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High Quality Optimum Driver
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200 W UFO LED
Total PPF 420 µmol/s - 2.1 µmol/J
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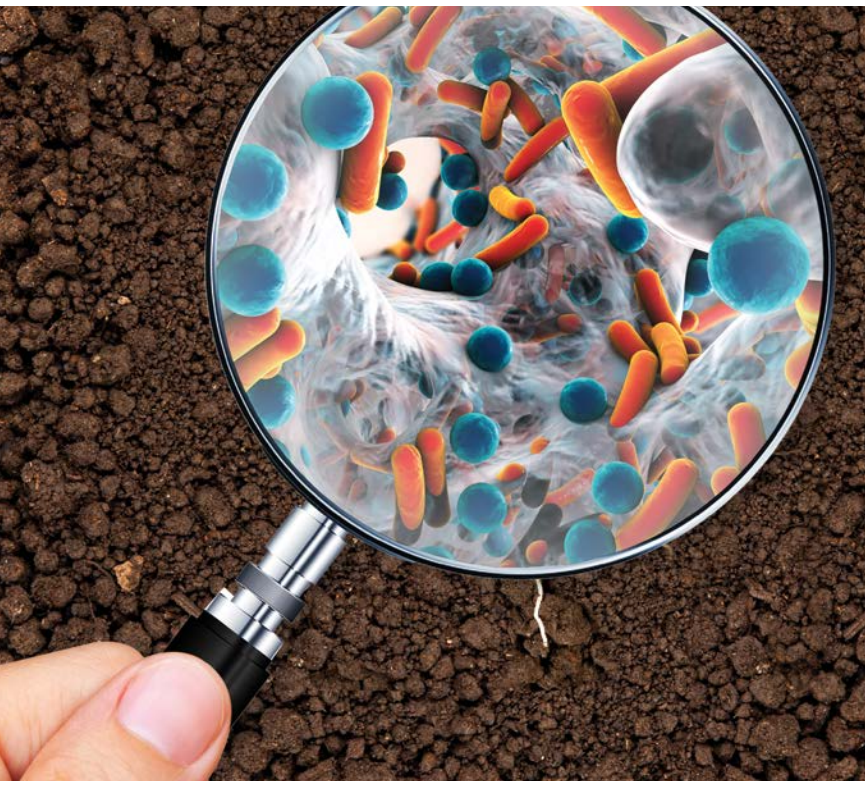

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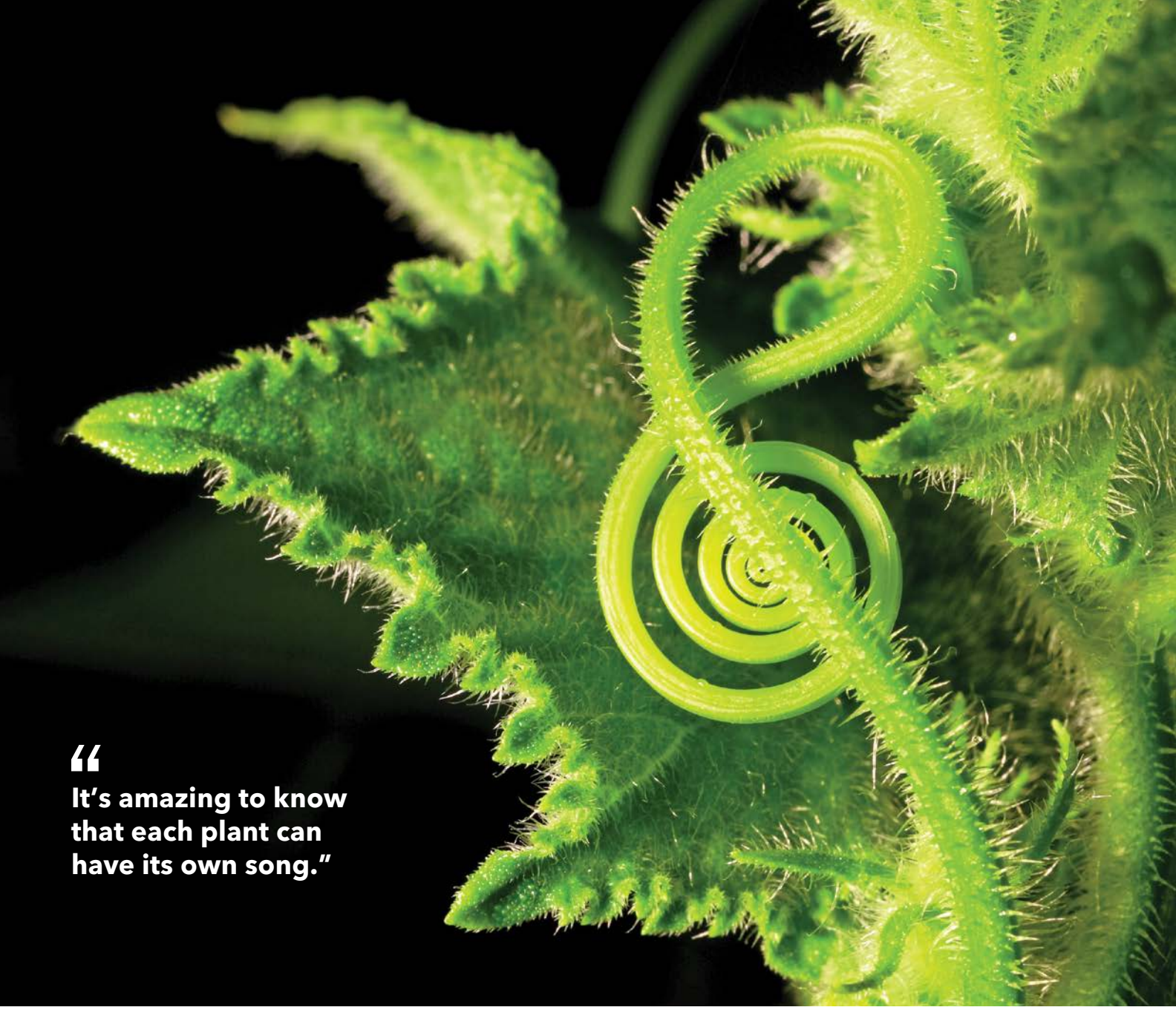

“It’s amazing to know that each plant can have its own song.”

from the **EDITOR**

TG **Toby Gorman**

It is well known that people like to play music for their plants to help them grow, and, anthropomorphically, keep them entertained.

In these very pages (“The Science of Serenading Your Plants,” *Maximum Yield* April 2018), we covered how science determined that certain plants prefer certain music to inspire their growth.

But what if plants could play a major role in composing their own music? Recently, artist and photographer Laara Cerman and geneticist Scott Pownall teamed up to translate the DNA from creeping buttercup and brown knapweed into music.

A DNA sequence is a long, continuous chain made up of four nucleotides known as A, G, C, and T. Each letter represented a musical chord, of which four notes were assigned. The nucleotide that was sequenced determined which note was played and for how long.

The result? By playing notes based on the DNA sequence, with a little help from humans, each plant was able to play its own song.

It’s a form of sonification, the auditory equivalent of data visualisation. In this instance, the data from DNA is used to make music, but sonification can have other applications such as identifying mutations, or at least complement visual inspection to identify mutations.

Who knows what applications it might have in the future, but for now, it’s amazing to know that each plant can have its own song, and some day, with a little help from technology, your plants will be able to play you a song composed by them.

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bare ROOTS

Featured Contributors

Kent Gruetzmacher, MFA, is a Colorado-based freelance writer and the director of business development at Mac & Fulton Talent Partners, an employment recruiting firm dedicated to the indoor gardening and hydroponics industry. He is interested in utilising his MA in Humanities to critically explore the many cultural and business facets of this youthful, emergent industry by way of his entrepreneurial projects.

Monica Mansfield owned an indoor garden store for 5½ years before selling the business to start a seven-acre homestead with her husband, Owen. Monica is passionate about gardening, sustainable living, and holistic health. She writes about these topics and her homestead adventures on her blog, *thenaturelifeproject.com*.

Contributors

Chris Bond
Luis Cordova
Kasey Craig
Grubbycup
Philip McIntosh
Dr. Lynette Morgan
Alan Ray

PHOTOPERIOD

Photoperiod refers to the ratio of a plant's exposure to light in a 24-hour period. Many types of plants require certain lengths of light exposure to enter various life cycle stages. The number of hours of darkness – not the photoperiod itself – is what influences photoperiodic plant responses, including flowering, stem extension, and dormancy. Growers can control the photoperiod in a plant's life cycle to appropriately encourage the plant's vegetative state, flowering, ripening, and ultimate harvest. Some plants also respond favourably to a longer than natural photoperiod by producing a more abundant yield. A given photoperiod exerts profound effects on the growth and flowering of many plant species, and manipulation of this light/dark cycle is essential for the success of many greenhouse crops. Indoor plants in the vegetative stage should ideally be receiving 18 hours of light and six hours of darkness in a 24-hour time period. This is represented as an 18/6 photoperiod. This is only a recommended average; with any given crop requiring more or less light/darkness.

If planted outside, photoperiod crops are dependent on natural light cycles: they must be planted at the beginning of the summer and naturally enter flowering mode at the end of the summer when the days become shorter.

Check out Dr. Lynette Morgan's article on photoperiod on page 46.

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branching **OUT**

Anthony P.

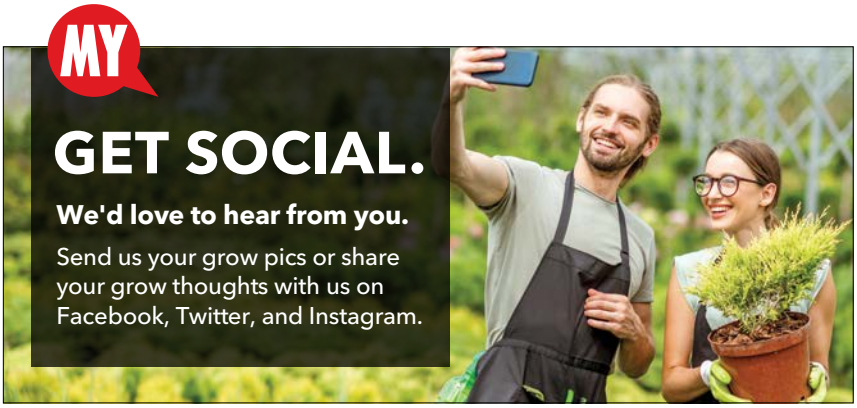
I recycle my heat into my bloom from veg. And bloom's heat goes into my basement in winter. Then summer everything goes outside lol.

Ben F.

Good to see Eric is still spreading knowledge.

@jessalittledisturbed

This is amazing! As an organic farmer.
I love seeing how other people grow and cultivate.



Article Archives

Can't recall that great gardening tip from a few months ago? Look it up online! We have hundreds of indoor gardening articles available at *maximumyield.com*.

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DO YOU HAVE A QUESTION FOR A GROWER? Email *editor@maximumyield.com* to get an answer.

ask a **GROWER**

by Chris Bond

Q What method should I use to grow pineapples hydroponically?

Thanks, Anthony

A Great question! Though pineapples are not typically thought of as a viable hydroponic crop, they certainly can be grown in hydro systems. The main drawback is the amount of time devoted to care of each plant and the extremely long development period. It can take up to a year and a half to harvest a pineapple, so unless you just really like to grow things and challenge your horticultural skills, don't expect to grow them as a lucrative crop.

Having said that, it is important to keep pH and nutrient levels monitored just as with any other hydroponic crop. Pineapples like a more acidic environment than many other hydroponically grown crops, so they should not be grown in the same system as other plants with different cultural needs. Pineapples like a pH around 5.5 but have been successfully grown in the range of 5.0 to 6.0. EC levels should be between 2.0 and 2.4, ideally.

Keep the temperature between 15-26°C in the growing area and make sure they get at least eight hours per day of light at a minimum. Natural light is of course preferable but grow lights have been used to successfully produce hydroponic pineapples.

Pineapples can be grown in gravel, stonewool, or Styrofoam. A bucket system, where each pineapple plant is in its own media and container, with its own reservoir, would probably be the most effective way to hydroponically grow pineapples. I suggest this, as due to the lengthy cultivation period, there is ample time for things to go wrong, and if you have multiple pineapple plants growing in the same system, you could potentially lose them all.

Best of luck on this one!
Chris Bond

CB **Chris Bond's** research interests are with sustainable agriculture, biological pest control as well as alternative growing methods. He is a certified permaculture designer and certified nursery technician in Ohio and a certified nursery professional in New York, where he got his start in growing.

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FACTS

Possible French Fry Shortage After Poor Harvest

After cold wet weather damaged potato crops for key producers in the US and Canada, potato processors were scrambling to find potatoes in order to keep french fry production numbers up. As the wild weather hurt crops, an increase in fry-processing capacity in Canada has boosted demand. The combination will lead to tight supplies, and it's likely potato prices could climb this year across North America, says Stephen Nicholson, a senior grains and oilseeds analyst at Rabobank. International costs may also rise as the US won't be able to export as much. "French fry demand has just been outstanding lately, and so supplies can't meet the demand," says Travis Blacker, industry-relations director with the Idaho Potato Commission. The United Potato Growers of Canada estimates about 18 per cent of Manitoba's planted area was left unharvested, while the USDA forecasts drop of 6.1 per cent in the US this year.

– bloomberg.com

Hardest Plant to Grow? Wasabi

Most horticultural experts will tell you wasabi is the hardest plant to grow commercially. That's probably why it fetches $550 per pound on the market. There are several reasons why it's so hard to cultivate. First is the difficulty in finding seeds. One farmer said it took nearly six years to source viable seeds. Wasabi is also very finicky and too much humidity or the wrong nutrient composition can destroy an entire crop. While needing plenty of water, wasabi can't be submerged like a water lily and it's very prone to disease when planted on a large scale. Wasabi takes more than a year to mature, so cultivators need a lot of patience before seeing returns on their investment. And that wasabi at your local sushi restaurant? It's not wasabi at all; rather it's a mix of horseradish, mustard, and food colouring. Only five per cent of restaurants in the world serve real wasabi.

– spoon-tomago.com

Report Details How EPA Is Promoting 'Worst of the Worst Pesticides'

A new review into approved pesticide products in the US from 2017-18 shows the Environmental Protection Agency (EPA) allowed 69 new products containing an ingredient the EPA recognises as a "known" or "likely" carcinogen. The review, *Toxic Hangover: How the EPA Is Approving New Products With Dangerous Pesticides It Committed to Phasing Out*, slams the EPA for knowingly approving new pesticides with dangerous chemicals. "It's disgusting that rather than do the right thing and phase out the worst of the worst pesticides, the EPA is quietly encouraging their ongoing use," says Nathan Donley, a scientist at the Center for Biological Diversity, which released the report. Recently approved pesticides included 15 new products containing neurotoxic carbamates or organophosphates (OPs), including chlorpyrifos. The EPA also green-lighted six new products containing paraquat, which is so lethal that one spoonful can kill a full-grown adult.

– commondreams.org

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FACTS

Kitchen Greenhouses: Wave of the Future?

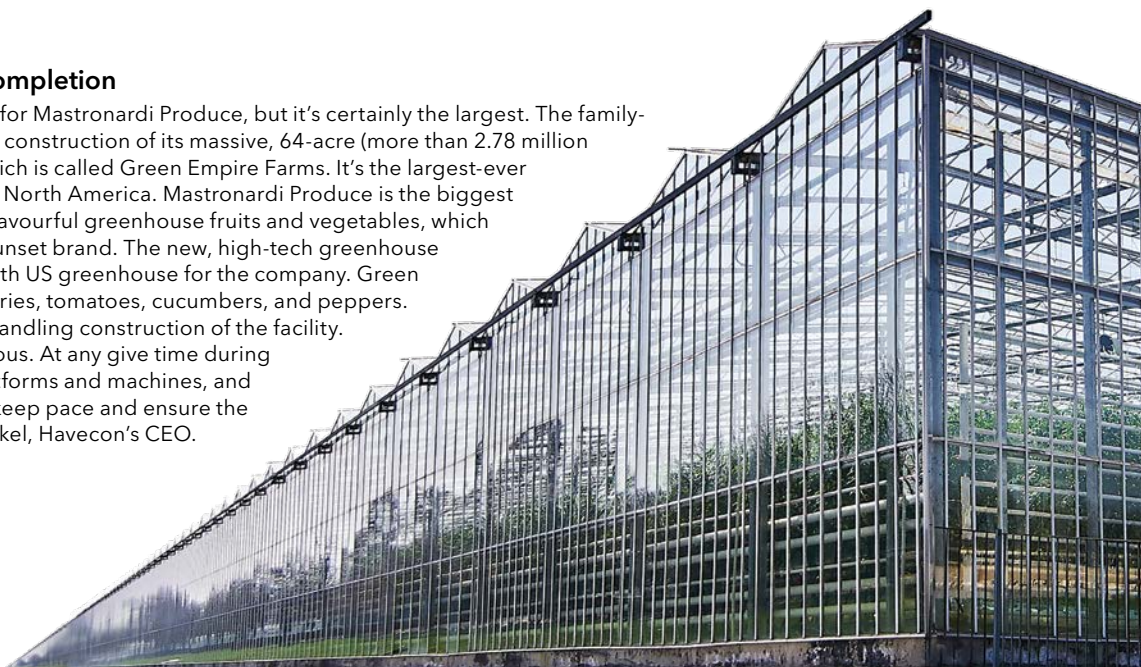
Stove? Check. Dishwasher? Check. Soon the list of kitchen appliances might include intelligent greenhouses alongside the usual suspects. Electronics company LG has designed a kitchen greenhouse that can be installed to obtain vegetables that are fresher than those found in any grocery store. The LG Indoor Garden looks like a fridge, but contains several trays to plant seeds. LG developed a smart system that controls vital aspects such as light, temperature, and water. This appliance, which includes 24 planters and their different seedbeds, replicates the conditions of the plants' natural habitat, according to LG. Each planter or pot has everything necessary for the plant to grow, from peat moss to fertiliser, including, of course, the seeds themselves. The greenhouse would feed a family of four with their own crops (20 kinds) including romaine lettuce, arugula, chicory, and basil. The appliance was unveiled in January at the CES show in Las Vegas.

– digitaltrends.com

American Hop Production Booming

With craft brewing experiencing major growth, so too are American hop producers. Hops, which can be grown hydroponically, are a key ingredient in beer production and, before 2007, hops were only produced in three states: Oregon, Washington, and Idaho. Now 29 states are engaged in growing hops. Researchers from Penn State and the University of Toledo used data from the US Census of Agriculture and ReferenceUSA and found that from 2007 to 2017, the number of breweries in America more than quadrupled from 992 to more than 4,000, and the number of breweries in a state is associated with more hop farms and hop acres five years later. The number of hop farms grew from 68 to 817. "It suggests that in areas where hop production is possible and not cost-prohibitive, breweries are expanding markets for farmers and providing an opportunity to diversify farm income," says Claudia Schmidt, a research team lead.

– sciencedaily.com



Mega-Greenhouse Nears Completion

It's not the first greenhouse rodeo for Mastronardi Produce, but it's certainly the largest. The family-owned company is almost finished construction of its massive, 64-acre (more than 2.78 million square feet) single greenhouse which is called Green Empire Farms. It's the largest-ever single build greenhouse project in North America. Mastronardi Produce is the biggest vertically integrated producer of flavourful greenhouse fruits and vegetables, which it sells and distributes under the Sunset brand. The new, high-tech greenhouse located in Oneida, NY, is the seventh US greenhouse for the company. Green Empire Farms will grow Sunset berries, tomatoes, cucumbers, and peppers. Havecon Horticultural Projects is handling construction of the facility. "The scale of this project is enormous. At any give time during construction, we have 10 to 15 platforms and machines, and over 75 staff working non-stop to keep pace and ensure the schedule is held," says Henk Verbakel, Havecon's CEO.

– freshplaza.com

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2 | Fluence SPYDR 2 Grow Lights

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3 | Avert Bumbag

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4 | Phresh In-Line Filters – V2

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5 | Hortivision 600W Digital Kits

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6 | Rhizo Boost

THC Australia has developed a unique and exclusive horticultural additive formula that will increase your quality and quantity while saving money at the same time. This bio-organic super liquid will ferment its own variety of enzymes that break down nutrients and deliver them direct to the plant where it's needed the most, eliminating the need for continuous use of expansive enzyme additives. Rhizo Boost unlocks insoluble phosphorus, which is normally frozen within soil and substrate ions, increasing yields significantly. It works in hydro, coco, or soil.

7 | FloraMax Resin-XS

Designed to meet the critical demands of growers wanting larger and more potent yields, FloraMax's Resin-XS delivers enhanced resin and oil content, greater potency, and more fruit weight. Growers report more than 30 per cent improvement in trichome population and independent labs have verified significantly higher concentrations of essential oils than other leading products. Clean as a whistle, Resin-XS won't induce foul odours or bio films in the reservoir and contains no plant growth regulators for consumer protection.

8 | Hyperfan V2

Featuring a much-improved 0-10V motor, the Hyperfan V2 offers among the highest static pressures of any fan type in the industry (up to 680 Pa). The motor provides seamless speed adjustment from full stop to full power without any droning or motor degradation. The fan blade balance has also been refined to near-perfect tolerances which reduces air noise and increases bearing life. Additionally, the new steel housings increase fan strength and integrity. It's available at Growhard Australia.

9

10

11

12

9 | **Ed Rosenthal's Zero Tolerance Pesticide**

Ed Rosenthal's OMRI-approved pesticide is a potent mix of food-grade plant oils that eliminate and control spider mites, broad mites, aphids, and powdery mildew. Diluted and used as a repellant, it prevents infestations. Ed's blend of herbal oils fully evaporates, leaving no residue. Zero Tolerance is approved for organic production, is Clean Green Certified, and 100 per cent vegan. As the commercial market becomes more competitive, it is critical that crops test clean.

10 | **Bio Diesel Supernatural**

Supernatural is a premium organic root and shoot stimulant made from a blend of organic sea algae extracts and Bio Diesel's famous bio stimulants. It helps your plants create and grow massive lateral feeder roots, with increased nutrient uptake and immediate plant response. It's ideal for correcting plant stress and trace element deficiency, while promoting faster root and plant growth. Supernatural contains a full spectrum of trace elements and is compatible with soil or hydroponic growing, as well as coco fibre, clay balls or any inert hydroponic media.

11 | **FloraMax Ca-Mg-Fe**

Ca-Mg-Fe is a powerful 'cure-all' for leaf yellowing and growth abnormalities. The researchers at FloraMax have taken this nutrient category to a new level – unlike other Cal-Mags, Ca-Mg-Fe also contains iron and high levels of essential trace elements such as copper, manganese, zinc, molybdenum, and boron in an "alkaline stable" form. This combination not only ensures abundant nutrient supply but also "bullet-proofs" the nutrient if pH spikes within the range of 6.5 to 9. Ca-Mg-Fe excels in situations where nutrients are subject to volatile changes in pH and EC.

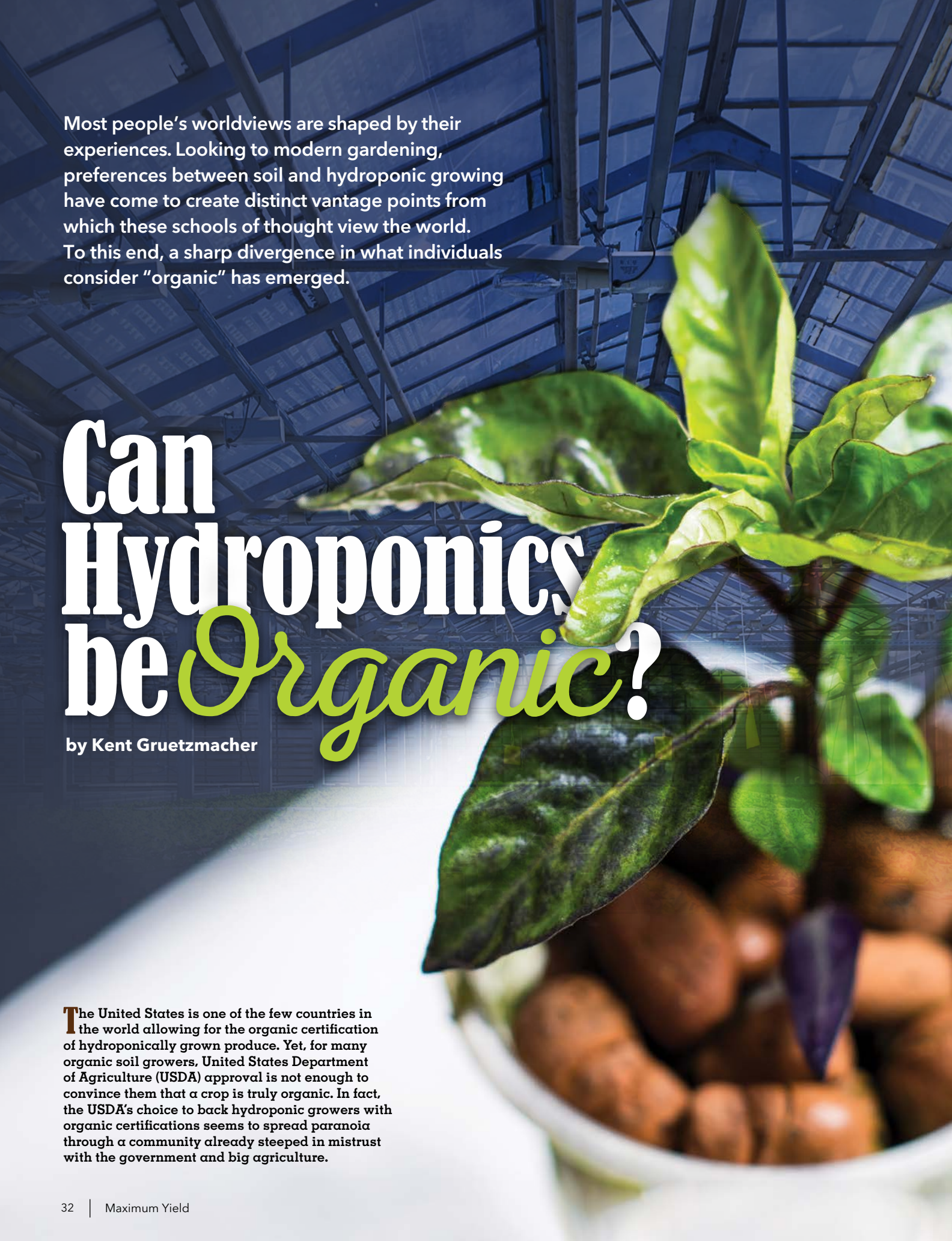
12 | **Reiziger Grow Food A&B**

Grow Food A&B is a two-part nutrient designed for use in all hydroponic growing media including both recirculating and non-recirculating systems. It contains no sulphates, chlorides, carbonates, excess soluble salts, or other undesirable elements to damage plants or the environment. Reiziger Grow Food A&B is a balanced, fast-acting formula to instantly promote healthy, energetic new growth, and root development. Maximum nutrient absorption and water penetration is guaranteed with large quantities of rapidly absorbable nitrate nitrogen and high-grade magnesium and calcium.

Most people's worldviews are shaped by their experiences. Looking to modern gardening, preferences between soil and hydroponic growing have come to create distinct vantage points from which these schools of thought view the world. To this end, a sharp divergence in what individuals consider "organic" has emerged.

Can Hydroponics be *Organic*?

by Kent Gruetzmacher



The United States is one of the few countries in the world allowing for the organic certification of hydroponically grown produce. Yet, for many organic soil growers, United States Department of Agriculture (USDA) approval is not enough to convince them that a crop is truly organic. In fact, the USDA's choice to back hydroponic growers with organic certifications seems to spread paranoia through a community already steeped in mistrust with the government and big agriculture.

In an era inundated with controversy in food production, including the bullying tactics of pro-GMO corporations like Monsanto, it's not surprising traditional organic farmers are skeptical of hydroponics, and groups like the Organic Farmers Association have made it a goal to discredit the organic distinction of hydroponics.

It is obvious that the hydroponic organic debate is being waged on a battlefield field already inundated with frustration. Yet, it is too easy to overlook what science and the natural world tell us about concepts like organics. After all, isn't Mother Nature herself 100 per cent organic?

HYDROPONIC CULTIVATION

Hydroponic enthusiasts purport that by fusing technology with food production, they can help curb the global food crisis. Most notably, hydroponics is an essential element in urban agriculture, where forward-looking horticulturists are transforming cityscapes from food deserts to vibrant agricultural centres.

The scientific argument behind hydroponic cultivation is intimately tied to environmentalism and conservation. Advocates of hydroponic cultivation assert that their methods are, in fact, more ecologically friendly than soil-based growing. This is because, with careful controls on inputs and outputs in their systems, hydroponic growers can produce crops with little to no wasted water. Also, advanced operations like vertical farms utilise far less square footage to produce crops than seen with traditional soil farms.

SOIL GROWING

For many organic enthusiasts, the use of soil in cultivation is the only way to produce organically grown goods mainly because soil growers generally mimic how plants are grown in the natural world. In organic soil cultivation (as in nature), essential plant processes occur in a dynamic community of living organisms within the soil and biosphere.

As such, plants grow among a symphony of life in the fields and forests, where complex systems of microorganisms and animals interact to stimulate growth.

From a scientific standpoint, soil growers assert that hydroponic growing lacks the complexity of life present in the natural world, rendering the practice inorganic. According to Linley Dixon, chief scientist for the Cornucopia Institute, "the soul … of organics isn't just about the singular crop: it's about the ecosystem, the environment, and the planet. Proper soil-based organics ensures healthy soil for generations, allows for thriving communities of beneficial insects, and, in turn, an entire ecosystem around them."

> "**Hydroponic enthusiasts** purport that by fusing technology with food production, they can help curb the global food crisis."

ORGANIC CERTIFICATION

The debate occurring between soil and hydro growers stems largely from the USDA's organic certification process. According to the USDA website, "Overall, organic operations must demonstrate that they are protecting natural resources, conserving biodiversity, and only using approved substances." Within this regulatory schematic, they state that "synthetic fertilisers, sewage sludge, irradiation, and genetic engineering may not be used" in organic operations.

From the information provided by the USDA in their accreditation process, both hydroponic and soil growers can lay claim to the organic certification. Yet, within this debate, the confusion doesn't really lie with what sorts of fertilisers or sprays are being used to produce organic crops. Rather, the divergence is ideological, as both parties feel they are honouring the ecological stipulations set forth by the USDA. To illustrate, hydroponic growers feel their water conversation efforts set forth in "protecting natural resources" while soil growers feel their practices defend the "biodiversity" present in the natural world.

> **The debate** occurring between soil and hydro growers stems largely from the USDA's organic certification process."

WHAT DOES MOTHER NATURE SAY?

While the USDA's views on organic certification are helpful in picking out key points in the hydroponic organics debate, it can't be argued that nature is the standard in understanding the concept of organics. Therefore, looking for hydroponic plant growth in the natural world offers a viable way of demystifying this convoluted debate. As such, if plants grow hydroponically in nature, shouldn't the process be considered organic?

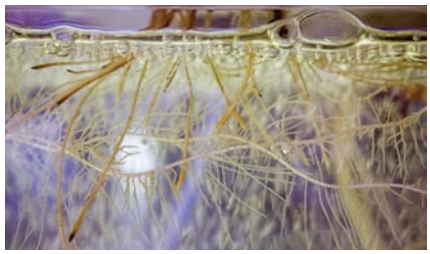
The most defining characteristic of hydroponics is growing plants in nutrient rich water as opposed to soil. This practice stands in stark contradiction to soil cultivation, where earthen materials provide a support for a plant's root system, as well as vital nutrients. Nonetheless, by using hydroponics to grow plants, cultivators are not necessarily creating an unnatural phenomenon.

There are several edible plant species that grow exclusively in bodies of water. These "natural hydroponics" plants include wild rice, watercress, water spinach, wasabi, Chinese water chestnut, water caltrop, taro, cattail, and bulrush. What's more, the water systems where these plants grow are often ecosystems unto themselves, offering the biodiversity so cherished by proponents of organic soil growing.

In looking at natural systems in lakes, ponds, and rivers, aquaponics takes the next step in developing self-sustaining ecosystems in hydroponics growing. In the mini biospheres created by aquaponic growers, fish waste provides nutrients to crops. In turn, both fish and plants are harvested as food sources.

Unlike industrial farming, where an astounding amount of energy goes into producing crops, aquaponics systems are known as "closed loop" systems because they don't require any additional energy inputs (fertiliser, water, etc.) to continue to produce both foods from both fish and plants.

With such things as biodiversity, organic soil cultivators do their best to mimic the cycles of Mother Nature. However, can't the same be said about aquaponics growers? Even more,



soil growing is defined by large mono crop fields of plants that have often been transplanted from the other side of the globe. To illustrate, "organic" potatoes are grown in massive farms in the central valleys of Colorado, even though these tubers are originally found in South America. Is this arrangement of plant life more "natural" or "organic" than an aquaponics operation where tilapia waste feeds lettuce greens? In the end, these questions simply boil down to preference and taste.

SUMMARY

The hydroponic organics debate is an offshoot of a larger question facing humankind: what is our place in the natural world? There is no easy answer to this question. Our ability to manipulate natural systems is a result of our capacity for rational thought. As such, the hydroponic organics debate is largely philosophical in nature. In this debate, we are essentially assessing the place of rationality in the natural world. Humanity's propensity to alter the "natural order of things" has developed these confusing global food systems, as well as mono-crop fields, hydroponics growing, and genetically modified foods.

In reality, all commercial farms utilise technology to manipulate nature. Through this lens, a monocrop field of soil grown potatoes is no more "natural" than an aquaponics operation. Moving forward, and following the lead of Mother Nature herself, soil and hydroponic growers should be focusing on their similarities instead of differences. Within this exchange, biodiversity is a great starting point. With a more educated respect for one another's practices, perhaps these two groups can work together to solve important issues related to world hunger, natural foods, and basic nutrition.

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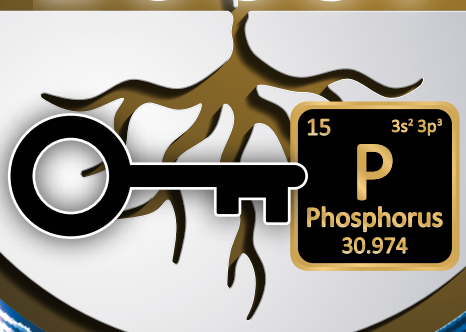

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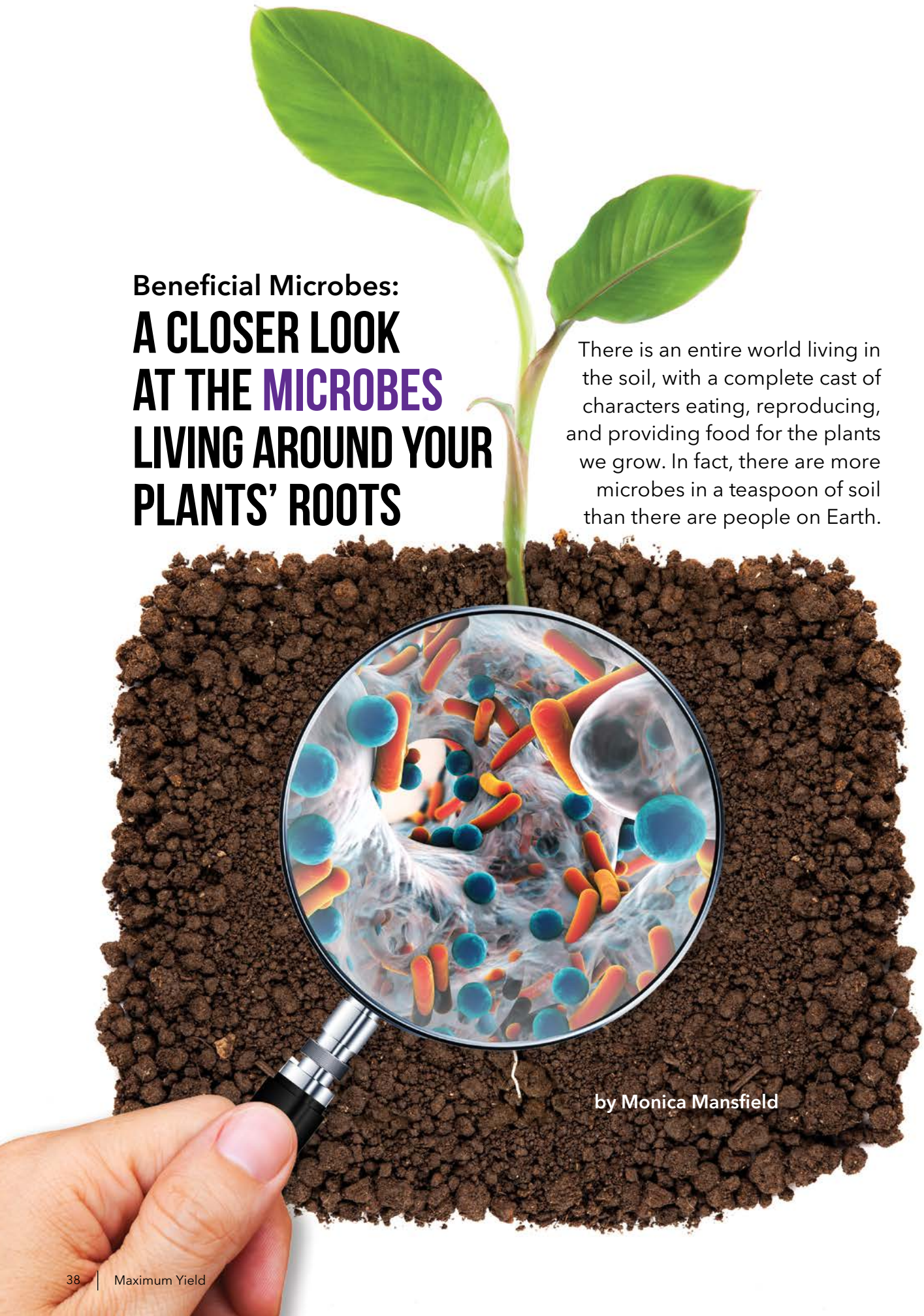
Beneficial Microbes:

A CLOSER LOOK AT THE MICROBES LIVING AROUND YOUR PLANTS' ROOTS

There is an entire world living in the soil, with a complete cast of characters eating, reproducing, and providing food for the plants we grow. In fact, there are more microbes in a teaspoon of soil than there are people on Earth.



by Monica Mansfield

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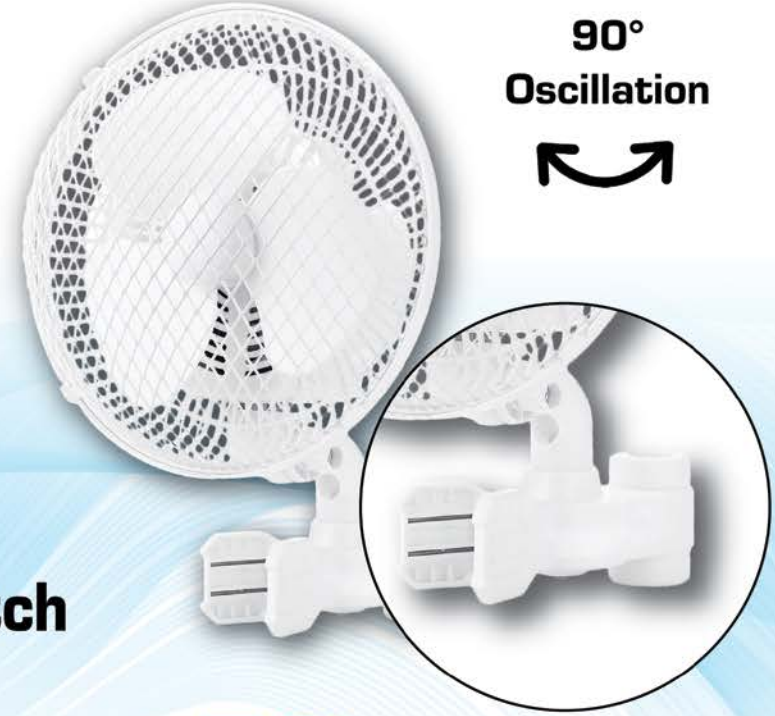

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Microorganisms living in the rhizosphere have a symbiotic relationship with the plants who host them. Bacteria, fungi, nematodes, protozoa, and arthropods are all beneficial microbes connected in the soil food web and working together to feed the plants in our garden. As gardeners, it helps us to learn about these beneficial microbes and how to support them, so they thrive in the soil and work to give us a healthy garden.

BACTERIA

One teaspoon of healthy soil contains between 100 million and one billion bacteria. These tiny, one-celled organisms are a miniscule 0.1 millimetres wide and only slightly longer in length. They are the first microbes to digest new organic matter in the soil. They recycle nutrients, suppress diseases, and improve the soil's ability to hold water. There are four kinds of bacteria: decomposers, mutualists, lithotrophs, and pathogens.

Decomposers feed on carbons, such as root exudates and plant litter. After digesting them, their waste becomes food for other soil organisms in the food web. This way, nutrients such as nitrogen are kept in the root zone instead of leaching out into the groundwater.

Mutualists have symbiotic relationships with plants. For example, nitrogen-fixing bacteria make their home in the root zone of legumes and certain trees. They convert nitrogen from the air into a plant-available form. This nitrogen is then returned to the soil when the plant drops its leaves.

Instead of consuming carbon compounds, lithotrophs consume nitrogen, sulfur, iron, and hydrogen. They play a role in the nitrogen recycling process and can be helpful at degrading pollutants.

While bacterial pathogens can damage plants, they can be kept in check with a healthy and diverse microbial community in the rhizosphere. Other microorganisms will compete with the pathogens and keep their populations and check.

FUNGI

Fungi are another key player in the soil food web. These microscopic cells grow strands called hyphae that weave throughout the soil and bloom above the soil as mushrooms. They can be grouped as decomposers, mutualists, and pathogens.

Decomposers play an important part in nutrient cycling by breaking down hard-to-digest materials, such as cellulose and lignin, and retaining the nutrients in the soil. They also help create humus, which is resistant to degradation and holds water well.

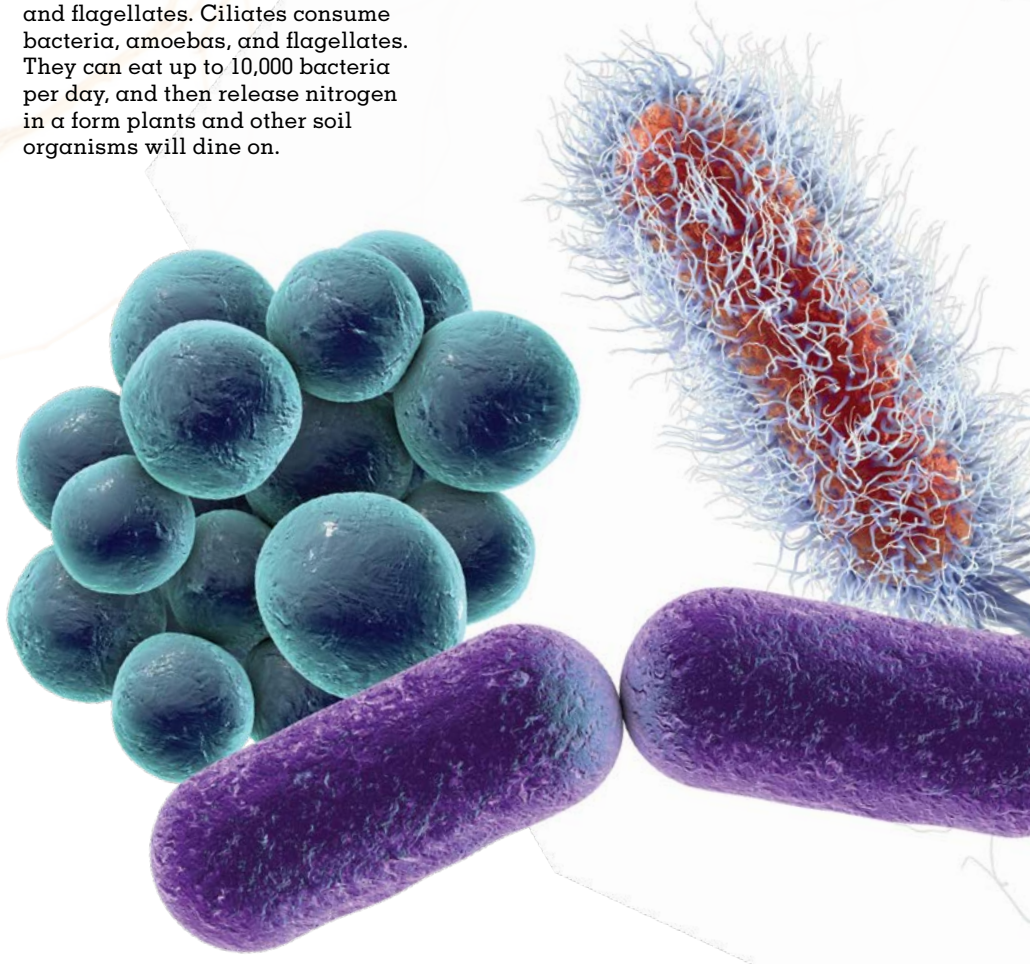
Mutualists have a symbiotic relationship with plants. They colonise the root zone and send out their hyphae to create a vast underground network. The hyphae resemble roots and can travel miles underground. Plants can communicate with one another through this network and warn one another of potential threats. These mycorrhizal fungi will bring soil nutrients and water back to its host plant.

Pathogenic fungi, such as *Verticillium* and *Pythium*, can reduce a harvest or kill plants completely when they colonise their root zone. However, some pathogenic fungi help to control pests and disease. For example, certain strains will set traps for harmful nematodes. Some strains create sticky traps, while others make circular rings with their hyphae to constrict and kill their prey.

PROTOZOA

Protozoa are several times larger than bacteria and can be classified into three groups: ciliates, amoeba, and flagellates. Ciliates consume bacteria, amoebas, and flagellates. They can eat up to 10,000 bacteria per day, and then release nitrogen in a form plants and other soil organisms will dine on.

"Fungi are another key player in the **SOIL FOOD WEB.** These microscopic cells grow strands called hyphae that weave throughout the soil and bloom above the soil as mushrooms."



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Explosive root growth.
Photo credit - P.B., Detroit, Michigan

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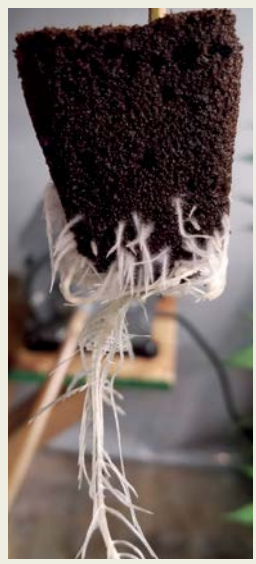

Cutting at Day 5.
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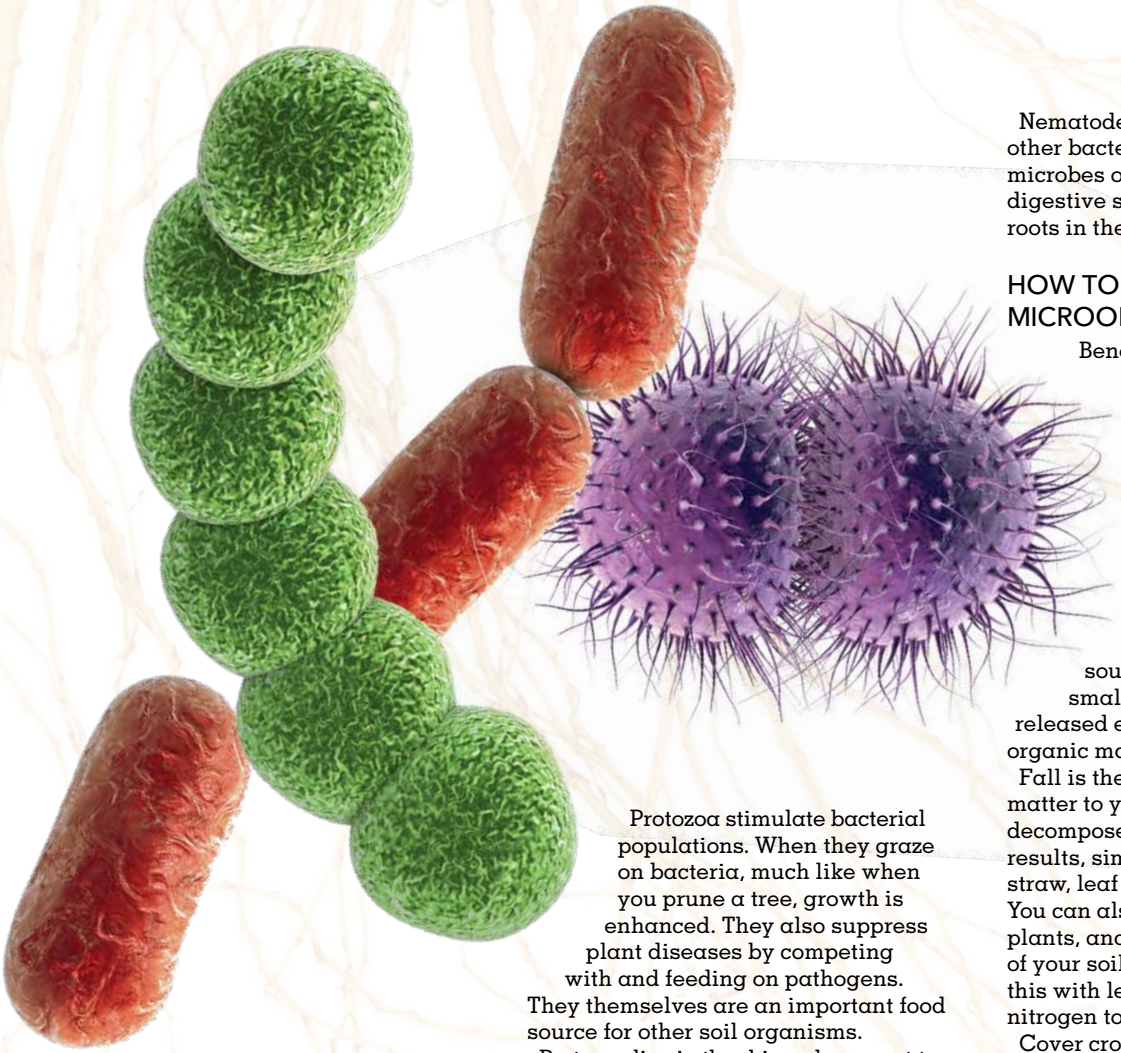

Protozoa stimulate bacterial populations. When they graze on bacteria, much like when you prune a tree, growth is enhanced. They also suppress plant diseases by competing with and feeding on pathogens. They themselves are an important food source for other soil organisms.

Protozoa live in the rhizosphere next to roots, where there are plenty of bacteria to eat. Moisture is important for protozoa because they travel by water.

NEMATODES

Nematodes are non-segmented worms that are only about 0.05 mm in diameter and 0.05 mm long. They feed on a wide variety of soil organisms. Some strains feed on bacteria and fungi while others consume plants, algae, and other nematodes. When they eat bacteria or fungi, ammonium is released into the soil in a form plants can use.

Their grazing stimulates bacterial growth, however, too many nematodes can reduce bacterial populations, which in turn decreases plant productivity. Predatory nematodes, soil microarthropods, insects, and parasitic bacteria and fungi keep nematode populations in balance.

While some nematodes can cause plant diseases, others suppress them by feeding on disease-causing organisms. In fact, you can purchase beneficial nematodes as a biocontrol agent at most garden centres.

> “Nematodes act as a taxi cab for other bacteria and fungi. They carry **MICROBES** on their surface and in their digestive system as they travel along roots in the soil.”

Nematodes act as a taxi cab for other bacteria and fungi. They carry microbes on their surface and in their digestive system as they travel along roots in the soil.

HOW TO SUPPORT SOIL MICROORGANISMS

Beneficial soil microorganisms thrive in soil that has plenty of organic matter and has not been tilled. While tilling initially releases a burst of nutrients, it also destroys established fungal networks. Over time, organic matter becomes depleted and microbial populations shrink because they have lost their food source. Under no-till conditions, small amounts of nutrients are released every year and high levels of organic matter are maintained.

Fall is the ideal time to add organic matter to your garden so that it can decompose over the winter. For great results, simply mulch with compost, straw, leaf litter, manure, or wood chips. You can also chop and drop your spent plants, and either leave them on top of your soil or turn them under. Doing this with legumes will add plenty of nitrogen to your soil.

Cover crops also feed soil microbes. There are 1,000 to 2,000 times more microbes living around roots then there are living in bare or tilled soil. Planting a winter cover crop to a no-till field will prevent nutrients from being lost through erosion and leaching, and give beneficial microbes a place to call home with plenty of food nearby.

Synthetic fertilisers and pesticides can do serious damage to microbe populations. The salts in fertilisers and chemicals in pesticides harm microbes. Better to add organic matter and amendments to the soil if you want a thriving microbial population. When your soil contains a diverse population of microorganisms, you'll find pests tend to be less of a problem. However, if problems do arise, organic pesticides such as neem oil or soap sprays will effectively treat infestations without harming soil biology.

If you create an environment that is favourable to beneficial microbes in your soil, they will do many of your garden chores for you. They will recycle nutrients and create rich soil that will grow a happy, healthy garden.

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IS CANNABIS A SUPERFOOD?

by Luis Cordova

When it comes to the cannabis plant we smoke it, extract it, cook it, or bake it. But are there any health benefits experienced by just eating it raw? Luis Cordova examines if raw cannabis can be considered a superfood.

With no real scientific criteria to define it, the term superfood has become overused in modern lexicon. Many dietitians regard the concept of superfoods as a marketing tool for the purpose of selling healthier and sometimes not so healthy products. The term was first introduced during World War One as a marketing tool to sell bananas. After scientists began studying the nutritional value of consumer foods, the use of the term has evolved. Many marketers promote superfoods with magic abilities to reduce weight or heal many diseases. However, when it comes to science, there is no specific definition or test used to determine what constitutes a superfood.

The modern definition of superfoods are foods that are unprocessed, rich in vitamins, minerals, and other nutrients. These types of compounds are mainly derived from fruits, vegetables, and herbs. Chemical analysis of superfoods shows high levels of antioxidants, carotenoids, micro-minerals, and other beneficial properties. Because of these attributes, many medical practitioners now believe cannabis should be considered a superfood.

Should Cannabis be Considered a Superfood?

Cannabis can be grouped as a superfood because of its health benefits, nutrient value, and chemical compounds. Cannabis seeds, specifically *Cannabis sativa* (hemp), contain many amino acids, proteins, and healthy fatty acids. Hemp seeds contain iron, calcium, magnesium, phosphorus, potassium, zinc, and folate. They also contain a large amount of protein for their size, as well as vitamin C and small amounts of vitamin B. Hemp seeds provide more than 30 per cent fats, including linoleic acid (omega 6) and alpha linolenic acid (omega 3). These fatty acid types are good for the heart and protect against many other diseases. They have also been shown to reduce inflammation, allow for management of arthritic pain, and remove particulate matter caused by air pollution. While the seeds are beneficial, cannabis contains many vitamins as well as nutrients found in the leaves, stems, buds, and roots of the plant.

As the entire cannabis plant can be used for food, doctors advise cannabis should be eaten in its raw state. Cannabis in its raw state (before decarboxylation) contains a vast array of cannabinoid acids, however, two are the most concentrated: tetrahydrocannabinolic acid (THCA) and cannabidiolic acid (CBDA). THCA is a compound offering many medicinal benefits while being non-intoxicating.

> "THE TERM WAS FIRST INTRODUCED DURING WORLD WAR ONE AS A MARKETING TOOL TO SELL BANANAS."

It is primarily found in raw or living cannabis. THCA is composed of two isomers named THCA-A and THCA-B. Due to THCA-B's stabilisation and crystallisation abilities, research for this isomer is focused on the modelling of the molecule for cannabinoid receptor studies and the biosynthetic cannabinoid pathway. For this reason, the medicinal benefits are not well known. However, THCA-A is of growing research interest for its therapeutic properties, which include anti-inflammation, neuroprotectiveness, anti-emetic, and anti-proliferative properties. These properties can reduce nausea, pain, cancers, and other neurodegenerative diseases. THCA-A is of great interest but lacks clinical application. This is largely due to its thermal instability and how easily it is decarboxylated into THC. The heat instability is so great, it can be decarboxylated by smoking, baking, and even storing at room temperature. To overcome this instability clinically, extracting using olive oil shows greater durability for a longer period of time when compared to other extraction methods. Additionally, shelf life can be extended when storing without any heat inputs, exposure to sunlight, and being stored in a refrigerator.

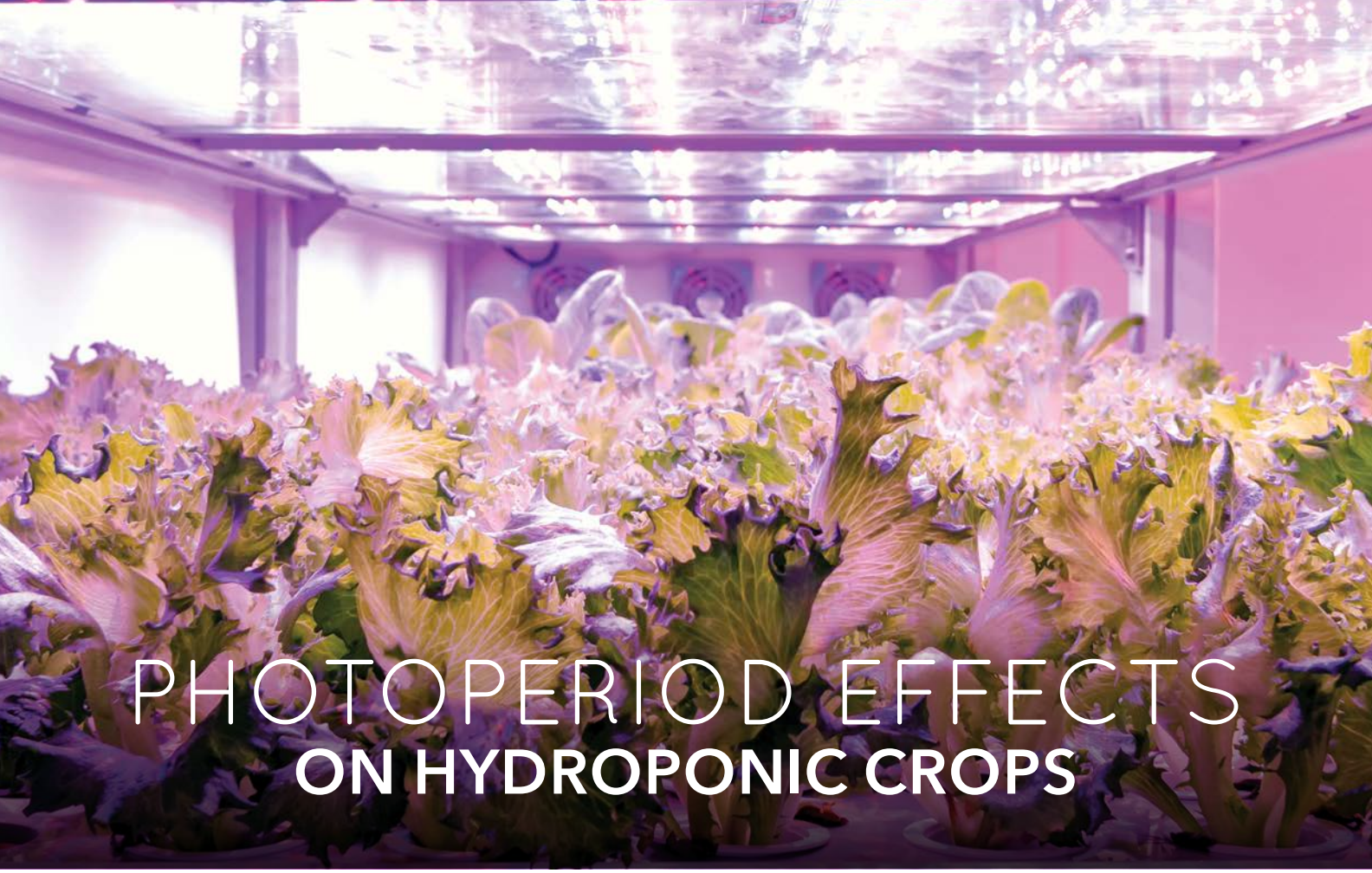
Other studies have shown THCA-A can be protected in its raw state when glandular trichomes with 10 per cent terpenoids are present. Essentially, the trichomes act as a seal and the terpenoids provide many antioxidant compounds protecting the internal compounds from thermal degradation as well as oxidative stress. THCA-A is of great potential as it shows it can bind to cannabinoid receptors at lower concentrations. However, THCA-A is more desirable therapeutically as it is both more potent and has no psychoactive effects. For these reasons, it is the main reason why juicing or eating raw cannabis is of great benefit.

Much like THCA, CBDA is a non-psychoactive cannabinoid compound with many therapeutic effects. CBDA is an acidic precursor to CBD and is easily morphed into CBD with heat. CBDA is largely found in the leaf material of cannabis. While there is much information regarding CBD, the study of CBDA is just beginning. However, it has been reported that CBDA is a selective cyclooxygenase-2 (COX-2) inhibitor. COX-2 is the main pathway responsible for pain, inflammation, and other diseases in humans. CBDA has also been reported to aid in the reduction of highly aggressive breast cancer cells. CBDA also helps in reducing symptoms of nausea, vomiting, and some symptoms of psychosis. Furthermore, these chemical compounds have shown to create synergy with the gut microbiome by reducing inflammation, creating greater microbiological diversity, inhibiting gastric acid secretion, and enhancing food intake.

Superfood By Definition

Considering the modern definition of what a superfood is, it's difficult to argue cannabis is not a superfood. Not only does cannabis offer many health benefits, it can be consumed in many ways, and is able to be eaten in its entirety. Cannabis chemical compounds have been shown to greatly inhibit many disease-causing pathways. In time, cannabis may become one of the greatest therapeutic plants we know. Research has shown the best way to get all these benefits is to consume the plant in its raw form and use every part of the plant. The best way to get all these benefits is to juice or eat the plant from seed to root.

"HEMP SEEDS CONTAIN IRON, CALCIUM, MAGNESIUM, PHOSPHORUS, POTASSIUM, ZINC, AND FOLATE."



PHOTOPERIOD EFFECTS
ON HYDROPONIC CROPS

All growers seek to push their yields to the limit. One technique researchers have focused on recently is how continuous light methods compare to light/dark stages. Lynette Morgan examines the research for you and breaks it down. | **by Dr. Lynette Morgan**

Continuous light is not an option for crops such as fall flowering chrysanthemums which require short day lengths to induce blooms.

Hydroponic growers on both a large scale and smaller indoor enthusiasts often have the same aim: to maximise growth and yields from their production systems. While choice of suitable cultivars, optimal nutrition, and an ideal growing climate significantly increase the potential of a hydroponic system, we are always searching for other possibilities to further push growth and productivity. One technique that has come under increased study, particularly since the uptake of advanced and more cost-effective indoor lighting technology, has been the use of continuous light as an alternative to the normal light/dark period used for most crops. If photosynthesis, assimilate production, and utilisation by plants can be increased via continuous lighting there is potential for an increase in growth and yields. This may seem like a simple and successful formula for plant production to increase light and thus growth, but plant physiology and response to continuous light is far more complex and, it seems, also species dependant.

Light and Flowering

Light has numerous different effects on plant growth and development. Apart from the obvious use in photosynthesis to produce assimilate for growth, light plays a role in several other physiological processes. Some plants require either short- or long-day lengths to either promote or inhibit flowering, thus continuous light is not suitable during certain phases of growth when growers are manipulating flowering times. However, most of the widely grown, modern varieties of hydroponic crops such as lettuce, tomatoes, cucumber, and capsicum are not day-length sensitive when it comes to flowering, so they could potentially benefit from continuous day length under certain circumstances.

Light Intensity

The amount of light intercepted by a crop is dependant not only on the number of hours per day light is provided, but also by the intensity. The amount of light received over a 24-hour period can be calculated as the daily light integral (DLI), which is a combination of intensity and duration. This is a much more meaningful way of measuring the light received by a plant than just a spot reading of intensity. Plants grown under longer photoperiods (18 hours of light compared to 12 hours, for example), can be provided with a lower light intensity, however, the increased day length means they will receive the same overall light total as those under the shorter day length. This means plants grown under continuous light can only use so much light within a 24-hour period before they become completely light saturated at a high DLI, thus continuous lighting regimes typically use lower output lamps. Low-level continuous lighting is currently used for some crops such as seedlings, lettuce, and leafy vegetables, however, the most potential seems to exist with those crops which require a high overall day light level and have a strong demand for assimilate to maximise fruit growth.

Low-intensity continuous light is often used for seedlings and small salad greens.

Continuous Light and Plant Injury

Continuous light has been reported to cause leaf and crop injury and is somewhat species dependant. Tomatoes are particularly sensitive and cultivated tomato varieties have been widely reported to develop leaf injury when grown in continuous light.

"EVEN IF SUFFICIENT LIGHT IS PROVIDED, the build-up of assimilate in the leaf and subsequent slowing of photosynthesis means that no increases in yield and productivity will occur even under continuous light."

The mechanism for this damage is not completely clear, but appears to at least be partially a result of the hyper accumulation of starch and soluble sugars produced in the leaf under the prolonged lighting conditions that can cause a range of symptoms, the most common being leaf chlorosis (yellowing) and necrosis (death of leaf cells). Continuous light may also accelerate leaf aging and photo-oxidative damage due to excessive light levels and there may be other factors involved with foliar damage.

Studies have found that running a lower temperature for several hours in each 24-hour period under continuous light benefited a number of species — tomatoes grown with 28/16°C alternating temperatures and cucumbers with a short-term exposure to 12°C decreased the severity of injury symptoms caused by continuous light. Leaf injury under continuous light appears to be not just caused by the long light exposure itself but by an interaction between light duration, light intensity, and light quality as well as temperatures provided by thermoperiods.

Capsicum is a fruiting crop that could benefit from continuous light if leaf injury could be prevented.

Continuous Light and Assimilate Unloading

One of the limiting factors for the use of continuous light is the process of assimilate unloading — the transport of photosynthesis products out of the leaves where photosynthesis has been occurring to the sites where it is required for growth (such sinks for assimilate include rapidly developing cells in fruit, buds, flowers, and new root growth). Under normal light/dark conditions, photoassimilate produced during the light period can be exported out of the leaf during both the light and the dark period when no photosynthesis is occurring, thus preventing a build-up of sugars in the leaf cells. If the assimilate produced via photosynthesis is not exported out of the leaf cells fast enough, there is a build-up of these sugars that creates a negative feedback and slows or even stops further photosynthesis.

> "TO FURTHER CONFUSE THIS PROCESS of whether continuous light may be beneficial to certain crops is the fact temperature interacts with light on several different levels."

So, even if sufficient light is provided, the build-up of assimilate in the leaf and subsequent slowing of photosynthesis means that no increases in yield and productivity will occur even under continuous light.

In fact, a reduction in growth can happen. This is seen as the major drawback in the use of continuous light for increasing the rate of food production. The other issue is this overproduction of assimilate that builds up in the leaf cells and can't be shipped out of the leaves fast enough. This may be what is responsible for the damage and leaf injury some species experience under continuous light.

To further confuse this process of whether continuous light may be beneficial to certain crops is the fact temperature interacts with light on several different levels.

First, temperature determines the rate of photosynthesis, so more assimilate is produced under continuous light when optimal warmth is provided than when it is cooler than optimal, so an excess build-up of starch is more likely to occur in foliage under these warm conditions.

Second, temperature plays a major role in the rate of transport of assimilate out of the leaves (the source) to the sinks (fruits, flowers, buds). The temperature differences that typically occur under a normal day/night regime are warmer during the day and cooler at night. Under continuous light, temperature often remains the same right throughout the 24-hour period in order to allow maximum rates of photosynthesis to occur.

Eggplant is one of the crops that are prone to leaf injury under continuous light at constant temperatures.

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"THE EVIDENCE SUGGESTS the cooler temperatures running for 12 hours in every 24 under continuous light favours the metabolism of starch and sugars and translocation from the leaves and into the sinks."

Nights that are cooler than days favour phloem unloading (the transport of sugars out from the rapidly cooling leaves as darkness falls, followed by high rates of photosynthesis under warmer day temperatures).

Some research studies have found that while continuous light under the same optimal warm temperatures that allow maximum rates of photosynthesis to occur can cause an overall reduction in growth due to assimilate build-up in the leaves. However, if the temperature is varied within a 24-hour period under the same continuous light, then growth benefits occur, and leaf damage is often prevented.

This seems to be particularly beneficial for plants such as tomatoes and eggplant, which are prone to leaf injury under continuous light. It has been found that running temperatures of 26/16°C during a 12/12 hour period under continuous light as compared to a constant 23°C, the accumulation problems of sugars in the leaves was reduced and a higher rate of dry matter production and yields occurred. The evidence suggests the cooler temperatures running for 12 hours in every 24 under continuous light favours the metabolism of starch and sugars and translocation from the leaves and into the sinks. Studies have found that by varying the temperature within each 24-hour period, leaf injury in species prone to damage under continuous light can be largely prevented.

Tomatoes are another crop that often develop damage symptoms under continuous light.

There could be significant growth advantages for crops with a high sink demand grown under continuous light if techniques such as temperature differences are used.


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The possibility of breeding new cultivars of tomatoes with tolerance to continuous light could be an exciting development for this hydroponic crop.

"FACTORS SUCH AS LIGHT intensity, spectrum, and temperatures all interact to determine the final response to this technique."

Conclusion

While low-level continuous light can give increases in growth and productivity with some crops, under certain conditions, it is not always a simple case of switching the lights on permanently and hoping for the best result. Some species such as tomatoes are particularly sensitive to continuous light and suffer leaf injury and losses in productivity, while factors such as light intensity, spectrum, and temperatures all interact to determine the final response to this technique. What is promising, however, is the use of temperature variations under continuous light to maximise carbohydrate metabolism and unloading of sugars from the foliage into developing cells, thus increasing the potential of light usage.

There exists a genetic potential within many commonly grown hydroponic species to breed varieties that are less prone to damage under continuous light, while at the same time be able to maximise the extra hours of photosynthesis to result in increased growth rates and yields. For those wanting to experiment with continuous light, choosing plants that don't require a certain day length to flower or prevent flowering is the first step, followed by careful consideration of the intensity of the light for the species chosen, and, finally, maintaining a temperature difference within each 24-hour period that provides some cooler conditions to assist with sugar unloading and carbohydrate metabolism.

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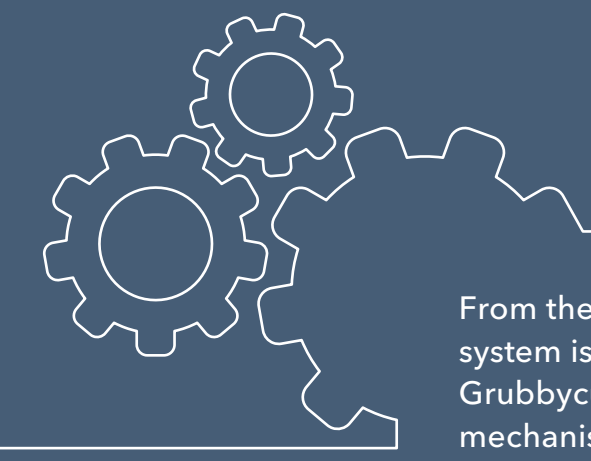
The Mechanisms Behind Vascular Plants



From the Casparian strip to the phloem, the vascular system is crucial to nutrient uptake and plant health. Grubbycup puts on his biology hat and explains the mechanisms of vascular plants. | **by Grubbycup**

Vascular plants include trees, plants with flowers, dicots, monocots, land plants, and pretty much any plant that is isn't a moss, liverwort, hornwart, or algae. They all have a vascular system (hence the name) including some form of xylem and phloem. This system allows for the plant to absorb moisture and nutrients from the growing medium and move essential resources around the interior of the plant.

The Casparian Strip

Water and nutrients enter through the root hairs. Once inside the root hair, the liquid can move either by going along the spaces between the cells (apoplastic pathway), by entering a cell and moving from cell to cell through the adjoining cell walls (symplastic pathway), or a combination of the two (transcellular). Regardless of the type of pathway taken, they all lead to a layer of cells known as the Casparian strip.

The Casparian strip blocks the pathways between cells (which ends the apoplastic paths), and forces liquids to enter through a plasma membrane (in symplastic fashion) to cross the barrier. This plasma membrane can not only regulate the flow of liquid, but filters out a variety of contaminates and microbes. It selectively allows desired nutrients and water to pass through, while (mostly) preventing undesirable substances a pathway to the plant's sapstream. The filtered nutrient solution passes through the Casparian strip to vascular bundles in the stele.

Trundle over to the Vascular Bundles

Vascular bundles include both xylem and phloem, which are the main fluid pathways. In most dicots (plants with two seed leaves) there is a layer separating the two called the vascular cambium.

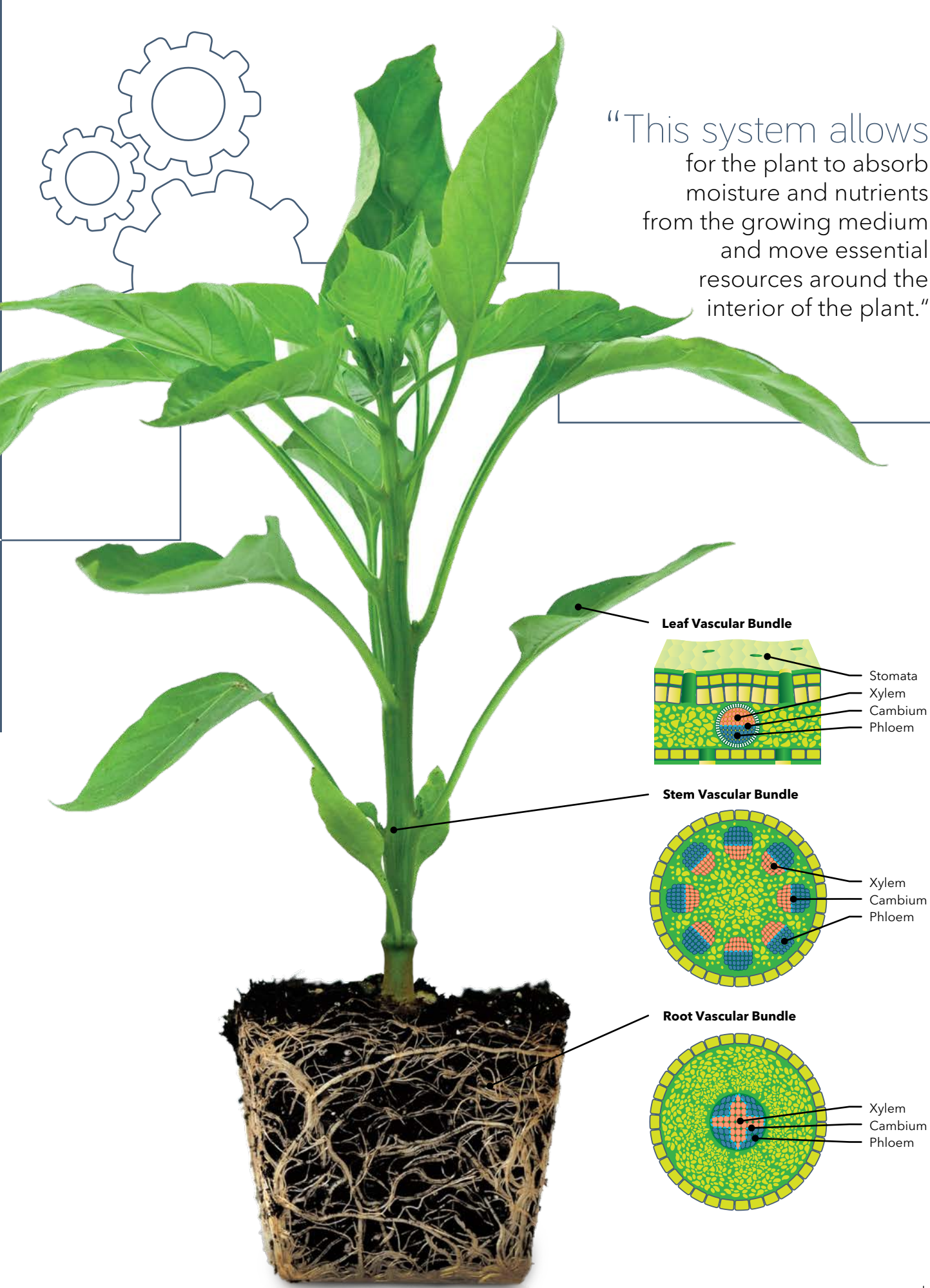
The xylem and phloem allow the plant to transport internal fluids. There are different arrangements for the xylem and phloem within the bundles, but in general the xylem tends to be toward the centre of the stem while the phloem is closer to the bark. In leaves, the xylem side tends to be closer to the top or "face" of the leaf, while the phloem tends to be closer to the undersides of leaves.

Xylem from Start to Exit

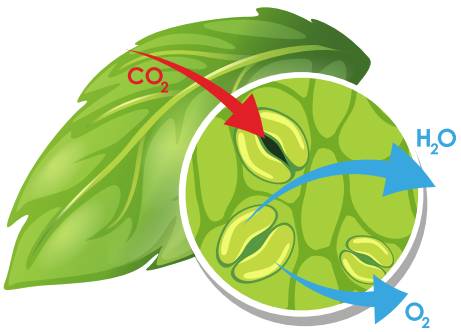
The filtered water and nutrients pass through the Casparian strip to the xylem. The xylem is a series of long, connected dead cells (tracheids or vessel elements) that form "pipes" that carry water and nutrients from the roots up through the plant to the undersides of leaves where most of the water exits the plant through openings called stomata.

Each stoma opening has a pair of guard cells that can open and close the opening as needed. The opening and closing of the stomata resemble a pair of lips, which are closed when relaxed, and when swollen create pursed or "duck" lips to create an opening between them.

"This system allows for the plant to absorb moisture and nutrients from the growing medium and move essential resources around the interior of the plant."



"Once enough of the chains have been broken, the plant will go into 'terminal wilt,' will no longer respond to watering, and will die."



The stomata not only allow water vapour and oxygen to escape, but they let in carbon dioxide. In times of high heat or in the absence of light (at night), they may close to prevent excess water loss. When the guard cells have closed, they cut off the supply of CO_2, which retards plant growth.

Movement of water through the xylem is passive and does not require energy from the plant. The xylem tubes are small enough to take advantage of capillary action (with the help of some of water's more unusual properties) to draw water up from the roots to replace what has been lost due to evaporation through the stomata.

This effectively creates "chains" of water that lead from the roots to the leaves. If an insufficient amount of water is available, at first these chains will shrink, causing the plant to droop. This can be seen in a slightly underwatered plant that starts to wilt. In the early stages, this can be corrected by watering the plant, which should respond fairly quickly (within an hour or so) by replacing the lost water and swelling back to normal appearance.

If the plant continues to dehydrate due to lack of water, the water chains will get thin enough to begin to break, causing air pockets to develop. Once enough of the chains have been broken, the plant will go into "terminal wilt," will no longer respond to watering, and will die.

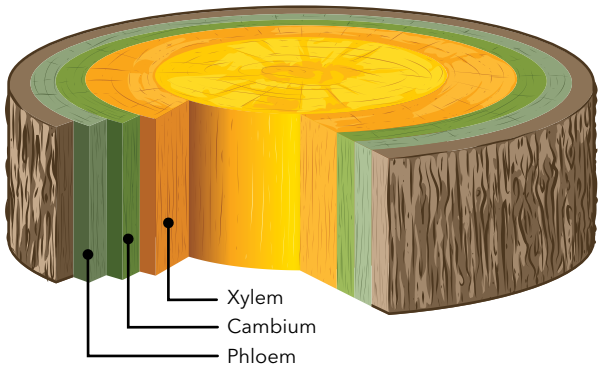
While it is usual to consider the xylem as carrying water, hormones, and nutrients, and the phloem as transporting water, hormones, and sugars, in some cases, such as with maple trees, sugars stored in the roots can use the xylem as a pathway to lift them up. Maple syrup is collected by piercing the xylem to collect this sugar sap, which is then boiled to condense and thicken.

Vascular land plants can grow taller than their non-vascular counterparts such as mosses and algae in part because the xylem gives strength and structure to the plant stems.

Can't Cross the Cambium

The vascular cambium layer often forms as a cylinder along the stem (or trunk), with the xylem (wood) on one side and the phloem (bark) on the other. The vascular cambium has a concentration of meristem (building block) cells which are used to increase both the xylem to the inside and the phloem on the outside.

As an example, tree trunks add a yearly layer of wood (tree rings) formed from xylem, and the cambium grows a new layer of xylem to replace the old one. As the inner wood diameter increases, the cambium on the phloem side adds additional cells as needed.



Go with the Phloem

While the xylem carries water and nutrients in only one direction (from the roots to the leaves), the phloem carries sugars, hormones, amino acids, and relocating nutrients around the plant from stores (where the resources are in the plant) to sinks (where the resources are needed). For example, in the spring, sugars stored in the roots are moved to new growth sinks to plant growth. During photosynthesis the sugars made in the leaves act as stores that can be transported to sinks such as the roots (to prepare for the following spring) or to flowers and fruits.

When growing vascular plants, it is helpful to be at least acquainted with vascular systems. By understanding that guard cells close at night, it becomes apparent that supplemental CO_2 is better used during the day. By understanding that guard cells close in extreme heat, it is easier to comprehend why plant growth "stalls" during a heat wave. Each piece of the puzzle makes it easier to get the big picture.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DEALING WITH HORNWORMS IN THE GARDEN

With an ultimate camouflage making them hard to spot, tomato hornworms are elusive and can wreak havoc on your plants. Alan Ray explains how to effectively identify and deal with these ravenous pests.

by Alan Ray

If you've gardened before, especially if you've ever grown tomatoes, you are likely familiar with that green grinch of the garden, the tomato hornworm. The hornworm (*manduca quinquemaculata*), is actually the larval stage of a family of hawk moths that includes the Sphinx and Hummingbird moth, of the family sphingidae.

The hornworm derives its name from the distinct hook-like horn protruding from its posterior. These hooks are often mistaken for stingers, but in truth, are harmless. Fascinating little creatures resembling a hummingbird when mature, they are destructive little devils during their multi-stage transformation into caterpillars.

Hard to Spot

Hornworms are masters of camouflage. Although more than 10 centimetres long, their near perfect colour-match of your green tomato vines affords them virtual invisibility. You really have to look carefully to see them. Once you do though, it's almost an aha! moment. But don't limit your inspection to just tomato plants. These worms also feed upon potatoes, peppers, and eggplants, and can defoliate a plant rather quickly.

Though you may not see a hornworm, look for tell-tale signs revealing their presence. Check any leaves beginning to droop or vines that appear stripped of leaves. Take the time to look your plants over thoroughly because once laid, their eggs hatch quickly, usually within four to five days. Once hatched, these newbies are voracious and destructive eaters. Careful inspection can be the difference between a good harvest and a good cry.

All in the Family

The tomato hornworm isn't alone when it comes to eating plants and dreams. Its cousin, the tobacco hornworm (*manduca sexta*), can be just as devastating to its namesake, the tobacco plant. Strangely, both are drawn to plants of the nightshade family to include tomatoes, green peppers, tobacco, eggplants, and potatoes. So, you may find a tobacco hornworm on a tomato plant and vice versa.

While quite similar in looks, the tomato and tobacco hornworms are distinguishable. The tomato hornworm sports a set of white, v-shaped markings along its sides with a black horn on its tail end. The tobacco hornworm displays vertical white lines with a red-coloured hook adorning its back bumper.

The pneumonic I use to remember which-worm-is-which is associating the v-shaped markings of the tomato hornworm with V-8 Juice, made from tomatoes.

Both insects pupate underground over the winter months and emerge as moths in the spring. Time is of the essence and reproduction is numero uno on their bucket list. After breeding, the female deposits her eggs on the verso of the leaf. When they hatch, the next four weeks are spent feeding on your plants until reaching maturity, at which time they drop back into the earth to pupate and reset the cycle.

Plant Friendly Pest Control

Gardeners wishing to avoid potentially dangerous chemicals have some effective options. Here are some simple homestyle remedies for dealing with hornworms.

The simplest, time-tested method to rid your plant(s) of tomato hornworms is the hands-on/bugs-off approach. It's as uncomplicated as it sounds. You manually pluck the hornworm off your plants with gloved fingers. Some use water to blast them off but you run the risk of damaging the plant and besides, it's so messy.

"The **simplest,** time-tested method to rid your plant(s) of tomato hornworms is the hands-on/bugs-off approach."

Regardless of method, once removed, you can free-fall the little critter into a container of water and effectively drown him, or simply drop him to the ground and do your best Bigfoot impression.

Spraying Your Tomatoes

Another deterrent to the hornworm and other garden pests is to make up a sprayable solution from a base of biodegradable, liquid dish soap. There are no set proportions for the recipe. Just add water to a little soap until it's somewhat soapy then sprinkle in some cayenne powder/pepper. Spray your plants down with this solution. The soap helps the pepper-laden elixir stick to the plant.

This has proven to be an effective treatment. Many garden pests are repelled by the smell and taste of this concoction. As an added benefit, this potion won't harm your plants. Reapply as needed.

Note: Should you discover a hornworm with a cluster of white eggs attached to its back, give thanks. Those eggs are not the eggs of the hornworm but of a garden-friendly parasitic wasp (Braconid Wasp) that lays its eggs on the back of the caterpillar. When those eggs hatch, it's role reversal. The wasp larvae become the diners and the hornworm becomes the dinner.

Not to mention you'll soon have a little army of wasps (harmless to people) that feed on the tomato/tobacco hornworm larvae while helping defend your garden against other harmful insects.

For additional protection, place sheets of plastic on your garden floor. This will help prevent the moth from breaking through the ground come spring. This is also effective weed control.

Nature vs Nature

Other methods of combating hornworms include the use of pesticides. But good ones. *Bacillus thuringiensis*, or BT as it is also known, is a safe biological pesticide or living organism. It is a soil-dwelling bacterium that kills a variety of garden pests including hornworms. Another perquisite, BT is harmless to vegetation.

BT begins to work after an insect has eaten a leaf from the treated plant. Once ingested, a specific protein is produced that causes the insect to completely lose its appetite. We all know what happens when you don't eat. BT can be readily purchased wherever gardening supplies are sold and even online. Begin treatment early or at the first sign of leaf damage.

And there you have it. With a bit of discipline and a little help from Mother Nature, you too can enjoy a healthy tomato/garden harvest and go from having a little green worm to a big green thumb!

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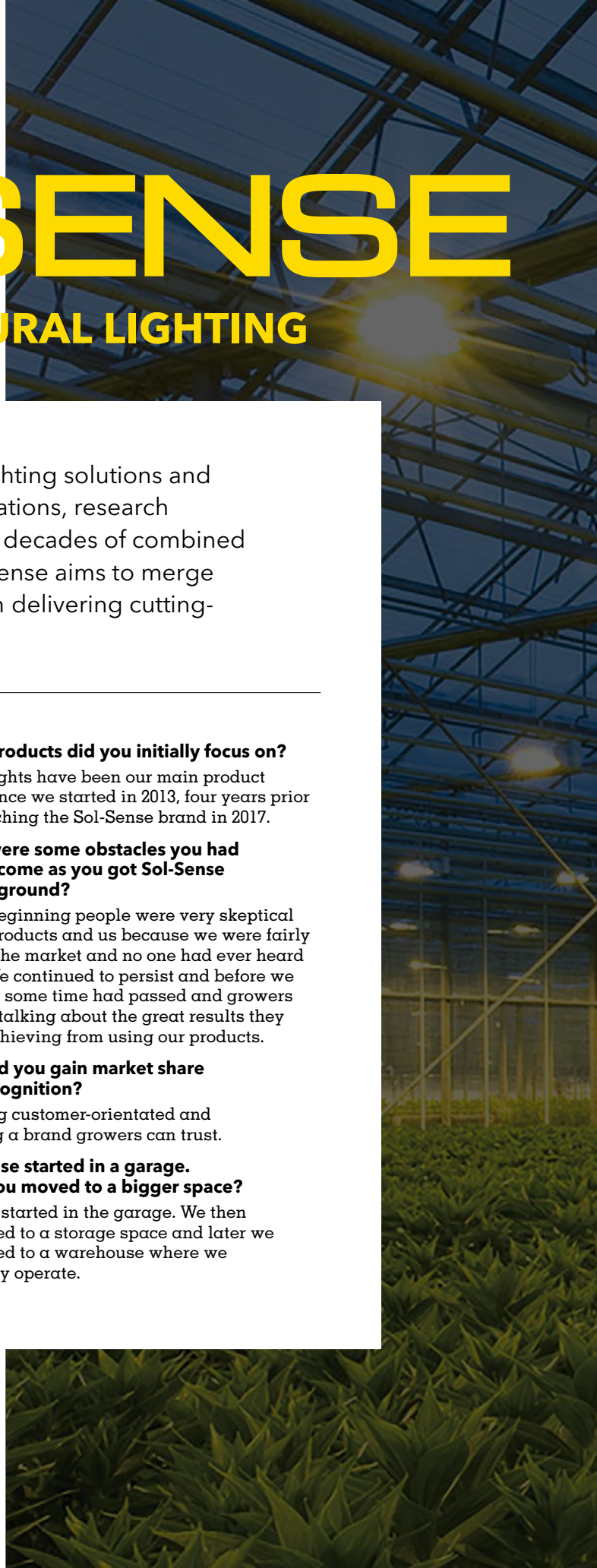

Sol-Sense provides innovative horticultural lighting solutions and accessories for commercial greenhouse operations, research institutions, and horticulture enthusiasts. With decades of combined experience, co-founder Richie May says Sol-Sense aims to merge their knowledge and passion for growing with delivering cutting-edge technology to the market.

What did you and your partners do before starting Sol-Sense?

We all came from different backgrounds ranging from hydroponics and accounting to importing and logistics. We have a combined 20 years of experience in horticulture.

How did you get into this industry?

My business partner and I had started an importing company in March 2013. Soon after we started, a friend of ours who is a long-time grower, was planning a commercial setup and wanted us to import the equipment for him. The deal was a success and as they say, the rest is history. Six years later and we are still in the market with more than enough passion for the industry and no intentions of slowing down.

When and where did Sol-Sense begin?

North Western Sydney, March 2013.

How does Sol-Sense's philosophy translate to opportunities?

We recognised the issues growers were facing with their current lighting systems, so we decided to research and develop alternative solutions.

What products did you initially focus on?

Grow lights have been our main product focus since we started in 2013, four years prior to launching the Sol-Sense brand in 2017.

What were some obstacles you had to overcome as you got Sol-Sense off the ground?

In the beginning people were very skeptical of our products and us because we were fairly new to the market and no one had ever heard of us. We continued to persist and before we knew it, some time had passed and growers started talking about the great results they were achieving from using our products.

How did you gain market share and recognition?

By being customer-orientated and creating a brand growers can trust.

Sol-Sense started in a garage. Have you moved to a bigger space?

Yes, we started in the garage. We then upgraded to a storage space and later we upgraded to a warehouse where we currently operate.

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in the business:
6 years

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> "We believe that focusing our innovations on the needs and wants of growers is our core strength."

What is your current product line?

We are currently releasing an exciting new range of advanced horticultural lighting fixtures. The range focuses on increased essential oil production, increased efficiency, and reduced operating temperature.

Where do you distribute?

Our products are available at all trusted hydroponic outlets nationwide in Australia.

How many people now work for Sol-Sense?

We started off with just two of us and now we are five in total.

What are Sol-Sense's strengths?

We believe that focusing our innovations on the needs and wants of growers is our core strength. We also stock a unique line of high-end products put together by an experienced team in the field of growing. We package those efforts with excellent customer service and aftersales warranty.

What are some of your proudest moments at Sol-Sense?

Not only is it rewarding to see our hard work and effort paying off, but also to receive feedback from growers who have benefitted immensely from using our products.

What significant things have you learned so far about the industry?

The industry is full of down-to-earth and honest people that are willing to support the small players so they can become big players. We are still relatively new to the industry and we intend to make our supporters proud.

What have you learned about growing a company?

It's extremely tough, but with a bit of brains and a whole lot of hard work and persistence we are sure to enjoy the fruits of our labour.

Any words of wisdom can you share about the future of the industry?

With the growing populace, resource and space-efficient farming methods are in more demand than ever. It is an exciting time for indoor farming technology and innovation and we look forward to what the future holds.

Any favourite stories from a day on the job?

There are too many crazy stories to mention but one thing we know is there hasn't been a dull moment since we joined the industry. Every day is a new challenge and something new is learned and achieved.

What makes Sol-Sense's employees so awesome?

The guys are an extremely knowledgeable and hard-working bunch that know how to have a good time.

5 Healthy Activities TO DO WHILE YOU'RE HIGH

Adding the right cannabis strain when you're engaged in a healthy activity can take you to a whole new level, whether it's running that extra mile or creating an amazing work of art. Kasey Craig offers some suggestions that will make your healthy pastime even better.

by Kasey Craig

Doing healthy activities when you're high fully awakens your mind, body, and spirit. Sure, meditation and gardening are great, however, meditation and gardening while high are better.

Besides, doesn't everyone want to find the best things to do while high?

There are many different ways to partake in cannabis before you begin a healthy activity. Sometimes smoking makes more sense than edibles and other times fresh flower is the most beneficial.

The best way to maximise the benefits from your workout and your cannabis is to choose activities that complement the type of euphoria expected.

For example, you wouldn't smoke an indica and go for a run. However, a sativa or hybrid pre-jog could increase your focus and speed.

The best method of intake can vary depending on the type of activity you plan on doing.

Edibles Before Yogalates

Yogalates is a class that incorporates yoga and Pilates. Much like cannabis, yogalates relaxes and strengthens the mind as well as the body.

This healthy activity is one of few workouts that stimulate muscles and internal organs. The increase of blood flow decreases recovery time and flushes out toxins.

In Ayurvedic medicine, smoking cannabis dries out the whole body, especially the lungs. Instead, edibles are recommended.

Eating a serving of berry punch gummies about an hour before yogalates is a great way to ensure clarity of the mind. The gummies taste just like candy and come in a variety of flavours.

Whether you decide to eat brownies, drink a cannabis-infused lemonade, or both, you'll notice the mental and physical benefits of edibles before yogalates.

Fresh Flowers for Gardening

What better way to enjoy a Saturday than a bong rip of fresh Strawberry Cough before entering the garden? The health benefits of gardening include both mental and physical improvements.

Caring for plants is a great way to increase overall well-being. Plus, a good-looking backyard is always a bonus. Tending to a garden while baked is the most invigorating feeling; the high is full of energy and the fresh air connects you with nature.

> “Chocolate Haze is the best pre-workout strain you can find if you’re looking for **A NEW LEVEL OF RUNNER’S HIGH.**”

Plus, you may not even realise gardening burns up to 330 calories during about an hour of yardwork. Gardening is an easy way to get vitamin D from the sun, giving the body the ability to absorb calcium.

Strawberry Cough is a sativa-dominate hybrid with a sweet tropical flavour. This strain is perfect for someone looking to relieve agitation and improve focus — the ideal companion for any gardener.

Also, Strawberry Cough is excellent for treating pain and providing users with a calm, yet energised high. No matter what you grow in your garden, the benefits of eating home-grown food go far beyond healthy.

If you decide to grow your own Strawberry Cough, it’s not too hard to cultivate as the plant is resistant to viruses, mold, mildew, and bacteria. Although, no matter what you grow, gardening is beneficial. Just don’t forget to stop and smell the buds.

Chocolate Haze Jogging

Imagine feeling so much energy that you have to run, or at least jog, to burn some of it off. Well, Chocolate Haze is the best pre-workout strain you can find if you’re looking for a new level of runner’s high.

Jogging increases lung capacity, boosts happiness, and relieves stress. I don’t know about you, but increased lung capacity sounds like bigger bong hits to me.

Jogging is the perfect activity to help maintain a healthy weight and improve cardiovascular fitness. Chocolate Haze is almost pure sativa offering users a very motivating high. So, forget the pre-workout and grab a Chocolate Haze sativa vape cartridge to smoke before your next run.

Stoned Meditation by the Water

Northern Lights is a pure indica that gives users a nice, dreamy head high. This strain commonly treats insomnia and stress.

The Beth Israel Deaconess Medical Center did a study indicating meditation plays a role in slowing the progression of Alzheimer’s. Meditation has positive long-term effects including better sleep, more happiness, more compassion, better concentration, enhanced memory, and a healthier immune system.

Pairing the calming effects of Northern Lights with meditation is a dream come true. During this high activity you’ll concentrate on deep breaths and not much more.

Indica Mood to Write, Draw, or Paint

White Widow is great for boosting creativity and happiness. Also, this strain is known for diminishing stress, insomnia, and depression.

There are even health benefits to creating art including better focus, reduced stress, and other cognitive gains. Plus, “getting in the zone” is good for the brain, giving us strong positive effects on our mood.

The Puff, Pass, and Paint cannabis art class is certainly one to attend. Being able to create, inspire, and be a part of the cannabis community is incredible.

Writing and drawing can help with self-discovery, increase our empathy, and boost feelings of love. There’s no doubt that this healthy activity is perfect when high.

It’s important that before you change your lifestyle, you consult your primary care physician. Healthy activities are great when done safely; remember to wear sunscreen if you’re outside for long periods of time, drink plenty of water, and avoid overexertion.

Whether you decide to start meditating or grow your own plants, the best way to do healthy activities is to do them while you’re high.

Given all the possibilities, how do you prefer to incorporate cannabis into your healthy activities?

a brief
HISTORY OF

THE TOMATO

by Philip McIntosh

It was only a few generations ago that tomatoes were taboo, feared to be poisonous. A few brave souls allayed those fears, and now tomatoes are one of the most widely grown crops in the world. Philip McIntosh explains how tomatoes made the turn from shunned to loved.

One day in 1820, so the story goes, Col. Samuel Gibbon Johnson arrived at the Salem courthouse with a basket of tomatoes. He had offered a prize for growing the largest tomato fruit (it contains seeds — not a vegetable, technically a berry) but no one was taking him up on it. The tomato, you see, was an object much feared by many. To allay the fears of his fellow citizens, Johnson proceeded to publicly eat a quantity of the suspect fruit to prove they were in fact not poisonous. It must have worked. Today, the tomato (named *Solanum lycopersicum* by the founder of the binomial system of organismal classification, Linnaeus) is the most widely grow greenhouse crop and is cultivated and loved by countless gardeners around the world.

Exactly how much Col. Johnson's stunt contributed to the advancement of the tomato in American cuisine is debatable (many others before him had shown that the fruit of the tomato was safe to eat). But, the tomato does have a rather up and down reputation since it was first brought into wider use from its original home in western South America. From there the tomato plant gradually spread northward into southern Mexico, where the Aztecs were familiar with it around 3,000 years ago.

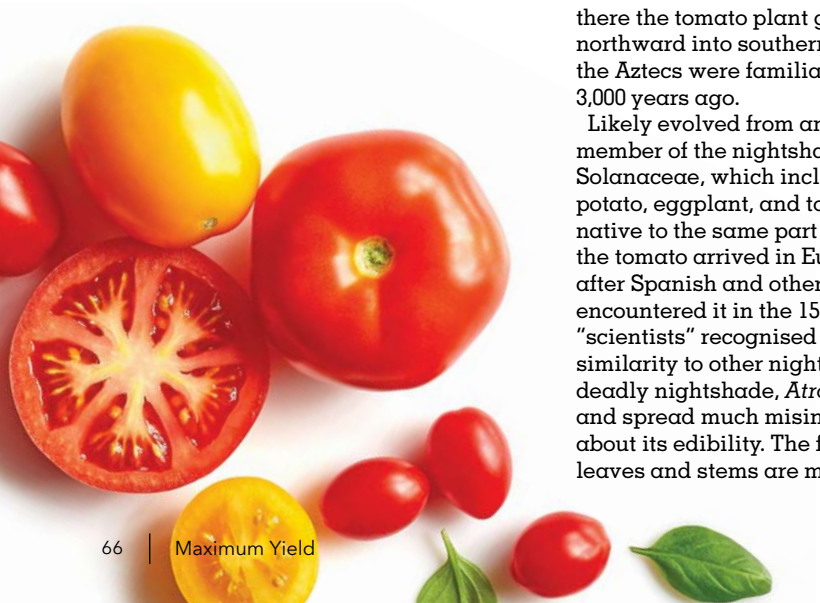
Likely evolved from an earlier extant member of the nightshade family (the Solanaceae, which includes peppers, potato, eggplant, and tobacco) and native to the same part of the world, the tomato arrived in Europe soon after Spanish and other explorers encountered it in the 1500s. Early "scientists" recognised the tomato's similarity to other nightshades (e.g. the deadly nightshade, *Atropa Belladona*) and spread much misinformation about its edibility. The fact that the leaves and stems are mildly poisonous, containing the toxic alkaloids tomatine and solanine, did not help the fruit's reputation. Will eating the leaves kill you? Not likely. Eventually, people figured out (thanks in small part to Col. Johnson and others) that the fruit of the tomato was safe to eat and was actually pretty good. The tomato later surged in popularity in America starting in the 1880s accompanying a wave of Italian immigration.

So, why is the tomato so popular today? From a health and nutrition perspective, the tomato is a winner: low in calories, zero fat, high in vitamin C, rich in folic acid, and full of antioxidants such as lutein and the carotenoid lycopene. Since there are thousands of cultivars ranging from small cherry tomatoes to large heirloom varieties with diverse shapes and colours, a tomato can be found for just about any purpose. Tomatoes add colour and acidity to any dish and those types high in sugars can be quite sweet.

Tomatoes are a good source of the so-called fifth taste — umami. Umami derives from the flavour of glutamate, which tomatoes are rich in, and for whatever reason, people like it. A lot.

Tomatoes are the fourth most purchased food in grocery stores and tomato production is on the rise globally with China being the largest producer. Since they are such a valuable agricultural commodity, tomatoes also tend to get hit with a lot of pesticides in non-organic production. For that reason, wash tomatoes thoroughly before use.

Considering how common it has become it may seem odd that the tomato was once thought to be to unfit for human consumption. So, the next time you are enjoying a pizza, or an appetiser of chips and salsa, tip your hat to the brave souls who paved the way for everyone else to enjoy the flavour of the delicious and versatile tomato.



distribution **LIST**

retail stores are listed alphabetically in each state

ACT

South Pacific Hydroponics
#2 - 84 - 86 Wollongong St.
Fyshwick ACT 2609
(02) 6239 2598

South Pacific Hydroponics
70 Oatley Crt.
Belconnen ACT 2617
(02) 6251 0600

NEW SOUTH WALES

24/7 Hydroponics
151 Wine Country Dr.
Nulkaba NSW 2325
(02) 4990 4291
admin@simplydvine.com.au

99 Trading
57 Hoskins Ave.
Banks Town NSW 2200
(02) 9790 1525

Accent Hydroponics
Unit 1/5 Clerke Pl.
Kurnell NSW 2231
(02) 9668 9577
accenthydroponics.com

ASE Hydroponics
Factory 10/45 Leighton Pl.
Hornsby NSW 2077
(02) 9477 3710

Ballina Hydro
19 Cessna Cres.
Ballina NSW 2478
(07) 3354 1588

Criscete Hydroponics and Organics
Unit 2/15 Kam Cl.
Morisset NSW 2264
(02) 4973 5779

Cougars Hydroponics
2/6 Ace. Cres
Tuggerah NSW 2259
(02) 4330 0190

Dubbo Hydro & Tobacconist
42c Victoria St.
Dubbo West NSW 2830
(02) 6885 1616

Earth & Colour Vertical Gardens and Hydroponic Supplies
1/43 Corporation Cir.
Tweed Heads South NSW 2486
(07) 5523 9565
earthandcolour.com.au

Favgro Hydroponics Growers
107 Glenella Rd.
Batehaven NSW 2536
(02) 4472 7165

Felanza - Hydroponics
140 Princess Hwy.
Arncliffe NSW 2205
(02) 9556 1494

General Hydroponics
7/14 Sunnyholt Rd.
Blacktown NSW 9676
(02) 9676 8682

Grow Your Own
Unit 6/34 Alliance Ave.
Morisset NSW 2264
(02) 4973 5179

Holistic Hydroponics Pty. Ltd.
Unit 21/322 Annangrove Rd.
Rouse Hill NSW 2155
(04) 8803 8807

Home Grown Aquaponics
8A-8B 13 Hartley Dr.
Thornton NSW 2322
(02) 4028 6388
home-grown.net.au

Hong Hung
D5 303 The Horsley Dr.
Fairfield NSW 2165
(02) 8764 1083

Hyalite Kingsgrove
1/4 Wirega Ave.
Kingsgrove NSW 2208
(02) 8068 5896

Hyalite Prestons (New South Wales)
2/4 Avalli Rd.
Prestons, NSW 2170
(02) 3824 3400

Hyalite Villawood
2/21 Birmingham Ave.
Villawood NSW 2163
(02) 9723 7199

Hydro Experts
34/2 Railway Parade
Lidcombe NSW 2141
(02) 8041 7959
info@hydroexperts.com.au
hydroexperts.com.au

Hydro Masta
100 Station Rd.
Seven Hills Sydney NSW 2147
(02) 8812 2845

Hydro Place
1/68 Nelson St.
Wallsend NSW 2287
(02) 4965 6595

Hydro Shop Pty Ltd
Unit 1/5-7 Channel Rd.
Mayfield West NSW 2304
(02) 4960 0707

Hydro Supplies
57 Flinders St.
Darlinghurst NSW 2010
(02) 9326 0307

Hygrow Horticulture (Greenlite)
252 Oxford St.
Bondi Junction NSW 2022
(02) 9369 3928

Indoor Sun Shop
745 Victoria Rd.
Top Ryde NSW 2112
(02) 9808 6873

Indoor Sun Shop
Unit 2/109 Junction Rd.
Moorebank NSW 2170
(02) 9822 4700

International Fans
PO Box 120
St. Mary's NSW 2760
(02) 9833 7500

Kyper's Tools and Hydroponics
Stuart & Tincogan Sts.
Mullumbimby NSW 2482
(02) 6684 4928

Lismore Hydro
1/106 Canway St.
Lismore NSW 2480
(02) 6621 3311

Lismore Hydroponics
Rear of 28 Casino St.
South Lismore NSW 2480
(02) 6621 3311

Lux Cutting Hydroponics
252 Oxford St.
Bondi Junction NSW 2022
(02) 9369 3928

North Coast Hydroponics
2/5 Wallis Ave.
Toormina NSW 2452
(02) 6658 7932
northcoasthydro.com.au

Northern Lights Hydroponics
6/46 Through St.
South Grafton NSW 2460
(04) 3110 5882

Northern Nursery Supplies Pty Ltd
14-16 Nance Rd.
Kempsey NSW 2440
(02) 6563 1599

Nowra Hydro
68 Bridge Rd.
Nowra NSW 2541
(02) 4423 3224

Nutriflo Hydroponic Systems
19/5 Daintree Pl.
Gosford West NSW 2250
(02) 4323 1599
nutriflo.com.au

Outside in Hydroponics & Organics
2/595 Main Rd.
Glendale NSW 2285
(02) 4956 5676

Parkview Plants
250 Princess Hwy.
Nowra South NSW 2541
(02) 4423 0599

Port Pumps and Irrigation
20 Uralla Rd.
Pt Macquarie NSW 2444
(02) 6581 1272

Quik Grow
510a Great Western Hwy.
Pendle Hill NSW 2145
(02) 9636 7023

Quick Grow
823 King Georges Rd.
S. Hurstville NSW 2221
(02) 9546 8642

Quik Grow Pty Ltd.
490 Parramatta Rd.
Petersham NSW 2049
(02) 9568 2900

Richmond Hydroponics
Unit 3/84 Bells Line of Rd.
North Richmond NSW 2754
(02) 4571 1620
richmondhydroponics.com.au

Simple Grow
Hassall St. & Windem
Wetherill Pk NSW 2164
(02) 9604 0469

South Pacific Hydroponics
84-86 Wollongong St.
Fyshwick NSW 2609
(02) 6239 2598

Sydney Garden Supplies
187 Waterloo Rd.
Greenacre NSW 2190
(04) 1460 9241

The Green Room Hydroponics & Organics
2/6 Davids Cl.
Somersby NSW 2250
(02) 4340 0339

The Grow Shed
4/22 Alliance Ave.
Morisset NSW 2264
(02) 4972 6872

The Grow Shop
5/5 Forge Dr.
Coff's Harbour NSW 2450
(02) 6651 9992

The Petshop Boyz
Unit 1/ 5-7 Channel Rd.
Mayfield West NSW 2304
(02) 4960 0708
petshopboyz.com.au

TN Hydroponics
1/43 Chadderton St.
Cabramatta NSW 2166
(02) 9724 5692

Tweed Coast Hydroponics
2/58 Machinery Dr.
Tweeds Head South NSW 2486
(07) 5524 8588

Uncle Wal's Gardenland
31 Cres. Ave.
Taree NSW 2430
(02) 6550 0221

VN Hydro
8 Robert St.
Belmore NSW 2192

Warrawong Hydroponics Centre
240 Cowper St.
Warrawong NSW 2502
(02) 4274 8001
warrawonghydro@hotmail.com

Westside Lighting & Electrical (Ezi Range)
PO Box 274
Mascot NSW 1400
1 800 661 475

Wollongong Hydroponic Centre
318 Crown St.
Wollongong NSW 2500
(02) 4225 8773

NORTHERN TERRITORY

Darwin Hydroponics
5/8 Andrews St.
Berrimah NT 0828
(08) 8947-2576

Katherine Hydroponics Centre
17 Rundle St.
Katherine NT 0850
(08) 8972 1730

Top End Hydroponics
1785 Leonino Rd.
Darwin River NT 0841
(08) 8988 6076

QUEENSLAND

Advanced horticultural Supplies - Gold Coast
6/68 Blanck St.
Ormeau QLD 4208
0435 255 856
adhs.com.au

Advanced Horticulture Supplies - Noosaville
Shop 3 11 A Venture Dr.
Noosaville QLD 4566
(07) 5641 1256
adhs.com.au

Allgrow Hydro
13 - 58 Bullock Head St.
Sumner Park QLD 4074
(07) 3376 7222

Aqua Gardening
Unit 3, 4 Billabong St.
Stafford, Brisbane QLD 4053
(07) 3354 1588

Aqua Gardening
Shop 3/73 PIckering St.
Enoggera QLD 4051
(07) 3354 1588

Aquatic Oasis
Unit 2/33 Smith St.
Capalaba QLD 4157
(07) 3245 7777

Billabong Hydroponics
Lot 1 Billabong Crt.
Childers QLD 4660
(07) 4126 3551

D-Bay Hydroponics Shop
5/404 Deception Bay Rd.
Deception Bay QLD 4508
(07) 3204 8324

E.T. Grow Home
Unit 1/4 Windmill St.
Southport QLD 4215
(07) 5591 6501

Eye Lighting Australia Pty Ltd.
PO Box 306
Carole Park QLD 4300
(07) 3335 3556

Frans Hydroponics
Shed 3 1191
Anzac Ave. Kallangar QLD 4503
(07) 3285 1355

Gold Coast hydroponics
42 Lawrence Dr.
Nerang QLD 4211
(07) 5596 2250

Grow Hydro
22 Mining St.
Bundamba QLD 4304
(07) 3816 3206

H2 Gro Pty Ltd
2 Sonia Crt.
Raceview QLD 4305
(07) 3294 3253

Home Grown Hydroponics
4/9 Barnett Pl.
Moledinar QLD 4214
(07) 5571 6666

Hyalite Varsity
Unit 1/10 John Duncan Crt.
Varsity Lakes QLD 4227
(07) 5593 7535

Hydrocenter Hydroponics
46 Spencer Rd.
Nerang QLD 4211
(07) 5527 4155

HydroMart Hydroponics
1/23 Victoria St.
Capalaba QLD 4157
(04) 3127 8211

Hydroponic Roots & Shoots
Lot 3 Herberton Rd.
Atherton QLD 4883
(07) 4091 3217

Hydroponics & Garden Supplies
93 Cook St.
Portsmith QLD 4870
(07) 4035 5422

Hydroponics Today
PO Box 785
Stanthorpe QLD 4380
(07) 4683 3133

Indoor Solutions
Unit 2/79 Oxford Tce.
Taringa QLD 4068

J&K Hydroponics
387 Progress Rd.
Wacol QLD 4076
(07) 3271 6210

KY Garden
3/31 Argyle Parade
Darra Brisbane QLD 4076
(07) 3375 9098

Logan Hydroponics
13/22, Allgas St.
Slacks Creek QLD 4127
(07) 3299 1397
loganhydroponics.com.au

North Queensland Hydro Supplies
Shop 2B/20-22 Fleming St.
Townsville QLD 4810
(07) 4728 3957

Northern Hydroponics
383 Mulgrave Rd.
Cairns QLD 4870
(07) 4054 5884

NQ Hydroponics
1/31 Casey St.
Aitkenvale, Townsville QLD 4810
(07) 4728 3957

Pioneer Hydroponics
194 Doyles Rd.
Pleystowe QLD 4741
(07) 4959 2016

Simply Hydroponics Gold Coast
42 Lawrence Dr.
Nerang QLD 4211
(07) 5596 2250

Slacks Creek Hydroponics
#13/22 Allgas St.
Slacks Creek QLD 4217
(07) 3299 1397

Sunstate Hydroponics
7/10 Fortune St.
Geebung QLD 4034
(07) 3265 3211

Sunstate Hydroponics
10/13 Kerryl St.
Kunda Park QLD 4556
(07) 5445 3499

Town & Country Hydroponics
Shop 1/8585 Warrego Hwy.
Withcott QLD 4352

Tumbling Waters Hydroponics
2 Clarkes Track
Malanda QLD 4885
(07) 4096 6443

Walsh's Seeds Garden Centre
881 Ruthven St.
Toowoomba QLD 4350
(07) 4636 1077

SOUTH AUSTRALIA

Adelaide Hydro
Shop 3.267 Goodwood Rd.
Kings Park SA 5034
(08) 7230 5907
adelaidehydro.com.au

Advanced Garden Supplies
3/8 Bredbo St.
Lonsdale SA 5160
(08) 8382 1191

Amazon Aquariums & Gardening
Unit 5 16 Research Rd.
Pooraka SA 5095
(08) 8359 1800

Ascot Park
753 Marion Rd.
Ascot Park SA 5043
(08) 8357 4700

Barry's Hardware
Saints & Main North Rd.
Salisbury Plains SA 5109
(08) 8281 4066

Back Street Traders
Unit 6/8 Lindsey Rd.
Lonsdale SA 5160
(08) 8322 4383

Bloomin' Hydroponics
5/535 Martins Rd.
Parafield Gardens SA 5107
(08) 8281 6395

Bolzon Home & Garden
103 Tolley Rd.
St Agnes SA 5097
(08) 8265 0665

Chocablock Discount Variety Store
15-17/1220 Grand Junction
Hope Valley SA 5090
(08) 8396 3133

Complete Hydroponics
1581 Main North Rd.
Salisbury East SA 5109
(08) 8258 4022

Country Hydro
434 Saddleback Rd.
Whyalla SA 5600
(08) 8645 3105

D & W Dependable Hardware
45B Kettering Rd.
Elizabeth South SA 5112
(08) 8287 6399

Every Thing Hydro
Shop 2/494 Main North Rd.
Blair Athol SA 5084
(08) 8260 3335

Festive Hydro
2 Kreig St.
Evanston Park SA 5116
(08) 8523 5100

Fulham Gardener Nursery
597 Tapleys Hill Rd.
Fulham SA 5024
(08) 8235 2004

Future Garden Concepts North
Shop 2 21-23 Kreig Rd.
Evanston Park SA 5116
(08) 8523 5100

Futchatec Distribution
4 Symonds St.
Royal Park SA 5014
(08) 8447-1122

Glandore Hydroponics
644 South Rd.
Glandore SA 5037
(08) 8371 5777
www.glandorehydro.com

Greener than Green
52 - 54 Cliff Ave.
Port Noarlunga South SA 51
(08) 8386 2596

Greenhouse Superstore Lonsdale
35 to 37 Aldenhoven Rd.
Lonsdale SA 5160
(08) 8382 0100

Greenhouse Superstore Royal Park
4 Symonds St.
Royal Park SA 5014
(08) 8447 5899

Gro Pro Hydro
3 Kelly Rd.
Willaston SA 5118
(08) 8522 7761

Ground-Up Service Nursery
3 Copinger Rd.
Pt. Pirie SA 5540
(08) 8264 9455

Gully Hydro
32 Famechon Cres.
Modbury North SA 5092
(08) 8264 9455

Hackham Garden & Building Supplies
32 Gates Rd, Hackham SA 5163
(08) 8382 4754

Harvest Time Hydroponics
Shop 3/146-148
Findon Rd. Findon SA 5023
(08) 8244 0222

Hindmarsh Hydroponics
39a Manton St.
Hindmarsh SA 5095
(08) 8346 9461

Highland Grow & Flow
14/1042 Grand Junction Rd.
Holden Hill SA 5088
(08) 8395 4455

Hong Kong Hydro
13 Research Rd.
Pooraka SA 5095
(08) 8260 2000

Hush Hydroponic Wholesalers
25 Charlotte St.
Smithfield, SA 5114
(08) 8254 1585

Hydro Heaven
Kane Motors-Hunt Rd.
Mount Barker SA 5251
(08) 8391 1880

Hydro Sales & Service
1 Salisbury Cres.
Colonel Light SA 5041
(08) 8272 2000

Hydro Technics
321 South Rd.
Croydon SA 5008
(08) 8241 5022

Hydro Technics North
22 Peachey Rd.
Elizabeth West SA 5113
08 8252 7988

Hydro Warehouse
181 Seacombe Rd.
South Brighton SA 5048
(08) 8377 1200

Hydro Wholesalers
181 Seacombe Rd.
South Brighton SA 5048
(08) 8377 1200

Hydro World
40 Folland Ave.
Northfield SA 5085
(08) 8262 8323
hydroworld.com.au

Koko's Hydro Warehouse
Unit 2/2 McGowan St.
Pooraka SA 5095
(08) 8260 5463

Larg's Bay Garden Supply
239 Victoria Rd.
Largs Bay SA 5016
(08) 8242 3788

Martins Rd. Hydro
5- 353 Martins Rd.
Parafield Gardens SA 5107
(08) 8283 4011

Mitre 10 Dr. In
152 Hanson Rd.
Mansfield Park SA 5012
(08) 8445 1813

New Age Hydroponics
135-137 Sir Donald Bradman Dr.
Hilton SA 5033
(08) 8351 9100
newagehydro.com

Owen Agencies
17-19 Railway Terr.
Owen SA 5460
(08) 8528 6008

Palms & Plants
175 Salisbury Hwy.
Salisbury SA 5108
(08) 8285 7575

Professional Hydro
4/522 Grange Rd.
Fulham Gardens SA 5024
(08) 8353 0133

Professional Hydro
Shop 5/645 Lower North East Rd.
Paradise SA 5075
(08) 8365 5172

Professional Hydroponics
113 Maurice Rd.
Murray Bridge SA
(08) 8532 3441

Rob's Garden Centre
Shop 3/364 North East Rd.
Windsor Gardens SA 5087
(08) 8369 2498

Seaton Hydroponics
129 Tapleys Hill Rd.
Seaton SA 5023
(08) 8268 2636

Soladome Aquaculture & Hydro
44 Chapel St.
Norwood SA 5067
(08) 8362 8042

South Coast Hydroponics
6/25 Gulfview Rd.
Christies Beach SA 5165
(08) 8384 2380

State Hydroponics & Homebrew Supplies
174 Semaphore Rd.
Exeter SA 5019
(08) 8341 5991

Tea Tree Gully Hydro
32 Famechon Cres.
Modbury North SA 5092
(08) 8264 9455

Two Wells Hardware
86 Old Port Wakefield Rd.
Two Wells SA 5501
(08) 8520 2287

Urban Grow Solutions
1/111 Main Sth Rd.
O'Halloran Hill, SA 5189
(08) 8322 0040

Waterworld Home & Garden Supplies
9 Aldershot Rd.
Lonsdale SA 5160
(08) 8326 2444

Warehouse of Garden
89 Helps Rd.
Burton SA 5110
(08) 8280 3314
warehouseofgarden.com.au

West Garden Centre
Peachey Rd.
Elizabeth West SA 5113
(08) 8255 1355

TASMANIA

Advanced Hydroponics
26 Mulgrave St.
South Launceston TAS 7249
(03) 6344 5588

Aqua Hydroponics
Rear 45 Burnett St.
New Norfolk TAS 7140
(03) 6294 9233

Ezy Grow
625 East Derwent Hwy.
Lindisfarne TAS 7015
(03) 6243 9490

Garden World
717 West Tamar Hwy.
Legana TAS 7277
(03) 6330 1177

Green Acres Hydroponics
46-48 Bingalong Rd.
Mornington TAS 7018
(03) 6245 1066
sales@greenacreshydroponics.com.au

Growers Choice
225 Main Rd.
Derwent Park TAS 7009
(03) 6273 6088

Hydroponics Systems
131 Main Rd.
Moonah TAS 7009
(03) 6278 3457

Hydroponic World
322 Bass Hwy.
Sulphur Creek TAS 7316
(03) 6435 4411

Lifestyle Gardens
167 Gilbert St.
Latrobe TAS 7307
(03) 6426 2003

Organic Garden Supplies
17 Don Rd.
Devonport TAS 7310
(03) 6424 7815

Tasmanian Hydroponic Supplies
99 Lampton Ave.
Derwent Park TAS 7009
(03) 6272 2202

The Hydroponic Company
69 Charles St.
Moonah TAS 7009
(03) 6273 1411

The Hydroponics Company
289 Hobart Rd.
Kings Meadow TAS 7428
(03) 6340 2222

VICTORIA

99 Garden Services
Unit 31 12-20 James Court
Tottenham VIC 3012
(03) 9314 8088

AAA Lush Hydroponics
2-4 The Arcade, Junction Village
Melbourne VIC 3972

Albury Hydroponics/ Cappers Hydroponics
62 Thomas Mitchell Dr.
Springvale VIC 3171
(02) 6024 4029

All Seasons Hydroponics
3 Springvale Rd.
Springvale VIC 3171
(03) 9540 8000

A-Grade Hydroponics
60/148 Chesterville Rd.
Cheltenham VIC 3192
(03) 9555 6667

Aquamatic
299 Monbulk Rd.
Monbulk VIC 3793
(03) 9756 6666
aquamatic.com.au

Banksia Greenhouse and Outdoor Garden
530 Burwood Hwy.
Wantirna VIC 3152
(03) 9801 8070

Barb's Hydro and Nursery
15 Wallace Ave.
Interverloch VIC 3196
(03) 5674 2584

Belgrave Hydroponics
5/ 60-68 Colby Dr.
Belgrave Heights VIC 3160
(03) 9754 3712

Brew 'N' Grow
4 - 479 Nepean Hwy.
Edithvale VIC 3199
(03) 9783 3006

Casey Hydroponics
12 The Arcade St.
Cranbourne VIC 3977
(03) 5996 3697

Casey Hydro
78 Spring Square
Hallam VIC 3803
(03) 9796 3776

Central Hydro
Factory 3/9 Mirra Court
Bundoora VIC 3083
(03) 9466 7635
centralhydroponics.com.au

Chronic Hydroponics
31 Anderson St.
Templestowe VIC 3106
(03) 9646 8133

Crown Garden Supplies
8 Glencapel Crt.
Hillside VIC 3037
(04) 5996 6344

Discount Hydroponics
18 Princes Hwy.
Doveton VIC 3177
(03) 9792 2966

Echuca Hydroponic Nursery & Supplies
23 Ogilvie Ave.
Echuca VIC 3564
(03) 5480 2036

Echuca Pump Shop
128 Ogilvie Ave.
Echuca VIC 3564
(03) 5480 7080

Epping Hydroponics
10 Dilop Dr.
Epping VIC 3076
(03) 9408 4677
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ten
FACTS ON

POTATOES

by Philip McIntosh

Potato or potahto… no matter. This tuberous vegetable is used for all kinds of things all over the world.

1. **Like other early staples** of central and South American agriculture (corn, squash, and beans) the potato has been in cultivation for many thousands of years, likely originating in Peru and Bolivia.
2. **The potato,** *Solanum tuberosum*, is yet another member of the nightshade family, which includes tomatoes, peppers and — the deadly nightshade — Belladonna.
3. **The green parts** are toxic if eaten in sufficient quantity. There are many reports of mass poisonings attributed to eating green potatoes.
4. **Unlike the other Solanaceae,** which are sources of fruit, the potato provides a starchy underground tuber that must be dug up to harvest. Definitely not a fruit.
5. **However, the noble spud** is indeed a reproductive structure, as anyone knows who has seen one sprout roots after sitting around for too long waiting to be eaten.
6. **The importance** and popularity of this vegetable is evident in the fact that it is the fifth-most grown crop in the world, only behind corn, wheat, rice, and sugar cane.
7. **The Irish Potato famine** of 1845 is well known to most, but the nearby Highland Potato Famine in Scotland resulted in the emigration of 15 per cent of the population, mostly to Canada and Australia.
8. **Ironically,** it is thought that the introduction of the potato to Europe by the early explorers actually reduced the incidence of famine in that part of the world going forward.
9. **The International** Potato Center in Peru is a source of germ plasm and cultivars of thousands of potato varieties.
10. **Potatoes can be** grown hydroponically in NFT beds. Hydroponically produced starters are field planted and then grown to full size.

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