of miles.

Dr Windsor said the Oxitec technology, like the sterile insect technique, aimed to break the breeding cycle of the Medfly through the rearing and release of the control flies.

Instead of using radiation to sterilise the male flies for release, the Oxitec fly has been developed to include a self-limiting gene, which shortens the lifespan of female flies.

“When the male flies mate, they pass on the self-limiting gene to their offspring which causes females to die before reaching adulthood so they cannot breed,” Dr Windsor said.

Scientists from the department and Oxitec undertook
glasshouse studies comparing the performance of the Oxitec flies against the sterile flies. Replicates were run with 21 mating trials in total under strict regulatory conditions.

“These involved releasing either Oxitec or sterile male flies, competing with wild male flies, to mate with females, in glasshouse trials,” Dr Windsor said.

“During the trials each mating pair was collected and checked to determine the male’s genotype.”

The mating performance by Oxitec males was comparable with that of sterile males irradiated at low levels, and exceeded that of sterile males treated with a higher dose of radiation, which is used to provide a better guarantee of sterility.

“The research found the Oxitec male flies are compatible with wild female flies, and their mating performance is promising,” Dr Windsor said.

“We now need to consider how the new strain will perform under field conditions.”

Government regulatory bodies including the Office of the Gene Technology Regulator for the next phase of testing.

More information at:
Deficiencies or excesses of mineral elements show in a number of ways: in colour, density, size and shape of leaves; in the thickness and colour of stems and the length of internodes; in the colour, fibrousness and thickness of roots; in the abundance and timing of flowers; and in the size, colour, hardness and flavour of fruit. Recognising those particular effects is the key to diagnosing nutritional disorders.

By Steven Carruthers
Potassium (chemical symbol K) is an essential macronutrient, the third major plant and crop nutrient after nitrogen and phosphorus. As part of various compounds, potassium makes up about 2.6 per cent of the weight of the Earth’s crust and is the seventh most abundant element, similar in abundance to sodium at approximately 1.8 per cent of the crust.

Potassium was first isolated from potash, the ashes of plants, from which its name derives. It has been used in bleaching textiles, and making glass and soap since about AD 500. Most of the world’s reserves of potassium were deposited as sea water in ancient inland oceans. After the water evaporated, the potassium salts crystallised into beds of potash ore. These are the locations where potash is mined today. The deposits are a naturally occurring mixture of potassium chloride (KCl) and sodium chloride (NaCl), more commonly known as table salt.

In agriculture, potassium is generally used in the form of chloride (KCl); in horticulture in the form of sulphate (K2SO4); and in hydroponics as potassium nitrate (KNO3).

Potassium is a mobile element, which means it is capable of being translocated within the plant. When a plant is deficient of this element, the nutrient that is already within the plant is transported to where it is needed most - the young tissues. Therefore, leaf symptoms of potassium deficiency most often appear on older (lower) leaves.

Potassium is most readily available to plants above pH of 5.5 – it becomes unavailable in very acid solutions.

FUNCTIONS OF POTASSIUM

Potassium maintains the ionic balance and water status within the plant. It is involved in the production and transport of sugars in the plant; enzyme activation; and synthesis of proteins. Potassium is also required for pigment synthesis, notably lycopene. Importantly, potassium ions open and close the stomata (how the plant ‘breathes’), which is regulated by proton pumps to make surrounding guard cells either turgid of flaccid. Potassium also affects how juicy a fruit can be by functioning to move water into the cell of the developing tomato fruit.

There is also strong evidence potassium increases disease resistance. The mechanisms involved result in decreased cell permeability and susceptibility to tissue penetration. Silica, which accumulates in great quantities when adequate potassium is present, is incorporated into cell walls, toughening the epidermal layer that acts as a physical barrier to pathogens. Potassium has been implicated to have a role in thickening cell walls.

POTASSIUM DEFICIENCY

One of the first tell-tale signs of potassium deficiency is plant wilting, even during mild temperatures. This is followed by brown scorching and curling of lower leaf tips, as well as yellowing (chlorosis) between leaf veins. Purple spots may appear on leaf undersides. Plant growth, root development and seed and fruit development are usually reduced in potassium-deficient plants.

Potassium deficient plants are more susceptible to frost damage and disease, and symptoms can be confused with wind scorch or drought.

Plants most prone to potassium deficiency among soilless crops are tomatoes, cucumber, strawberries and raspberries. Other crops sensitive to deficiency are potatoes, brassicas, currants, gooseberries, sugar beets, apples, cereal and clover.

In tomatoes, the onset of potassium deficiency is generally characterised by a marginal chlorosis, progressing into a dry leathery tan scorch on recently matured leaves. This is followed by increasing interveinal scorching and/or necrosis progressing from the leaf edge to the midrib as the stress increases. As the deficiency progresses, most of the interveinal area becomes necrotic, the veins remain green and the leaves tend to curl and crinkle. In contrast to nitrogen deficiency, chlorosis is irreversible in potassium deficiency. Because potassium is very mobile within the plant, symptoms only develop on young leaves in the case of extreme deficiency.

Other tomato plant symptoms include woody stems and slow growth. Fruits often ripen unevenly (blotch ripening), and sometimes have green patches nearest the truss, sometimes referred to as ‘green shoulders’ or ‘greenback’. Lack of potassium can result in misshapened fruit, ripening problems, precocious seed germination (seed germinate inside the fruit), soft, mushy or mealy fruit flesh texture, low acidity and puffiness.

Mild deficiencies can occur during fruit maturation. This is expected as it is a normal part of the growth cycle as most of the potassium is translocated to developing fruit.

Trials in the UK have shown that high levels of...
potassium provide high yields in tomato crops. Tomatoes have a relatively high potassium requirement. However, it is essential to maintain a good balance of potassium with magnesium and calcium. Too much potassium restricts the uptake of these other cations. Use of high levels of potassium is particularly important under saline conditions to maintain plant growth. Excess sodium reduces the uptake and transfer of potassium through the plant and thus potassium levels need to be increased in order to maintain plant growth.

In cucumber, potassium deficient crops are prone to wilting. As potassium is mobile in the plant, it moves to the younger leaves when supplies are short. Although the growth of deficient plants may not be seriously impaired, the yield and quality of fruit are often greatly reduced.

Potassium deficiency in cucumber causes yellowing and scorching of older leaves. These symptoms begin at the margins of the leaf and spread between the veins towards its centre. Large areas of tissue around the major veins remain green until the disorder is well advanced. A brown scorch develops in the yellow areas and spreads until the leaf is dry and papery. As each leaf dies, others further up the shoot develop the same symptoms. These symptoms can develop rapidly in hot weather. Fruit may not expand fully at the stem end, although they look swollen at the tip end, a symptom that is also caused by water stress.

The descriptions of cucumber leaf symptoms given here are similar for other cucurbits such as rockmelons, watermelons, pumpkins and gherkins.

In strawberries, symptoms of potassium deficiency can be easily confused with those of magnesium deficiency, or with leaf scorch caused by salinity, wind, sun or dry conditions. Mature leaves show a browning and drying of the upper leaf surface, progressing from the margin to the centre of the leaf between the veins. At the same time the mid-rib section of the leaf becomes dry and darker. These symptoms first appear on lower leaves. Fruit quality also is affected by low potassium levels. The fruit can fail to develop full colour, be pulpy in texture and lack flavour.

In raspberries, gooseberries and currants, dieback of shoots and branches is common, although plants may
produce many blossom buds in the early stages of potassium deficiency, however, fruit yields are low and of poor quality.

**POTASSIUM TOXICITY**

Excessive potassium can result in severe stunting, reddening, poor germination, older leaves wilt, the entire leaf is affected by chlorosis, edges and main vein often retain more colour.

Excessive amounts of potassium can also compete for the uptake of other ions such as calcium. Lack of sufficient calcium supply may lead to blossom end rot.

**MANAGEMENT PRACTICES**

Growers are generally unconcerned about leaf symptoms because the symptoms do not directly influence the market value of the crop. However, this ignores the fact that the same problems that cause the leaf symptoms can also reduce fruit production and quality. This is because leaves manufacture the food needed by the plant to produce fruit, so if they are not healthy, then yield and quality can be reduced, and the cropping season can be shortened.

An important fact is that plants produce leaf symptoms only when a nutritional problem has become serious. Often yield or quality has been significantly reduced before symptoms appear. Therefore, at the first sign of a problem growers should identify and treat the disorder. Although growers will not prevent production losses (and hence profit losses), they can minimise the extent and severity of fruit losses.

**REFERENCES**


The Institute of Simplified Hydroponics in USA is a non-profit with the mission of bringing hydroponic technology to those in need. Since its inception in 1995, ISH has been a part of the global effort to end hunger, developing simplified hydroponics to provide food production systems.

By Peggy Bradley

Sweet potato grown in perlite formed smaller roots closer to the surface. Possible reasons include the lower substrate temperatures of the insulating perlite.
The Institute of Simplified Hydroponics (ISH) defines simplified hydroponics as a technology that requires no pH testing or use of energy other than human labour.

ISH has been successful with most salad crops, lettuce, tomato, cucumber, bell pepper, and some table vegetables such as spinach and herbs. Current garden owners can reliably produce 500 calories a day for home use, or more if selling to the market. However, a human needs at least 1500 calories a day, and a source of carbohydrates.

In the summer of 2016, ISH announced a breakthrough in producing sweet potatoes in simplified hydroponics. This amounts to a potential to provide an additional 500 calories a day in the form of 0.5 kg a day of sweet potato. After initial successes in 2015, the protocol was tested in ISH USA, Colombia and Bangladesh. Results for a single season of 95 to 120 days ranged from 5 to 12 kg/m². Now ongoing trials of sweet potato are increasing those results to 20 kg/m² year.

The importance of reaching the 20 kg/m²/year means that a daily supply of sweet potato for one person can likely be grown in a space of about 9 m².

**WHY SWEET POTATO?**

In 2001, The Helen Keller Institute (HKI) got in touch with ISH USA asking that the production of Irish white potato in the family gardens be replaced with orange-fleshed sweet potato. The Helen Keller Institute was interested in preventing childhood blindness and felt that at least 50,000 cases of blindness could be prevented by supplying the young children sweet potato with its high vitamin A content.

ISH was already considering the switch from Irish potato due to a recurring problem of early plant death with the Irish potato. Too often the white potato crop would be lost, while the sweet potato reliably produced a crop.

In the early years, the sweet potato was always producing, but often producing only four to five to kg/m² year. First trials produced smaller roots and the vines were often attacked by insects. These disappointing results were partly due to the need for a root nutrient.

**ROOT NUTRIENT DEVELOPED**

In 1973, Abram Steiner published research that established a new hydroponic nutrient now known as the...
Steiner formula. This formula became the basis of a commercial hydroponic industry.

ISH based its hydroponic nutrient on the Steiner formula, with modifications of using chelates instead of sulfates for trace minerals. Although chelates added to the cost of the nutrient, it also allowed the nutrient to be successful in a wider range of pH.

However, in using the Steiner formula, many root crops were not growing or forming well. Although radishes would grow beautiful lush tops, the root, our desirable vegetable, remained spindly and not forming at all.

In 2000, at an International Hydroponic meeting in Israel, Professor Uzi Kafkafi presented work on hydroponic solutions and roots. His research showed that the plant would pick up nitrogen first and continue to grow green growth of plants until the nitrogen levels fell below the phosphorus levels. In creating a high phosphorus, lower nitrogen formula he was able to get more root growth.

Over the next year Dr Kafkafi helped develop a basic root nutrient solution for ISH, which is used to this day. Suddenly, plants switched to root nutrient would form
Trials in Bangladesh were kept low about 5kg/m² due to insect attack of vines.
radishes and potatoes, and ginger and sweet potatoes. When the sweet potato is allowed to first grow on the Steiner formula, called Grow Nutrient, lush vines form rapidly aboveground. When the vines cover the surface of the growing bed, the crop can be switched to root nutrient. This change of nutrient shows an increase in sweet potato root growth.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Grow Grams</th>
<th>Root Grams</th>
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<tbody>
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<td>136</td>
<td>250</td>
</tr>
<tr>
<td>Iron sulfate</td>
<td>17.75</td>
<td>17.75</td>
</tr>
<tr>
<td>Manganese sulfate</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Copper sulfate</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Zinc sulfate</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Boric acid powder</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Ammonium molybdate</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

The amount of root produced using the root nutrient was beginning to outstrip the best results in soil (5 kg/m2) with 12.5 kg/m2 produced in a 95 day season.

**CLIMATE CONTROL REQUIRED FOR YEAR-ROUND PRODUCTION**

The next step in creating a reliable daily supply of sweet potatoes was to work on a year-round production.

Most of the areas of hunger in the world are in tropical climates, where a garden can be in production year round. ISH and others have been working on creating suitable structures for year-round growth in areas with climate challenges.

In a project in Bolivia at 14,000 feet in altitude, greenhouses dug into the ground were constructed to provide family year-round gardens. This type of structure is useful if working to keep garden production year round (Figure 1).

In ISH USA, a tiny house structure has been designed and built to offer year-round growing space for food. A 49-square foot lean to greenhouse attached to the home was built to provide a solar greenhouse with year-round growing space (Figure 2).

It is being tested now to determine year-round growth of sweet potato. Clearly, the production of 0.5 kg a day will require some climate adjustments for global use of the vegetable.

**Sweet potato as a historic famine food**

The sweet potato is related to the morning glory, and was domesticated from a wild plant perhaps 10,000
years ago. While our remarkable modern vegetable swells up to produce edible roots, the wild varieties produce no swollen roots at all. Like corn, tomato and bell pepper, the sweet potato appears to be a domesticated developed version of the wild plant.

The sweet potato was certainly used in ancient Peru, and is found through the Central and South American areas by the time of Columbus in 1492. Columbus and his crew found the local population of the Caribbean island growing and using sweet potatoes as a staple food. Columbus then introduced the vegetable to Europe on a return voyage.

Today, the sweet potato is the seventh most important staple crop vegetable in the world with many countries around the world using it as the primary staple. In soil, the world average production is 13.7 tons of food per hectare, and Israel has reported as much as 40 to 50 tons/ha, or about 5 kg/m2/year. The global average of Irish white potato is 16.8 tons/ha with highest values of 40 tons/ha.

THROUGHOUT HISTORY THE SWEET POTATO HAS COME TO THE RESCUE AS AN IMPORTANT FAMINE FOOD.

In China 1608, a terrible flood ruined local crops in a region south of the Yangtze River. Xu Guangqi, a local scholar, looked for an alternative crop to keep local people from starving. After discovering that sweet potato was more tolerant to drought and flood, and more productive than rice, he started experimenting with the crop.

After producing large roots he wrote an article “Gan Shu Shu” on the sweet potato. Even today, the sweet potato is a staple crop in China also used for animal food.

In Japan, in 1732, crop failures led to a famine, now called the Great Kyoho Famine. Aoki Konyo, now called Professor Sweet Potato, was interested in the sweet potato of Okinawa, as a possible solution. The vegetable was grown in the warmer southern areas of Japan, so Konyo worked to develop a sweet potato that could be grown in northern areas of the Islands.

He developed a variety that could be grown in the northern areas and then introduced the crop to help end the famine. Japan now grows sweet potato as a staple crop, with Okinawa using the purple variety for one half their daily calories.

A MORE RECENT EXAMPLE OF SWEET POTATO PREVENTING FAMINE: BIOSPHERE 2

For ISH, the experiment of Biosphere 2 in 1991 was one of the most telling of reasons to concentrate on the sweet potato. The Biosphere 2 was a highly publicised experiment in Arizona, where eight adults were placed in a large greenhouse and asked to raise their own food.

The scientists at Biosphere 2 opted to grow their crops in soil, sadly rejecting using hydroponics. With this in place they produced 66 per cent of their diet in sweet potatoes, with sweet potatoes the only productive crop in the first year.

Table 1. Production results for staple foods in two-year experiment at Biosphere-2.
Adapted from Silverston and Nelson 1996.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield 1991</th>
<th>Yield 1992</th>
<th>Total 2YR Yield KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet potato</td>
<td>2.25</td>
<td>1.95</td>
<td>2765.15</td>
</tr>
<tr>
<td>White potato</td>
<td>0.62</td>
<td>1.42</td>
<td>240.41</td>
</tr>
<tr>
<td>Rice</td>
<td>0.29</td>
<td>0.20</td>
<td>276.47</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.22</td>
<td>0.14</td>
<td>191.87</td>
</tr>
<tr>
<td>Peanut</td>
<td>0.10</td>
<td>0.15</td>
<td>147.42</td>
</tr>
<tr>
<td>Soybean</td>
<td>0.15</td>
<td>0.34</td>
<td>21.41</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td>469.22</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>4111.95</td>
</tr>
</tbody>
</table>

Trials in Colombia in discarded tyres produced 12.5kg/m2 in a 95-day season.

The Biosphere scientists were therefore happy with their 2.26 kg/m2 year. This ignored William Gericke’s research on Irish white potato that resulted in 16 kg/m2 year. Gericke also experimented with sweet potato mentioning satisfactory results without sharing an exact yield.

The Biospherians did not know that the vines of the sweet potato are also edible. If so, they could have
doubled their food production, just by eating vines as well as root.

**WHY USE SIMPLIFIED HYDROPONICS?**

Hunger remains an everyday challenge for almost 795 million people worldwide, including 780 million in the developing regions. Poor nutrition causes nearly half the deaths in children under five – 3.1 million children each year. According to UN FAO research, most of the people dying of hunger are single mothers with children under the age of five. And the most common victim is the three-year-old child being weaned to a world of low resources.

More than 90 per cent of the 570 million farms worldwide are managed by an individual or a family, relying predominately on family labour. These farms produce more than 80 per cent of the world’s food, in terms of value. Globally, 84 per cent of family farms are smaller than two hectares and manage only 12 per cent of all agricultural land.

The number of displaced people at the end of 2013 was 51.2 million, more than at any point since the end of World War Two. The average length of displacement in major refugee situations is now 20 years.

**LIMITED RESOURCES OF THE POOR**

A survival garden of sweet potato needs to be mindful of the limited resources of the very poor.

The first limitation for a person in poverty is garden space. So the production of more kilograms per m² amounts to less space required for the garden. If the 20 kg/m² is used, about 9 m² are required for the 0.5 kilogram a day. If Gericke’s 16 kg/m² is used, 11.5 m² are required.

There are other resources required to set up and operate a hydroponic garden. Our test gardens are now using fabric pots, sand substrate and sweet potato starts. The required nutrients for the 180 kg a year are about 4 kilograms of nutrient (Grow, Root, Magnesium Sulfate and Calcium Nitrate), and estimated water required through the year is about 1600 gallons of water.

**SUBSTRATE DEPTHS**

Generally, in soil the sweet potato likes to be grown in a depth of soil of about 12” with 9” a soft soil and the 3” a clay that retains moisture. The sweet potato appears to like a very warm soft soil to expand its roots, and then...
requires some pressure to push against to grow.

In our trials, we trailed depths of 24”, 18”, 12”, 9” and found that the deeper depths did not improve sweet potato growth. The roots start expanding just below the surface of the vine. No roots were found growing lower than about 9”.

When going in our perlite, the roots did not lengthen well, and some curled near the surface (Figure 3). While some of this was likely due to not allowing roots to dangle down in transplanting, it seemed that the perlite was an insulation factor, not allowing heat to build in an ideal root zone. The ideal temperatures for sweet potato growth in soil are estimated at between 24 and 35 degrees C. The perlite has known insulation properties and therefore poor in heat transfer.

SUBSTRATE
The best results were in Colombia with a substrate of 30 per cent poor soil, 10 per cent household compost, 30 per cent green sand and 30 per cent rice hulls. This substrate is both soft and retains warmth. The results of 12.5 kg/m2 in 95 days were obtained in tyre growers with only a 4” depth. This validates Gericke’s comment that only 4” of substrate would be needed.

CONTAINER
The trials so far are using old tyres, cut lengthwise, plastic tubs, and fabric smart pots grow bags. High Caliper, the manufacturer of Smart Pots has donated bags for our trials.

It stands to reason that a good gas exchange of the fabric pot would lead to better root growth and sweet potato growth inside the pot. So the fabric bags make sense as a trial. There is also the fact that Smart Pots can be sent to remote areas, without breakage and with reduced shipping costs. They have another possible benefit in that they are lightweight for possible use in rooftop gardens.

We are trialing more types of Smart Pots this summer in new types of growers. When the smart pot is placed directly on the ground, it loses the possible benefits of airflow through from the bottom. So a grower rack is being used that allows the tray-sized growers to be placed on an expanded metal shelf.

There is also a possible drawback to using fabric pots because the sweet potato wants to grow against some pressure. So there may be reinforcing of the container to introduce strength.

INSECT CONTROL
The 2016 trials of sweet potato also included yields of about 5kg/m2 that were caused by poor insect control. It is clear that a good plant health system would need to be in place for the small gardens.

Gad Loebenstein and others have devoted a lifetime of research in controlling insects and virus diseases in sweet potato. The viruses can be controlled through micro-propagation of the original propagation stock. There will likely be an industry in micro-propagation to support family gardens.

NUTRIENTS
Currently, the ISH trials are using six different root nutrients to improve the current formula. In literature, it is reported that the protein content of the sweet potato ranges from 1.6 grams per 100 grams to 10 grams per 100 grams. The implication is that the amount of protein in a sweet potato might be partly dependent upon the
nutrient regime. If we could increase the protein of a sweet potato, the same vegetable production could help reduce protein requirements of other foods.

Another root formula includes six minerals essential to human health. This experimental nutrient could supply valuable trace minerals to help with long term human health.

COMMERCIAL POTENTIAL OF SWEET POTATO

The Okinawa purple sweet potato has been identified as the vegetable with the most anthocyanin, a pigment to fight cancer. The purple and orange-fleshed varieties can help increase human health. The potential for producing organic sweet potatoes also may have a future.

FORAGE

Both sweet potato and sweet potato vine make excellent hydroponic forage for feeding many animals. This could be an alternative to producing hydroponic grasses that might be prone to fungus issues.

POTENTIAL: HOW YOU CAN HELP

ISH has been working on the issue of hunger for over 22 years. This breakthrough could be a step to seeing our technology helping end a terrible holocaust of death. We can use the help of children experimenting, classes, and anyone with interest to helping those who did not have the fortune to be born in more positive circumstances.

ISH is asking anyone interested in hydroponics to start working to grow sweet potatoes in hydroponic culture. As an industry we can do a lot more to establish growing protocols that work for a family in poverty.

This industry may hold a key to ending hunger. While continued research and development at ISH is valuable, with hundreds or even thousands of hydroponics experts working on this, we could make real progress.

Kits and more information are at ISH website at www.carbon.org. We also have an India hydroponic group on face book where people can join and blog on issues.

ACKNOWLEDGEMENTS

The work on “using hydroponics to end hunger” has been supported by the hydroponics industry through the Hydro for Hunger Initiative supported by several philanthropic hydroponic manufacturers and distributors. The total donations from supporters is over $350,000 and has been used by ISH to enable projects around the world. The objective is to offer hydroponics as a technology to end human hunger. Also thanks to Gad Loebenstein for review and comments on this article.

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 she has visited over 16 countries working to establish the technology.

REFERENCES

/Pndaily.shtml
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.

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.

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