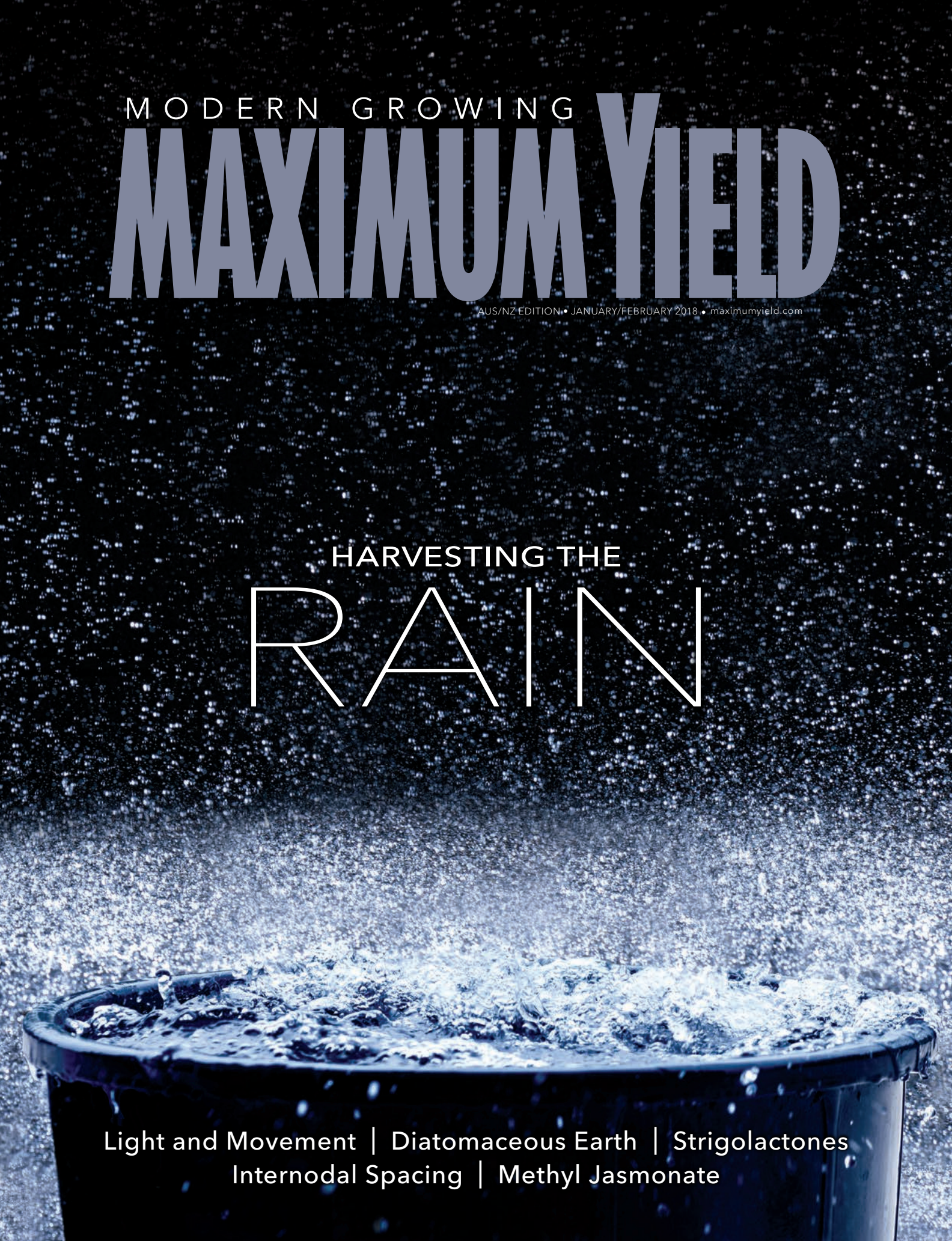
MODERN GROWING

MAXIMUM YIELD

AUS/NZ EDITION • JANUARY/FEBRUARY 2018 • maximumyield.com



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FEATURES

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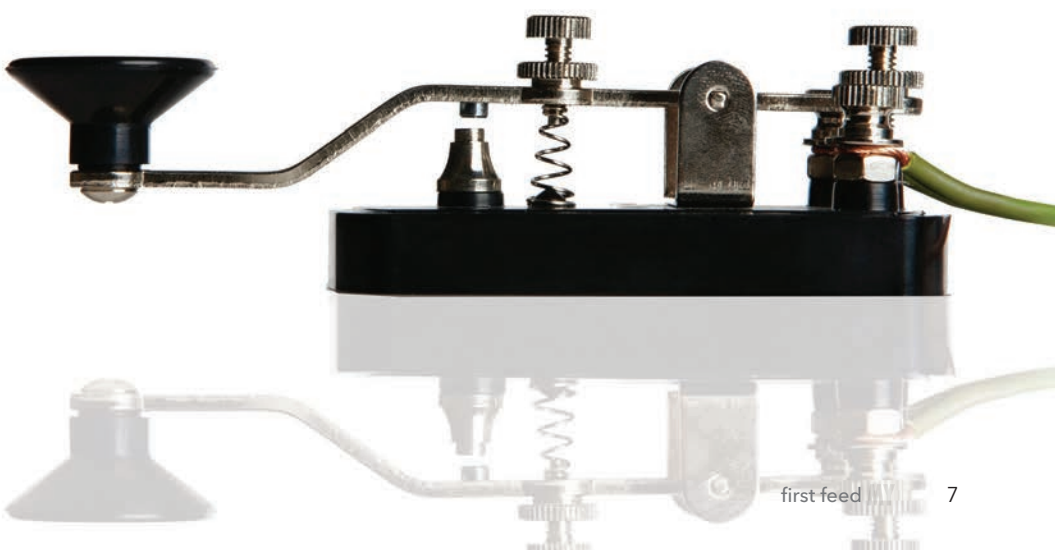

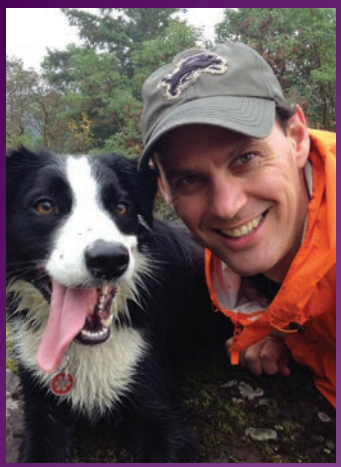

"Plants also communicate to us, if we as growers are paying attention."

Our plants may be more sophisticated organisms than we think. When we look at our gardens we see individual plants, each standing in isolation from one another, doing its best to survive.

But are they really alone? In our Nov/Dec issue of *Maximum Yield*, Philip McIntosh, in his "10 Facts On Jasmonates" (page 70), hinted at the fact that maybe plants could communicate with other nearby plants. We asked writer Chris Bond to investigate a little further for this issue, and his findings are very interesting. In his article "More Than a Pretty Smell: Methyl Jasmonates" on page 56, Bond writes that when a plant is subjected to a stressor and is injured, it alerts other plants that danger is nearby. Other plants receive the alert and immediately start producing methyl jasmonate to prepare for whatever onslaught is about to befall them. Amazingly, this signalling occurs between plants of different species.

Plants also communicate to us, if we as growers are paying attention. In his article "Morse Code for Plants: Interpreting Internodal Spacing" on page 34, Frank Rauscher explains that the distance between nodes on a plant can reveal quite a bit about how it's doing. Longer nodes may mean a plant is struggling, while shorter nodes generally suggest a positive growing environment. While not quite as advanced as methyl jasmonate communication, interpreting these internodal spacings is an important part of receiving information about your plant's health.

It's an amazing notion to think plants survive better when they work together. Like humans and other animals, strong teamwork often means success. I can't help but wonder, though, if my plants at home have been trying to tell me they hate the country music I've been playing for them all these years. Maybe we'll get to the bottom of that in a future issue.

As always, thanks for reading *Maximum Yield* and if you have any questions feel free to contact us at *editor@maximumyield.com*.

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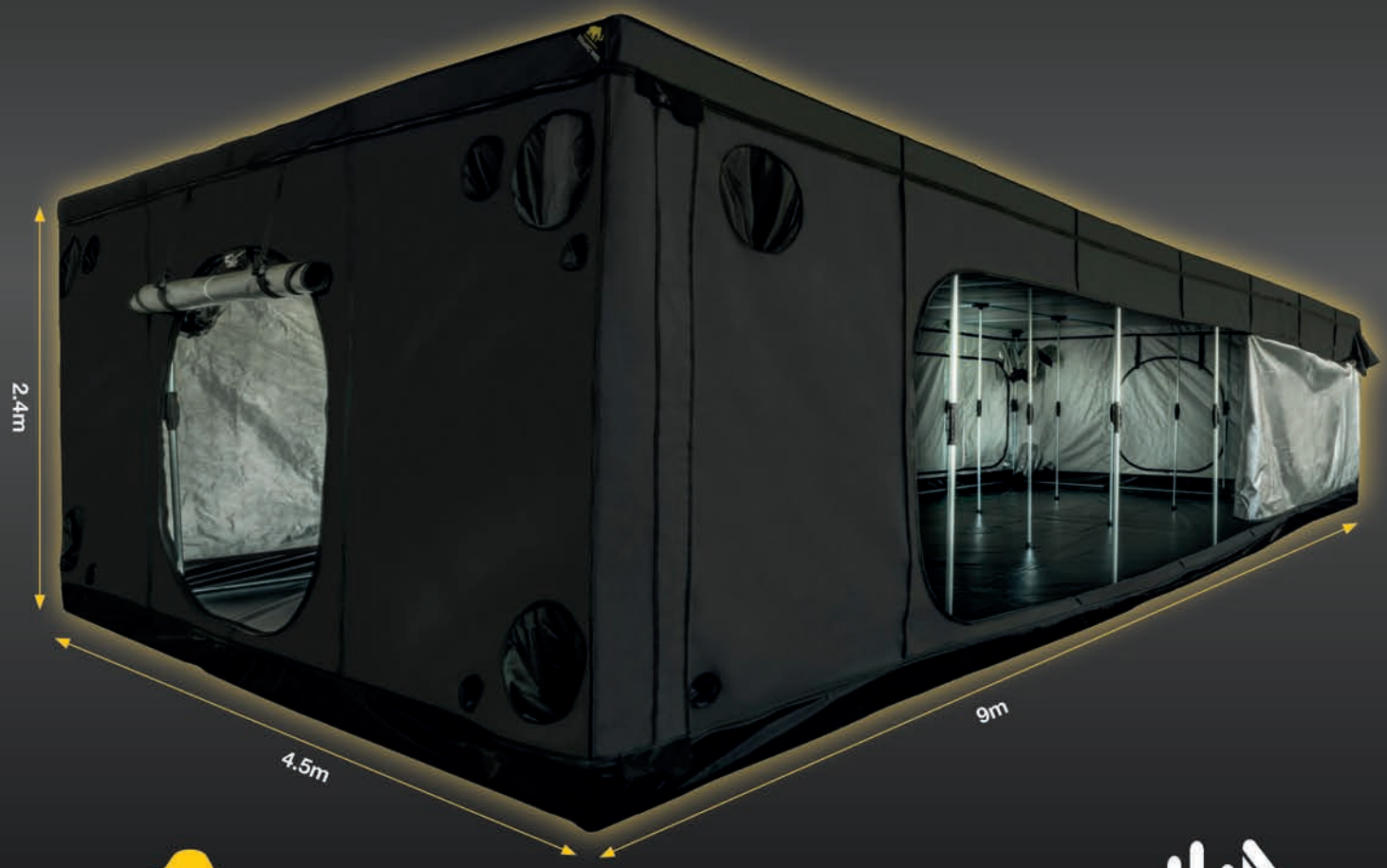

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Hydroponic containers should exclude light to prevent algae growth in the nutrient solution.

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The dark cycle is very important, even for plants in a veg state.

Denver Clone Store @DNVRclonestore

Next time you steam or boil vegetables, use the cooled water for your potted patio plants.

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Shop Shout Out

We'd like to give special shout-outs to Bee Happy Farms, Grow Masters, The Grow Hub, and The Growers Guide for regularly sharing our posts with their Facebook and Instagram followers. For a full list of shops that carry *Maximum Yield*, check out our distributors guide starting on page 66.

One of the many pollinators we've seen this year. Honeybees and butterflies loved the lemonbasil we grew.

Urban Rivers@UrbanRiv

I so love *Maximum Yield*. After all these years it's still No. 1.

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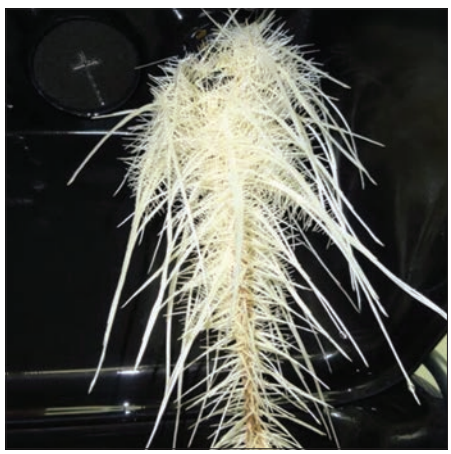

Young, hydroponic roots.

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BARBARA SHAW gardens, writes, and makes junk art in Oregon. She earned degrees in zoology, physiology, and journalism, and she writes about science, health, growing things, and energy management. She also delights in reading, cooking, photography, and eco-travel, which has taken her to 60 countries. Married to a sports journalist, she embraces being a grandmother.

FRANK RAUSCHER is a certified horticulturist and consultant for the hydroponic and landscape industry with a background in product development. Frank is a member of the Southern Nevada Landscape Association and active in the Southern California green industry, where his focus is drought-tolerant xeriscapes. He specialises in discovering the "root-cause" of plant stress.

NANCY HAMILTON is executive vice president of Gualala Robotics, Inc, the manufacturer of the LightRail brand. LightRail robotic light movers are instrument-grade light movers, rated for continuous duty and made in the USA since 1986. The company headquarters is based in Steamboat Springs, Colorado and its website is *lightrail3.com*.

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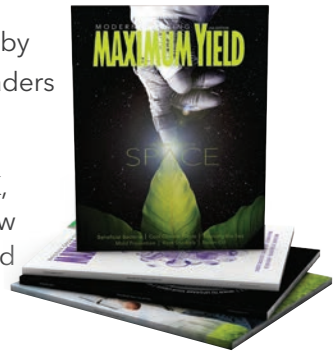

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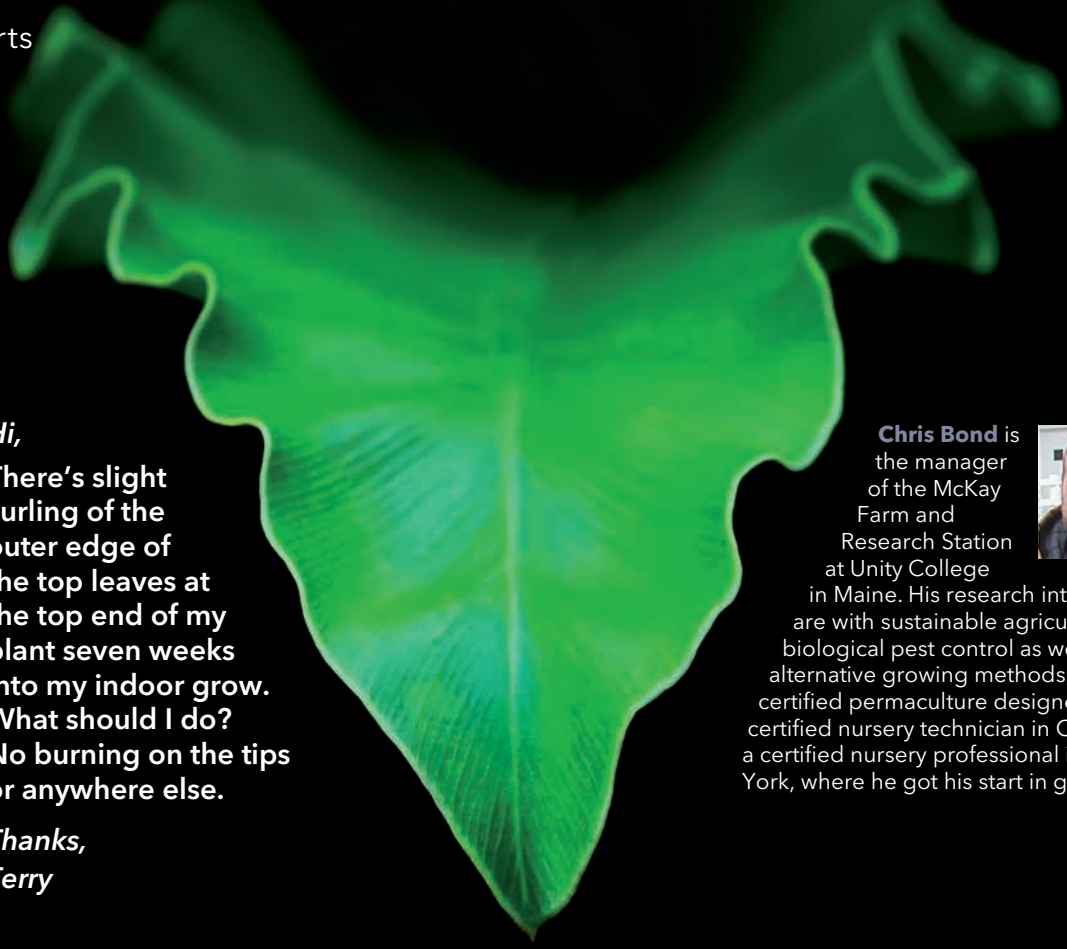

Q

Hi,

There's slight curling of the outer edge of the top leaves at the top end of my plant seven weeks into my indoor grow. What should I do? No burning on the tips or anywhere else.

Thanks,
Terry

Chris Bond is the manager of the McKay Farm and Research Station at Unity College in Maine. His 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.

A

Hi Terry,

There are several possibilities regarding what could be causing your curling leaves. Curled leaves that are not accompanied by any necrosis or browning of the foliar edges may be attributable to nutrient excess, insect damage, water, other cultural issues, or even possibly the genetics of your plant. There is no way to give you a definitive answer without having some background information, but we can cover some of the most likely possibilities.

Not enough water can cause this symptom, but if it does not correct itself after a good drink, this is not likely the issue. Conversely, the leaves of an oversaturated plant may curl or droop, but often this is followed by a yellow and or sick appearance of the plant too. Too much water and poorly drained soil may also set the stage for root rot, which will cause the leaves and ultimately the entire plant to collapse. If you are growing these plants in containers or planting beds and not hydroponically, make sure that the media you are growing in is well-drained and porous so that excess water can drain through. A moisture meter can help to identify how wet your media is and whether or not this may be the cause.

Too much nitrogen to the point of toxicity can cause curling leaves as well. Performing a simple soil or media analysis will help to rule this possibility out or in depending on your results. Your plant may also just be showing signs of stress due to cultural factors. Is the curling just on one side? This could be an environmental problem due to continual and proximal exposure to a fan.

Another likely culprit that can be easily checked and remedied is if you are growing these plants in pots and if they have become root-bound. If this is the case, scuff up the roots and pull them away from the root ball before transplanting them into a larger container.

If none of these seem to be the cause of the leaf curl that you are experiencing, the symptoms may be caused by a mite infestation. Several different species of mites, including broad mites, cyclamen mites, and russet mites may be feeding on your plant leaves and leave curled leaves in their wake as a result of a substance that they inject into the foliage while feeding. Generally, though, there will be other symptoms appearing shortly after you notice the curling such as a change of colour (yellow to brown) or a speckled appearance to the leaves.

If you have ruled out all of the above, there is possibility that the particular species of plant that you are growing has the naturally tendency to have curled leaves. This is not an unknown characteristic of some strains of plants.

Best of luck!

ROOT-BOUND

A root-bound plant is a plant whose roots are inhibited by some kind of barrier. A common problem in indoor gardening is that a contained plant's roots eventually outgrow the available space within a given growing container. These roots then continue to grow within the available space, displacing water and soil and eventually growing back upon themselves into a dense, unhealthy nest that can cause plant death.

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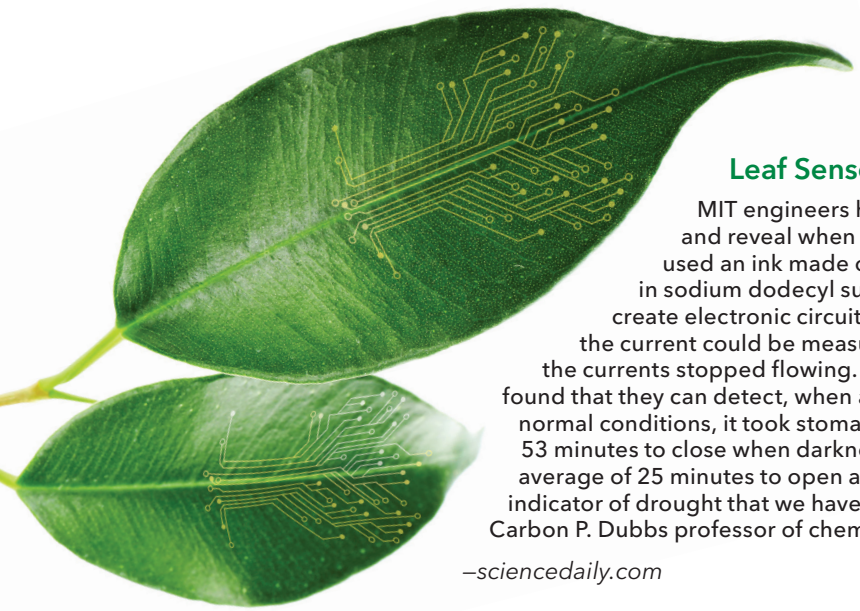
Want to Eat More Veggies? There's an App for That

Scientists have come up with an innovative approach to tackling Australia's poor vegetable intake, with the launch of a new app that challenges people to eat more veggies. Using a gamified approach, CSIRO's new VegEze app aims to motivate Australians to add extra vegetables to their daily diets and form long-term, healthier habits through a 21-day 'Do 3 at Dinner' challenge. CSIRO nutritionists will also study how effective the app's game-like nature is at helping transform people's eating patterns as part of a broader research study. "We need a fresh approach to improve Australia's vegetable consumption and overall diet quality," CSIRO senior principal research scientist professor Manny Noakes says. "Our research found two out of three Australian adults are not eating enough vegetables, especially as part of their evening meal. It's time to find more engaging, effective approaches to help break these entrenched diet habits."

–hydroponics.com.au



Leaf Sensors Warn of Water Shortage

MIT engineers have created sensors that can be printed onto plant leaves and reveal when the plants are experiencing a water shortage. Researchers used an ink made of carbon nanotubes, which conduct electricity, dissolved in sodium dodecyl sulphate. This was then printed across the plant's stomata to create electronic circuits. When the pores were closed, the circuits were intact and the current could be measured. When the pores opened, the circuits were broken and the currents stopped flowing. By measuring this opening and closing, the researchers found that they can detect, when a plant is experiencing water stress. They found that during normal conditions, it took stomata about seven minutes to open after light exposure and 53 minutes to close when darkness falls. However, in dry conditions, the stomata took an average of 25 minutes to open and 45 minutes to close. "This appears to be the earliest indicator of drought that we have for agricultural applications," says Michael Strano, the Carbon P. Dubbs professor of chemical engineering at MIT.

–sciencedaily.com

Moving Crops Could Feed Millions More People

A recent study published in *Nature Geoscience* states that changing the locations where food is grown could help meet growing demand for food and biofuels as well as reduce water stress in agricultural areas. The results show that "there are a lot of places where there are inefficiencies in water use and nutrient production," says lead author Kyle Davis, a postdoctoral researcher with Columbia University's Earth Institute. Those inefficiencies could be fixed by swapping in crops that have greater nutritional quality and lower environmental impact. The specific changes, however, would have to vary widely by country and water-use type due to differences in local climate, soil characteristics, and crop yields. In their study, the team proposed such changes would produce 10 per cent more calories and 19 per cent more protein—enough to feed an additional 825 million people—while reducing consumption of rainwater by 14 per cent and irrigation water by 12 per cent.

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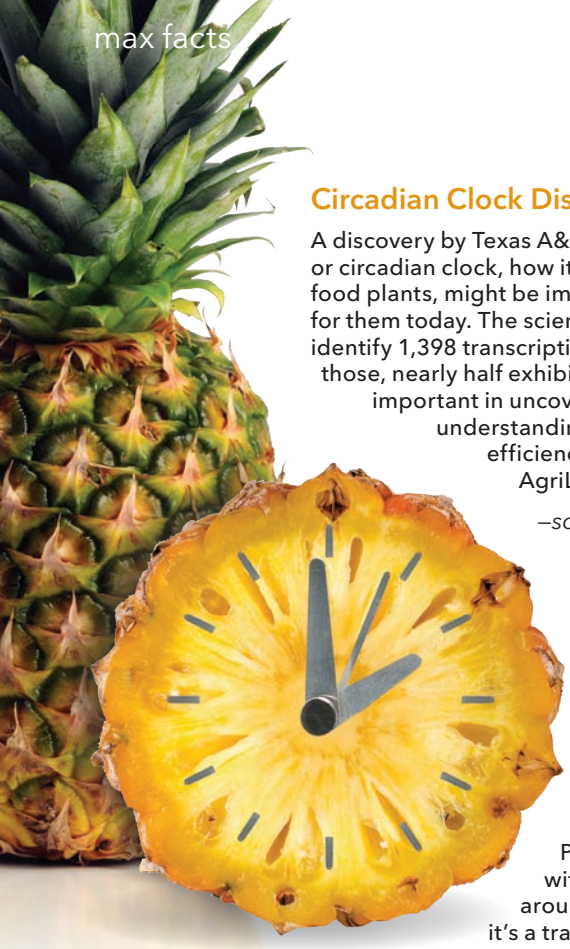
Circadian Clock Discovery Could Help Boost Water Efficiency in Food Plants

A discovery by Texas A&M AgriLife Research scientists in Dallas provides new insights about the biological or circadian clock, how it regulates high water-use efficiency in some plants, and how others, including food plants, might be improved for the same efficiency, possibly to grow in conditions uninhabitable for them today. The scientists in their study, published in the journal *Genome Biology and Evolution*, identify 1,398 transcription factors, proteins that regulate expression of certain genes in pineapple. Of those, nearly half exhibited time-of-day specific or diurnal gene expression patterns, which could be important in uncovering the genetic controls for water use in plants. "This is an important step in understanding the overall circadian regulation of water-efficient photosynthesis and how that efficiency might be replicated in other plants, namely food crops," says Dr. Qingyi Yu, AgriLife Research associate professor of plant genomics.

–sciencedaily.com



British Man Named a United Nations Young Champion of the Earth

Twenty-five-year-old British entrepreneur and inventor Adam Dixon has been named a United Nations Young Champion of the Earth for his hydroponic system Phytoponics. "An important motivator for me has been witnessing the extent of deforestation and habitat loss around the globe to feed our growing population. I think it's a tragedy that as a species we've had to use half our planet for our own needs," Dixon says. "Gaining the acknowledgement and support from the Young Champion of the Earth prize is a huge boost for me, which will help me achieve my vision for sustainability and food security." The prize comes from the United Nations Environment Programme and Covestro, which aims to identify, support, and celebrate individuals between 18 and 30 years of age with big ideas to protect or restore the environment. "The breadth of innovation and ambition shown by the inaugural winners is nothing short of exceptional, and proof that we must continue to channel support to the world's younger generation for the solutions we need to secure a sustainable future," says UN Environment head Erik Solheim.

–unenvironment.org

Federation University and Precision Agriculture to Boost Digital Record Keeping

The announcement of a three-year collaboration between one of Australia's most well-known agriculture technology providers, Precision Agriculture, and Federation University will create pathways to make digital data more easily accessible. As part of the initial series of projects in the collaboration, internally held Precision Agriculture data, such as soil test results, will be combined with climate, topography, and drainage information, along with other key data sets. Ben Fleay, chief executive at Precision Agriculture, says the company would work together with Fed Uni's Centre for eResearch and Digital Innovation (CeRDI), best known in agricultural circles for its work with the Grains Research and Development Corporation (GRDC) on the GRDC's on-farm trials project. "As an example, we see the issue of plant available water and how that is managed to be one thing we could really improve using these data sets," says Fleay.

–queenslandcountrylife.com.au

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Aloevate is also an amazing foliar Spray it creates thicker stronger cell walls and activates the plants' systemic required resistance response to deter pests and disease. It can also be added to any other foliar spray as a natural wetting agent and chelating agent to aid in mineral transportation. Available in one-litre, 5 L, and 20 L sizes.

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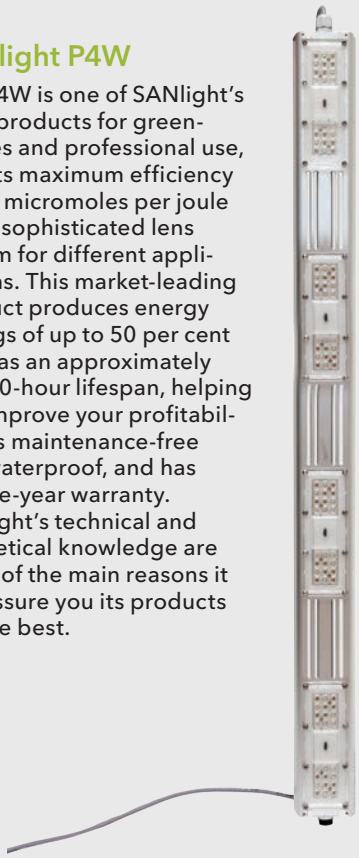
The P4W is one of SANlight's main products for greenhouses and professional use, with its maximum efficiency of 3.2 micromoles per joule and a sophisticated lens system for different applications. This market-leading product produces energy savings of up to 50 per cent and has an approximately 80,000-hour lifespan, helping you improve your profitability. It's maintenance-free and waterproof, and has a three-year warranty. SANlight's technical and theoretical knowledge are some of the main reasons it can assure you its products are the best.



Climate Control Solutions Ozone Pro System

The Climate Control Ozone Pro System is the key to ensuring your crop has fresh, clean, purified water every time you irrigate. This greenhouse water treatment system increases plant health reliance by killing any bacteria or pathogens in the water, and produces a better overall crop yield. The new CCS-SW80 Plasma Ozone Technology is ideal for sterilising irrigation waste water for greenhouse flower, vegetable crops, and the medical marijuana industries. The Ozone Pro systems are available for water flow rates from 10 US GPM to 1,000 US GPM. Each system is custom designed to suit your specific grower needs and water flow rate. It saves 30 per cent on water usage, 40 per cent on fertiliser costs, and removes bacteria and recycles your nutrient water.

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SANlight S4W

The SANlight S4W is a perfect substitute for high pressure sodium and metal halide lamps. With protection class IP40, it is designed for typical large indoor cultivations under controlled environments. It is passively cooled, which increases its lifespan and eliminates maintenance. No photon is wasted due to its rectangular illumination system and optics, which illuminate the specific target area. It also has a warm, white-light colour impression for comfortable working. Typical power consumption is 140 watts. Typical applications are powerful assimilation light and for all stages of growth

Bio Diesel Bloom Stimulant

The original natural bud enhancer designed to increase essential oil and terpene production. Bio Diesel uses a mix of fully digested vegetable proteins, amino acids, auxins, and complex carbohydrates in a micronised guano base, which is proven to increase biological processes and greatly add to overall quality and finished yield. Bio Diesel will also provide larger post-harvest extraction yields and medicinal values in herbs and flowers. Use in weeks one through six of the bloom stage. Growers are consistently reporting massive yield increases of over 30 per cent and higher-quality finished flowers with more essential oils and weight. Bio Diesel is very easy to use and pH friendly. It will only raise your final EC by 0.2 (100 ppm) and is compatible with all major nutrient programs. Find out why everyone's switching to Bio Diesel and experience heavy, quality yields without chemicals.

Spectrum King LED iHP Remote Power System

Avoid power spikes and surges, and keep your peace of mind. This power system provides accuracy, resolution, and stability as a programmable scheduling, voltage, and current source. The power rack houses EMC filtering and digital front-end power factor correction (PFC) circuits, input/output connectors, and related hardware. The modules can be connected in series or parallel, while achieving high accuracy voltage and current sharing. The iHP has flexible input and can take 180-528V single or three-phase power. Spectrum King is the first to market a 480V three-phase control system. The system drastically reduces your current loads and is configurable with all Spectrum King LEDs.

Spectrum King LED Grow Lights

Indoor gardening has been revolutionised by Spectrum King LED Grow Lights. The latest range are now available in Australia. Products range from the Closet Case 140W, which replaces CMH 315W and HPS 400W grow lights, to the dimmable SK402 and SK602 models, which outperform HPS DE 600W and DE 1,000W fixtures, respectively. Room temperatures can range up to and over 30˚C with full-spectrum LED lighting without stressing your plants or reducing yield. Make your money back with savings on power use, and grow throughout the summer heat. You can even use these fixtures outdoors. Spectrum King LED's are made in California and have the benefits of fanless operation, IP65 water resistance, and a five-year warranty and three-year light output warranty—which is not offered by any other manufacturer. Only available from Aqua Gardening, online or in-store in Brisbane.

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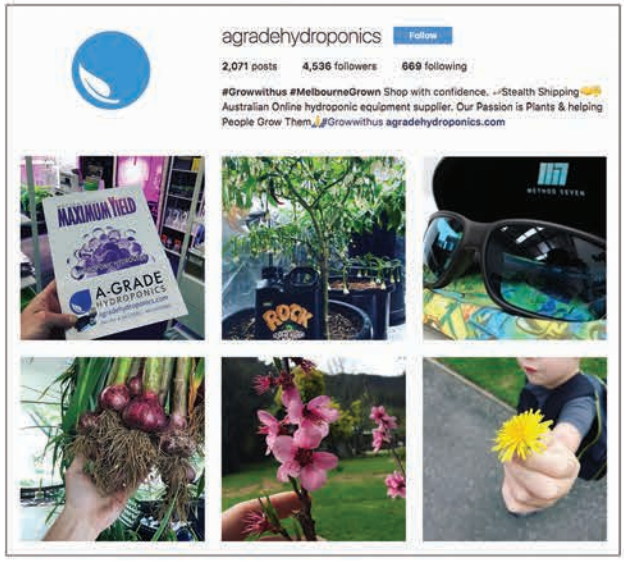

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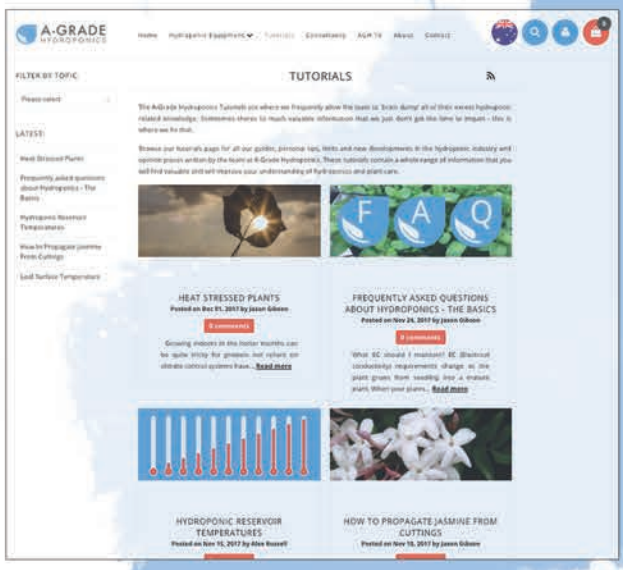

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HARVESTING THE RAIN

by Barbara H. Shaw

Whether it's out of necessity, to lower your water bills, or to help the planet, harvesting rainwater can be rewarding. However, there are a few things to consider before installing a system.

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I lived some months in Palau, in the Pacific, where rainwater was the only source of fresh water. Faulty pipes served the town, but out on the coral isles, every shelter collected water from the thatched or metal roof and stored it in a shiny steel tank with a mesh filter on top.

If you're considering your own collection system, check local regulations. In the US, some jurisdictions in dry, western states have old laws requiring all water to be under the control of a water master. Many areas of Australia, however, either allow or require it on new construction, while it's regulated by building codes in Canada. In India and other countries, newer laws make rainwater harvesting mandatory for new buildings.

After you check local laws, look at your goals. The idea is to create a long-lasting, safe, and efficient water collection system for your own use, with inexpensive materials using basic construction skills. While harvesting water from roofs using gutters is simple, storage requires more thought.

QUESTIONS TO ASK

The most basic questions before beginning any upgrade project are:

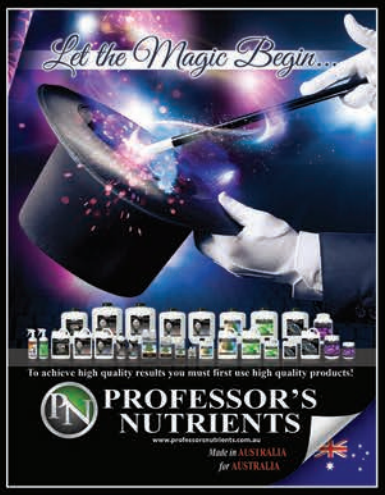
- Will this be cost-effective? In the case of water, is the local supply safe, dependable, and affordable? If so, would the cost of a system pay for itself?
- Will our gutters catch the rain, or can we create and attach some at the bottom edge of the roof? Is the roof a good collection surface? The ideal roof material for collection is metal as it is long-lasting, non-porous, and non-toxic. But other materials are fine, including slate, tile, thatch, planted surface, or shingles of wood or asphalt.
- How will we keep stored drinking water clean and free of insect larvae and other pathogens? A mesh filter on the intake side and a tight cover are generally all that's needed, though a little chlorine bleach, iodine, or bromine salts will discourage live things and maintain a higher level of cleanliness.

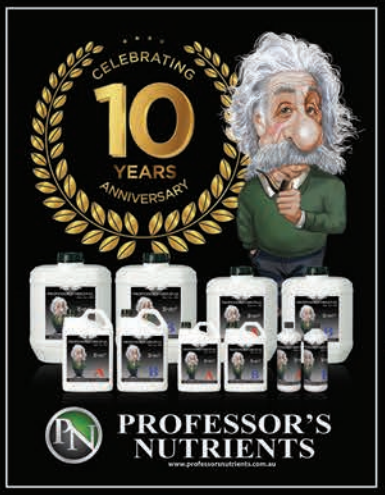
"THE IDEA IS TO CREATE A LONG-LASTING, SAFE, AND EFFICIENT WATER COLLECTION SYSTEM FOR YOUR OWN USE, WITH INEXPENSIVE MATERIALS USING BASIC CONSTRUCTION SKILLS."

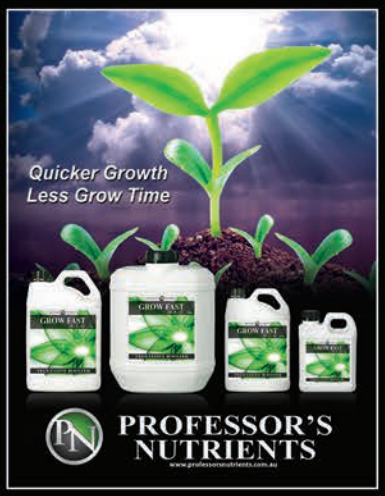
- Who is going to maintain the system once it's in place? What sort of care will it need? How much water do we need to store, and at what times of year? What quality of water do we need—drinking water with filtration or just water for washing, cleaning, or watering a garden? Gray water has already been used for washing or cleaning, but has its uses such as for animals, flushing, and irrigation.

CONSERVATION FIRST

With water, energy, food, and other commodities, it's invariably less costly to cut waste than to create a new source. Drip irrigation is a good water-conservation investment, as is flow control for a shower or tap and a low-flow toilet. If water is a serious issue in your area, don't waste it flushing toilets. Consider the advantages of composting toilets to create safe fertiliser from excrement. Simple plans for better systems are available online. In Palau, a teenager built a composting toilet as a science project, invited guests to use it, and vastly improved the output of the family fruit trees. By my next visit, officials had built composting toilets in parks there.







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WHY RAIN WATER?

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Most modern sources of drinking water come from surface water that flows into rivers, streams, lakes, and groundwater from wells and boreholes. That leaves 60 per cent of total precipitation to evaporate, transpire through plants, and to wet the soil. Or for people to harvest.

"A MESH FILTER ON THE INTAKE SIDE AND A TIGHT COVER ARE GENERALLY ALL THAT'S NEEDED, THOUGH A LITTLE CHLORINE BLEACH, IODINE, OR BROMINE SALTS WILL DISCOURAGE LIVE THINGS AND MAINTAIN A HIGHER LEVEL OF CLEANLINESS."

THE DOWNSIDE

Let's look at some of the disadvantages of rainwater harvesting. Supplies can be contaminated by bird and animal droppings on the catchment surfaces and guttering structures unless they are cleaned or flushed before use. Poorly constructed water tanks or containers can suffer from leakage, algal growth, and invasion by insects, lizards, and rodents. They can act as a breeding ground for disease vectors if they are not properly maintained. All of that implies a high level of responsibility for maintenance.

HOW MUCH WATER CAN BE COLLECTED?

The run-off from a roof is directly proportional to rainfall and the horizontal area of the roof. For every millimetre of rain, a square metre will yield one litre of water, in theory. Expect to be able to capture only 80 per cent of what hits the roof after losses from splashing, spillage, wind, evaporation, leakage, and overflow. Build guttering and down-pipes large enough to capture peak volume run-off during intense storms.

STORAGE TANKS

Storage is usually about 90 per cent of total system cost. It can range from small containers made for other purposes—oil drums, food cans, etc.—up to large tanks at ground level, or sometimes beneath it. Big tanks of concrete or ferro-cement are used as storage for schools, clinics, or other institutions with large areas of roof. In some parts of Africa, a group called Water Aid is teaching people better ways to create large village or neighbourhood storage tanks of local materials or a mix of cement and sand, reinforced with wood or fencing wire.

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Large-diameter, corrugated galvanized or safe PVC drainpipe is ideal as a ground-level tank when laid on slight slopes. Five-metre lengths of culvert pipe, 0.6 metres in diameter, is easy to locate. End caps and taps must be special-ordered. A full one holds about 1,700 litres.

In a semi-desert area, we built a water tower of beveled-edge thick cedar boards, like a very tall hot tub, with steel bands around it. Our homestead had a minimal well, but by collecting nearly all it produced and pumping into our 1,400-gallon (5,300-litre) wood tank, we always had plenty for home and garden use.

Consider your needs and study your options. If you need more, better, or cheaper water, consider harvesting the rain and storing it for dry periods of the year. MY

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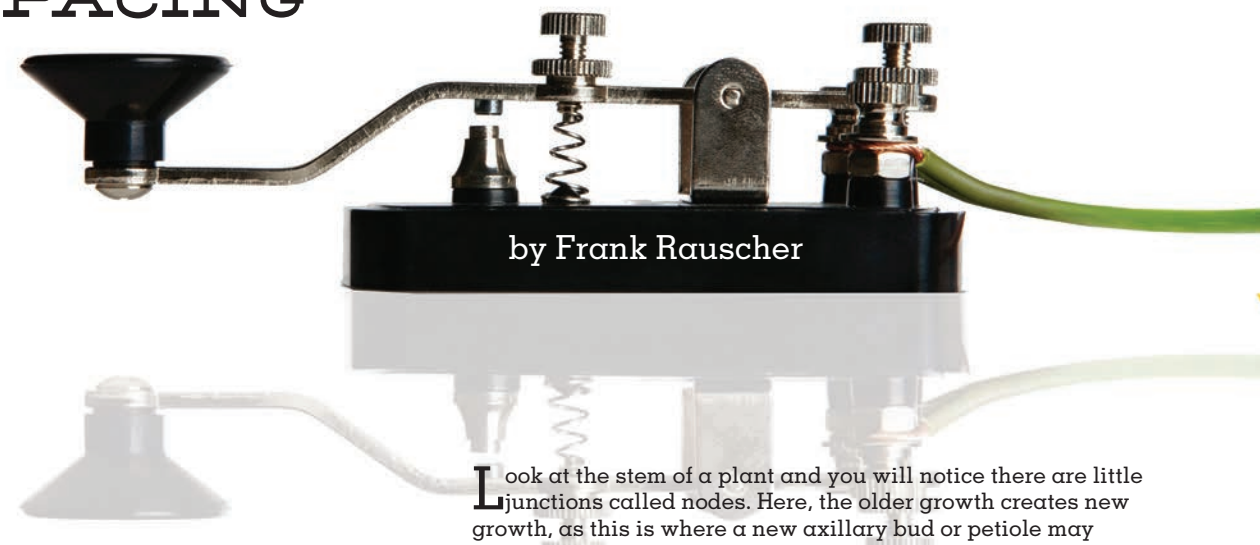
INTERPRETING INTERNODAL SPACING



by Frank Rauscher

The distance between nodes can tell us quite a bit about how a plant is doing. Here's how to decipher it.

Look at the stem of a plant and you will notice there are little junctions called nodes. Here, the older growth creates new growth, as this is where a new axillary bud or petiole may emerge. In fact, it seems all the above-ground action on a plant happens at the nodes. It is a very important place to access if you plan to do any grafting. Also, it is at the nodes that you can discover if your dioecious plant is male or female.

Similarly, the space between nodes, known as the internode, can be of great interest. That's because the length of the internode can tell you a lot about the conditions the plant is growing in.

LONGER INTERNODES

When a plant is overcrowded and needs to get additional sunlight, it will produce extra gibberellins and auxin in the upper growth regions. These hormones cause the plant to grow more rapidly, which in many cases will allow the plant to better compete for the available sunlight. This more rapid growth is what makes the internode spacing longer. When the plant can photosynthesise at its desired rate, the hormones will decrease and the growth rate will return to normal. However, if light levels continue to be low at the taller heights, the plant will continue to exhibit long internodes. This spindly, weakened condition obviously leads to a general lack of vigour and, often, failure to bud or bloom.

Heat is another reason that a plant may develop longer internodal spacing. In this case, the plant is trying to cool itself off by stretching upward. Often, winter crops like broccoli will "bolt," or produce longer stems and flower, as a response to excessive heat.

SHORTER INTERNODES

There is a general understanding that short internodal spacing is a sign of plant vigour. That's because one goal of every grower is to maximise their plants' rate of photosynthesis and thus maximise the entire crop's yield. More intense sunlight will typically cause a plant to have higher rates of photosynthesis and thus produce shorter internodal spacing. Of course, not all plants respond the same way to light stimulation, so some plants can photosynthesise properly and produce short internode regions in dimly lit locations. As such, knowing your crops is important. Being able to recognise what the normal internode spacing should be for healthy specimens of your plants allows you to react accordingly to deviations from this.

Wind can also cause the stimulation and release of plant hormones that affect growth, causing the production of shorter internodal spacing and a thicker stem. A minimal amount of modest wind is usually all that is needed to be beneficial for strengthening a plant.

PROBLEMS WITH SHORT INTERNODAL SPACING

Short internodal spacing is not always an indicator of plant vigour and health. The macronutrient nitrogen is responsible for both leaf and stem growth on a plant. Along with the yellowing and premature dropping of older leaves, insufficient nitrogen will also produce shorter internodal spacing on many plant types. Cold temperatures, particularly during specific growth stages, can also cause shorter internodal spacing.

> "BEING ABLE to recognise what the normal internode spacing should be for healthy specimens of your plants allows you to react accordingly to deviations from this."

Similarly, intense light radiation will cause the photodestruction of auxin, leading to shorter internodes and small plant height. Zinc is an important nutrient in the regulation of auxin production, so insufficient zinc levels can cause short internodal spacing too.

Most perennials, like the deciduous and woody grape vine, produce and store carbohydrates in their roots to produce shoots the following year. If these carbohydrate levels are low, the plant will subsequently show poor growth and closer internodal spacing. Even infestations of certain mites can cause shortened internodal spacing.

Most plants under normal conditions will respond to strong, long hours of sunlight by increasing photosynthesis and producing nodes on their stems more frequently. As such, growers are typically pleased to see their crop have shorter internodal spacing. It should be remembered, however, that this response is not universal for all types of plants and that short internodal space can actually be signal of a potential problem with some varieties. Knowing the normal characteristics for your crop is pertinent towards the ultimate success you obtain. For more information, scan the QR code.

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Light & Movement

by Nancy Hamilton, Gualala Robotics

Photos courtesy of Botany Unlimited Design Systems

Plants crave a natural supply of sunlight, which includes movement of the light so it reaches every leaf. The only way to achieve that in the growroom is to employ the use of automated light movers. Nancy Hamilton explains the benefits.

Light mover automation is an important part of the growroom set-up, and the more we automate, the better. With just a little planning, growers can free themselves and have confidence that the automation is working perfectly. With formulas for success plugged in to repeat, growers can advance with improved growth rates and yield numbers.

Complete Grow Light System Control

Automation in our growroom gives us that extra layer of perfection and protection. And, with grow light systems automated on light movers, growers can now expect much higher standards when it comes to results. In other words, we see an even, high-yield outcome from those perfectly keyed in variables. Consistent quality and yield results are what matters most, and robotic light mover automation can provide growers with that control. Automation is also about reducing human error, resulting in fewer mistakes in the growroom. Through automation, indoor growing systems can be dialed in for the exact results required. Specifically, a grow light system can be supercharged on light movers.

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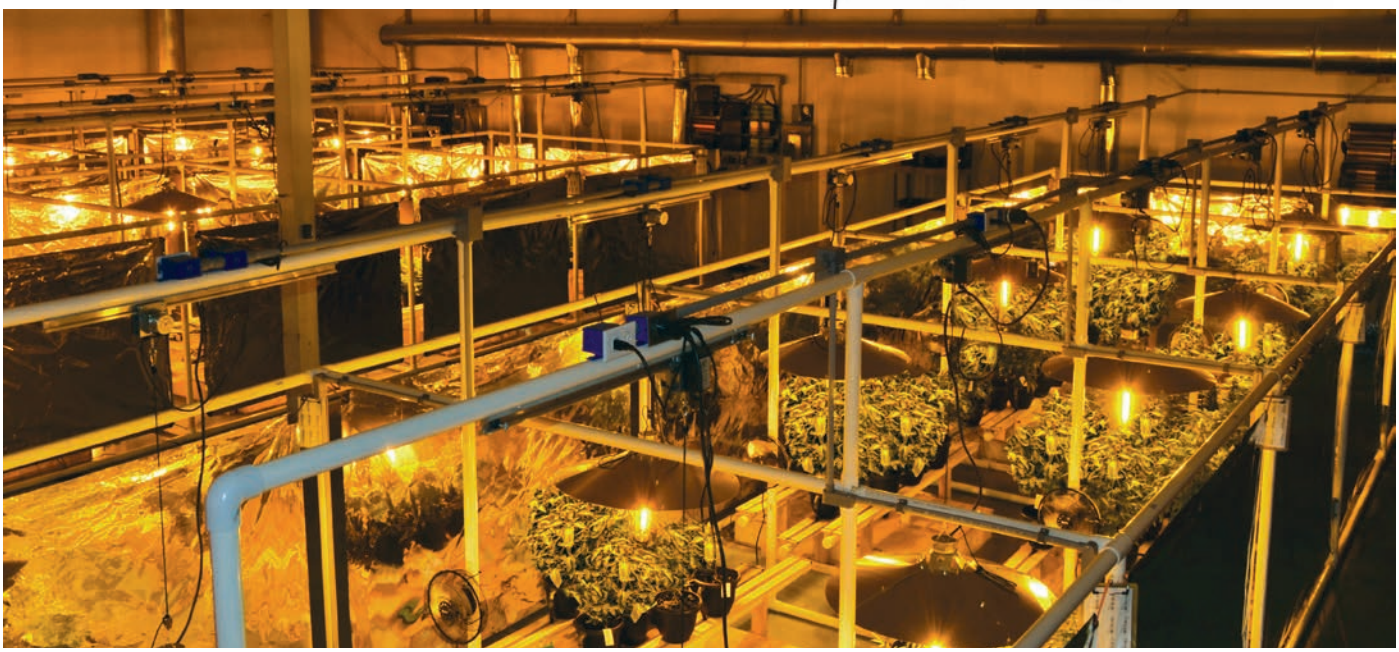
Lights Make or Break a Growroom

One thing to know by heart is this: a grow light system is the key to everything. Indoor grow lights will either make or break indoor growing results every time. Quality of light equals quality of yield; it's just that simple. That statement gets us to the specific details of light mover automation. Quality grow lights on light movers make all the difference in growth rates, numbers of nodes, and yield results.



Goodbye Hotspots, Goodbye Shadows

The light mover grow light system affects light as it relates to distance when the grow lights are moved along the light mover rail—it eliminates hot spots and shadows. Without the negative impact of hot spots and zoned light overkill, we can now get our grow lights closer for maximum photosynthetically active radiation (PAR) right to the canopy. It's an example of the Inverse Square Law, which states the following: The farther away an object is from a light source, the effect of that light is geometrically diminished. So, a grow light that is up close is powerful and effective. But, at five feet away (1.5 metres), that same grow light is only 50 per cent as powerful. Remember, it's geometrically diminishing, so at four feet away (1.2 m), we are still doing poorly and are fast approaching that 50 per cent number. Even at two to three feet away (0.6-0.9 m), we are not using the grow lights to their full potential, even though that is generally what light manufacturers recommend. However, they are giving us these numbers thinking in stationary grow light terms.

We can get 3,000+ PAR right to the canopy, but we cannot do that with stationary grow lights that are multiple feet away. We can only achieve that through robotic light movers. In other words, stationary grow light systems force us to position our grow lights at a certain distance. In doing that, and trying to avoid the hot spots while also trying for a little stationary light spread, it undermines our efforts. It is a catch-22 for indoor grow light systems. The solution is to use light movers. That simple change allows growers to break all the stationary grow light rules.

> **"THE LIGHT MOVER** grow light system affects light as it relates to distance when the grow lights are moved along the light mover rail–it eliminates hot spots and shadows."

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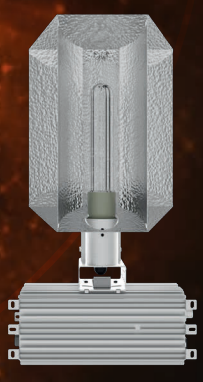

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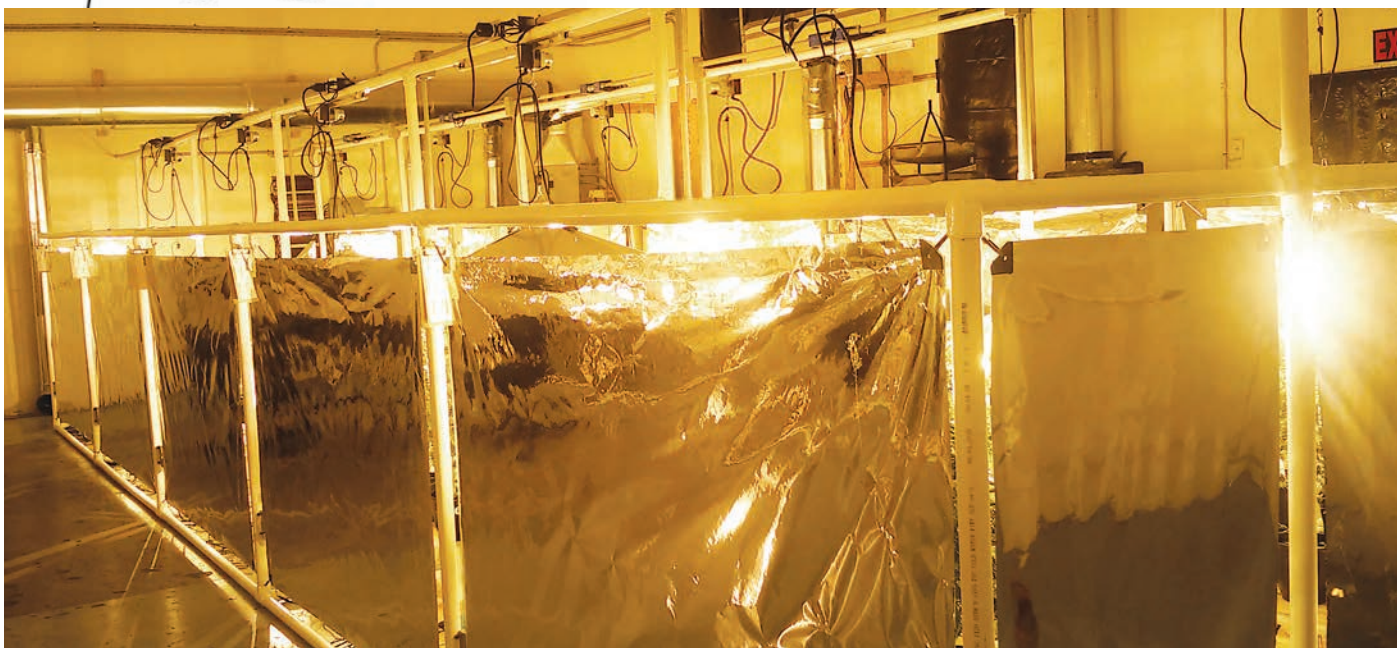
Robotic Lights Reach Every Leaf

At the same time, light movers also affect light as it relates to leaf area. When we move our grow lights along the light mover rails, each leaf area interacts with the intensity of those moving grow lights. That interaction is for the correct period of time for each leaf surface. This is called Leaf Area Index (LAI), and it's very important for achieving maximum yield. Light movers, which turn indoor grow lights into robotic moving lights, get all the leaves to interact and work for the good of the plant by getting that closer, quality, improved PAR indoor plant light to reach all the leaves for the right amount of time.



"**WE CAN** get 3,000+ PAR right to the canopy, but we cannot do that with stationary grow lights that are multiple feet away. We can only achieve that through robotic light movers."

To understand LAI, it's helpful to know that there is a limit to what each leaf surface can effectively absorb. To put it simply, each leaf surface needs intermittent light. What is ideal is to have a powerful and intense grow light interaction for a period, have it move off slightly, then return once again to being powerful and intense without the plants waiting too long for that return. That scenario is perfect for each leaf surface, as each leaf area can only absorb light at its own pace. Only then do all the leaves work best for the good of the plant. In other words, the sun isn't always at high noon and neither should our grow lights. Light movers are truly the only way to get the indoor plant light to duplicate a natural supply of sunlight.

Thirty Per Cent More Area Covered

Light movers can cover at least 30 per cent more area compared to stationary grow lights. Of course, that number depends on many variables including the number of stationary lights being used as a benchmark. Not only do light movers employ automation in the growroom, including closer coverage for maximum PAR and more leaves working for the good of the plant, but they also allow each light to cover more of the growroom. That creates efficiency and can reduce maintenance and electricity costs.

The more we automate our set-up, the better results we can achieve. This is especially true when we take the single most important variable, the grow light system, and we make it that much better. Light mover automation gives growers bang for the buck in efficiency, protection of outcome, and improved results. Robotic light movers provide the ultimate automation and that automation is in the very area that counts the most. MY

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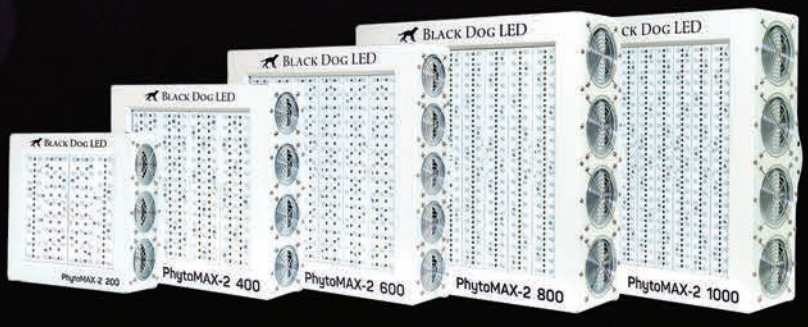

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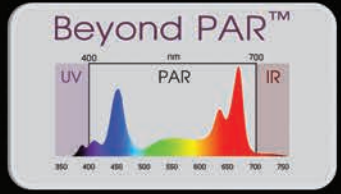

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by George Serrill


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One of the coolest things about diatomaceous earth (DE) is that it was originally plankton, meaning it went from being an organic material to a mineral. But how could that be? And what exactly is DE?

Well, in the time of dinosaurs, give or take an epoch, plankton flourished in lakes and seas. These plankton species multiplied to countless proportions, especially during volcanic periods, when they consumed carbon dioxide (CO_2) and extracted silica from the water. The silica was ingested to support cell walls that grew into beautiful, microscopic, porous silica structures. These plankton bodies were so porous that water flowed through them, providing a continuous supply of nutrient absorption. When they died, they sank to the bottom and accumulated in vast numbers as sediment. The skeletal remains of these structures are called diatoms. Eventually the waters receded, the topography changed, and these huge deposits of diatoms were discovered and named "diatomaceous earth."

Today, DE is mined much like sand or gravel. (For the record, DE contains amorphous silica, which is the safe kind.) Of course, DE is not one universal product. In the green industry, natural DE powder is used for insect control, while DE aggregates improve soil function for all types of plant applications. Natural DE powders are different from powders used for filtration purposes, which are combined with other ingredients and kiln-fired to create better properties for separating particulates.

Natural DE powders have no additives and, as mentioned, are designed for use on insects and plants. Under a microscope, powdered DE is made of a whole lot of broken diatoms. To an insect, these are extremely sharp, hard edges that resemble a minefield of broken glass, cutting and abrading away their waxy layered exoskeleton. Insects get severely injured in their joints and bodies. They desiccate and they die. They can't build up immunity because it is a mechanical mode of action.

Diatomaceous earth powder is blended into potting mixes to control insects at two to three per cent by volume. It can also be applied topically on the ground, applied to foliage as a dust with a puff bottle or hand-cranked blower, or mixed as a wettable powder to spray onto the top and underside of leaves. It is safe to use on food up to 24 hours before harvest, but just be sure to always wash your edibles before eating them. Even food-grade DE powder, which can be used in food production, such as mixing it with grains during storage to keep bugs away, shouldn't really be eaten (though we hear people use tiny amounts as a supplement and testify to results).

Diatomaceous earth in aggregate form is very versatile, comes with some compelling research, and is challenging traditional soil component choices in the greenhouse, nursery, potting soil, and hydroponic markets. Aggregates enjoy wide acceptance for rooftop gardens, outdoor gardens, structural soils, sports fields, landscapes, and bioswales. They can also be used in lieu of or in combination with peat moss, and mixed with sand for golf green construction.

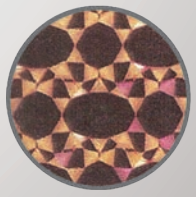
Diatomaceous earth aggregates have unparalleled physical properties designed by nature. They are 82 per cent porous and very absorbent (up to 142 per cent their weight in water), giving them great potential to influence water conservation. To help retain nutrients, they also have a cation exchange capacity of 27. Absorbed water and waterborne nutrients are readily released and available to plants.

> "**In the green industry,** natural DE powder is used for insect control, while DE aggregates improve soil function for all types of plant applications."

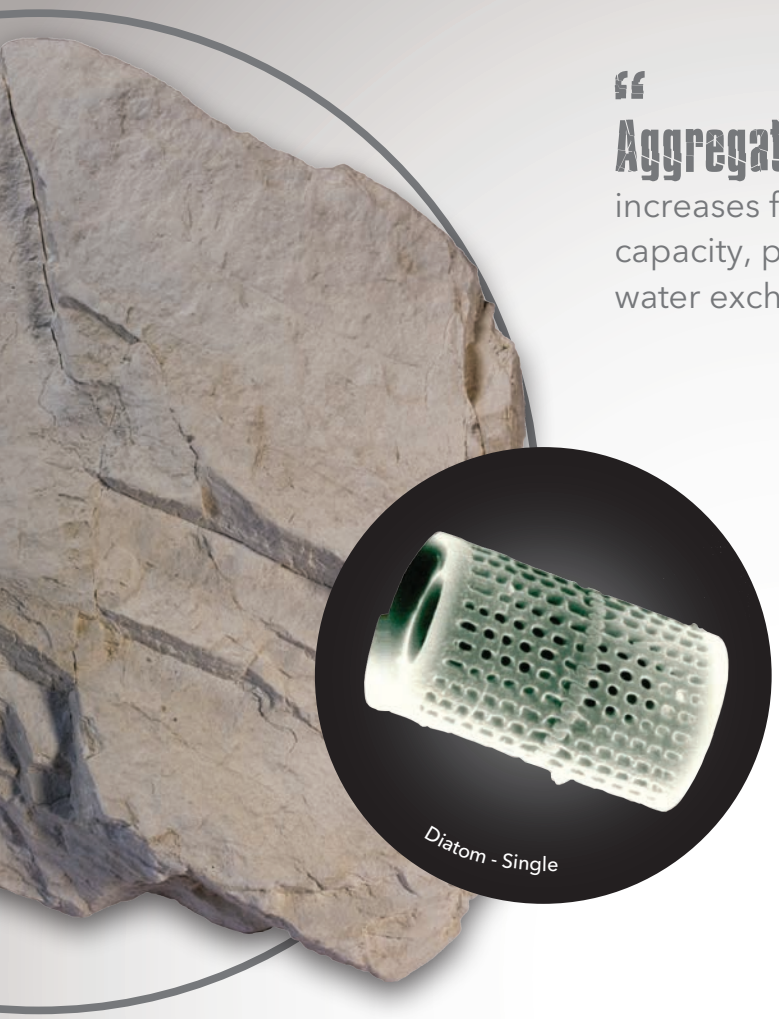
Interactive Pores

CALCINED CLAY
Absorbs 90%

CALCINED DE
Absorbs 142%



ZEOLITE
Absorbs 30%



> “**Aggregates show impressive** measurable increases for improved infiltration rates, water-holding capacity, plant-available water, and increased air and water exchange.”

Aggregates show impressive measurable increases for improved infiltration rates, water-holding capacity, plant-available water, and increased air and water exchange. They also increase porosity, serving as additional reservoirs of pore space where air and water can exchange into, and out of, the granules, unit for unit, as moisture fluctuates. This creates a much more interactive soil media for root growth, water uptake, and nutrient uptake. Aggregates promote easier establishment, excellent plant health, and legendary root mass due to increased air capacity and circulation, coupled with consistent reports of silica uptake. They are also pH neutral, and because it is a mineral source of pH, it tends to stabilise pH in soil and hydroponics. They reduce compaction, are essentially permanent, and perform long-term.

Remember how water flowed through the living plankton structures? The pores in DE aggregates have been identified by studies at the University of Augsburg as the same pore size that determines plant-available water (plants have an easier time getting water from pore spaces than from water as film on soil particles). Perhaps you've heard that if you want to reduce irrigation, just improve plant-available water. Well, DE aggregates have more plant-available water than peat moss, four times more than compost in native soil, and 90 per cent more than calcined clay from water release curves. This is worth considering if you want soil moisture uniformity and controlled wetting and drying, and if you believe in conserving water.

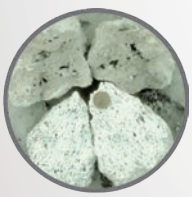
When it comes to soil water pores, there are three types: larger, free-draining pores; appropriately sized, plant-available water pores; and smaller, less-available water pores. Diatomaceous earth pores are invisible to the naked eye, so visible pores in other media indicate free-draining pores with less water retention and less plant-available water.

When we scan other inorganic choices for soil mixes and hydroponics, we see perlite, pumice, and clay spheres. (Though formerly organic, DE aggregates are inorganic amendments due to the silica transformation into a porous shape and from the kiln firing that reduces any organic fraction.) These other choices are all assumed to be porous, but the active porosity is skin deep. Only the surface pores can interact and contribute to physical activity within a mix, as the internal pores are isolated air bubbles trapped within mineral bodies. This represents a considerable amount of soil mix volume that is limited from interacting with air, water, roots, and other soil components.

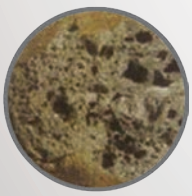
Another advantage of DE aggregates is that they do not float.

Aggregates come in a variety of sizes: larger grades (3/8 to ½ inch), which are suitable as inorganic hydroponic mediums; coarse and medium grades (3/8 to 1/8 inch) for soil mixes and potting mixes; and a fine grade (like large sand) for use with potting soils to improve soil performance, with the added potential for insect control. Some veteran growers may remember large DE chunks for hydroponics. Well, that super-size aggregate is available

Closed-cell Pores



PUMICE
Absorbs 90%



VITRIFIED SHALE
(expanded clay)
Absorbs 8-20%

PERLITE
Absorbs N/A

again and it rivals the best current mixes and inorganics. You can mix it at either 100 per cent by volume, or at 40-60 per cent and mixed with an organic. Users at these rates also remark they have less bugs.

Incorporating medium-size DE aggregates into native soils or soil mixes outdoors is a great way to ensure successful establishment of every plant. They provide permanent porosity to hard or sticky clay when mixed in at 10-15 per cent by volume. It provides excellent drought relief in hot climates and is suitable for turfgrass, trees, shrubs, gardens, and flowers. Moreover, each plant will enjoy an environment that is physically conducive to proper availability of water, nutrients, and pore space to grow.

For indoor containers, DE aggregates can be applied at 15-20 per cent by volume. Again, this will increase the water-holding capacity, homogenise moisture content throughout the pots, provide more plant-available water, and reduce watering needs. (Of course, outdoor containers with DE in the mix will experience similar results, but there will be a higher contrast between moisture levels becasue of increased evapo-transpiration.)

> “**The pores** in DE aggregates have been identified by studies at the University of Augsburg as the same pore size that determines plant-available water.”

Yes, DE is kinda cool. The porous structures are reminders of how they formed, how they work, and their modes of action. Best of all, they offer ideal solutions for plants and soils. MY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BREAKFAST OF CHAMPIONS

Nutrient Mush and Compost Teas for Your Plants

Just as you like your porridge and a cuppa for breakfast, your plants like some mush and compost tea for theirs.

Nutrient feeding "mush" and "tea" brews have been around for a while now. People that use them swear by them and will preach about them to everyone and anyone who will listen. However, not everyone is aware of them. With this style of nutrient feeding regimen making a comeback, let's have a look at what they are, what they do, how they work, and most importantly, if they work as well as people claim they do.

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Mush feeds normally come in bottle-form as a super-concentrated paste. When you buy a bottle, there is a small amount of thick mush at the bottom that must be diluted with water before use. So, for example, a one-litre bottle will have enough mush in it to make up one litre of standard concentration feed, which can then be diluted again or used as is. For the retailer, selling these mush super concentrates is very attractive, as they are cheaper to ship to both the store and the customer. Win-win all around.

Another benefit is that the mush is not fully active until it is diluted with warm water. This means that they don't necessarily have any extra preservative chemicals, which are sometimes added to standard nutrient concentrates to preserve or stabilise them.

A negative point with mush feeds is that because they must be diluted, the quality of the water used—be it hard, soft, medium, pure, RO, and so on—will affect the resulting solution. Some water may even have adverse effects on the overall quality of the diluted nutrient concentrate, so be mindful of what you use.

Mush nutrients are available for all growing mediums, but they work particularly well in deep water culture systems, such as bubblers.

Now on to compost tea. In its simplest form, compost tea is what you get if you soak a porous bag of compost in a bucket of water for some length of time. The idea is that the nutrients in the compost are transferred to the water, leaving you with a liquid "tea" containing all the goodness from the fertiliser.

Making compost tea is popular, as it is relatively easy and there are countless methods and recipes available online. If you are a seasoned indoor grower, you will probably already have most of the equipment needed to make it; however, compost tea kits can easily be bought online or at gardening stores. The good thing about DIY compost tea is that you can experiment. Try out different recipes, see what works for you, and play around to create your own super brew.

To make compost tea, you simply dilute your compost mix in water. You must also add an air line to aerate the mixture (making what is known as aerobic compost tea, or ACT for short). This makes the beneficial microorganisms—good bacteria, fungi, protozoa, and nematodes—multiply quickly, creating a rich microbial solution that enhances the soil and the plants' immune systems. The aeration process is key; without it, the organisms in the tea will use up all the oxygen in the water quickly and then die off. If this happens, the tea will become putrid, start to stink, and could harm your plants irreversibly.

> "Mush feeds normally come in bottle form as a super-concentrated paste."

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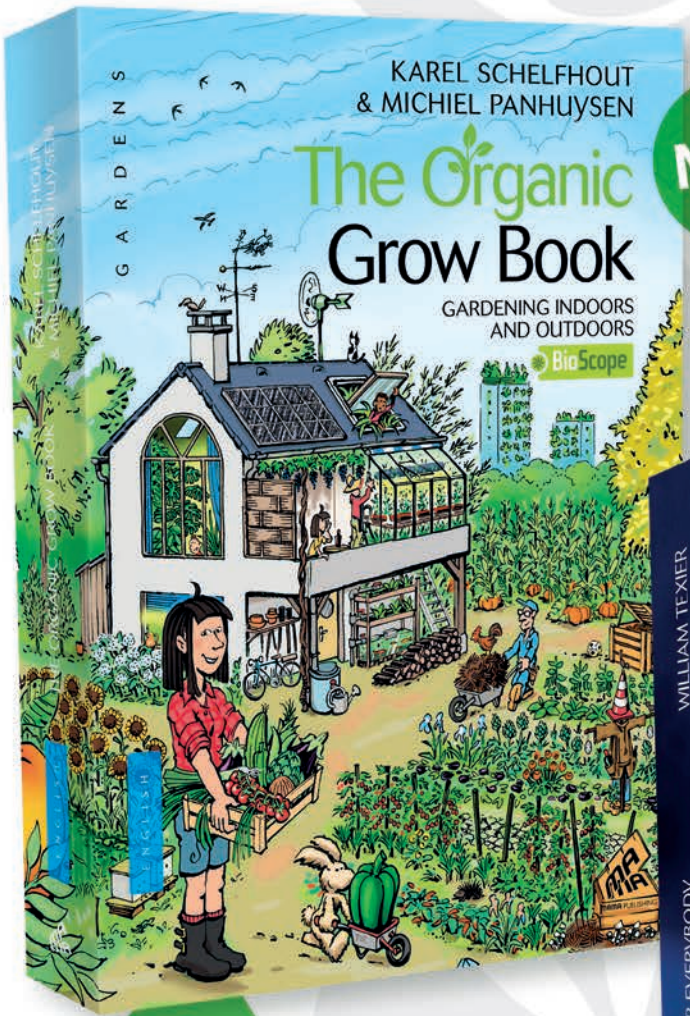

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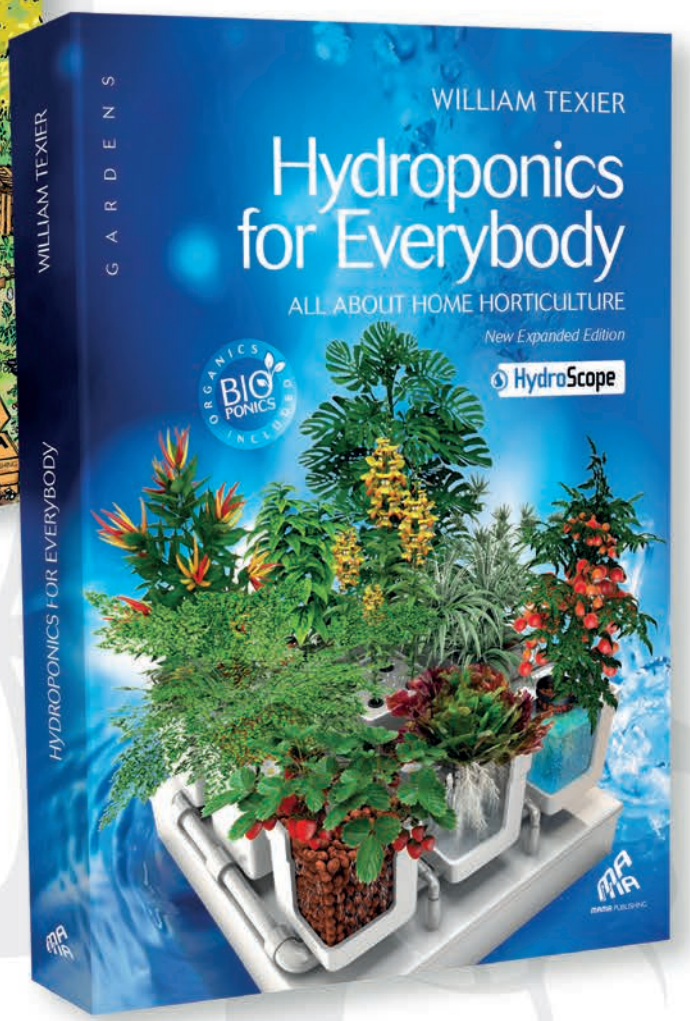

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> “Making compost tea is popular, as it is relatively easy and there are countless methods and recipes available online.”

To get the most from your tea, I would recommend brewing it with the aeration line for between three and seven days. The microbes will start to die off quickly once the air line is removed, so it is extremely important to keep the tea aerated right up until you are about to use it. Then, simply strain it and apply it.

You can buy compost tea as a dry mix or a concentrated liquid, both of which you then dilute. There are many things that can be used as the compost for these teas, ranging from animal waste to food scraps and plant matter. Some are also more organic than others. As such, the elements that make up these mixes can vary widely. So, it's worth noting what is in each one and what benefits that each can have for your plants before purchasing the tea that's right for your garden.

So, why use compost tea? There are many reasons, mainly that compost tea makes the benefits of compost go further and creates a healthy balance between soil and plant. When applied as a foliar spray to the leaves, it helps to prevent foliar diseases, increases the amount of nutrients available for the plant to take up, and speeds up the breakdown of toxins. Compost tea can also increase the nutritional quality and improve the flavour of your fruits and vegetables.

Compost teas can be used either as a foliar spray or a soil drench. It can be used in all growing systems, but is best used as a foliar spray on systems that do not use a medium such as soil.

Apply compost tea whenever you spot signs of disease or undernourishment, such as wilting, failure to flower, discoloured leaves, stunted growth, or small fruits. With foliar spray, it is best applied directly to the leaves at lights out, as UV radiation can have a negative effect on microbial life. Once applied, the microbes work to overcome the problems by combating fungi and increasing soil fertility as well as providing nutrients directly to the plant. You can apply compost tea to your plants as part of your regular feeding schedule, applying liberally to the soil and leaves once every two weeks. If you are growing edible crops, however, do not apply compost tea in the three weeks before harvest so you can be sure that you do not transfer any harmful bacteria such as E. coli to your crops through your tea.

So, there you have it: two more ways to get some extra nutrients into your plants that are well worth a try if you are looking for change or an improvement in your growing. And with all that talk of tea, why not put the kettle on for yourself too. MY

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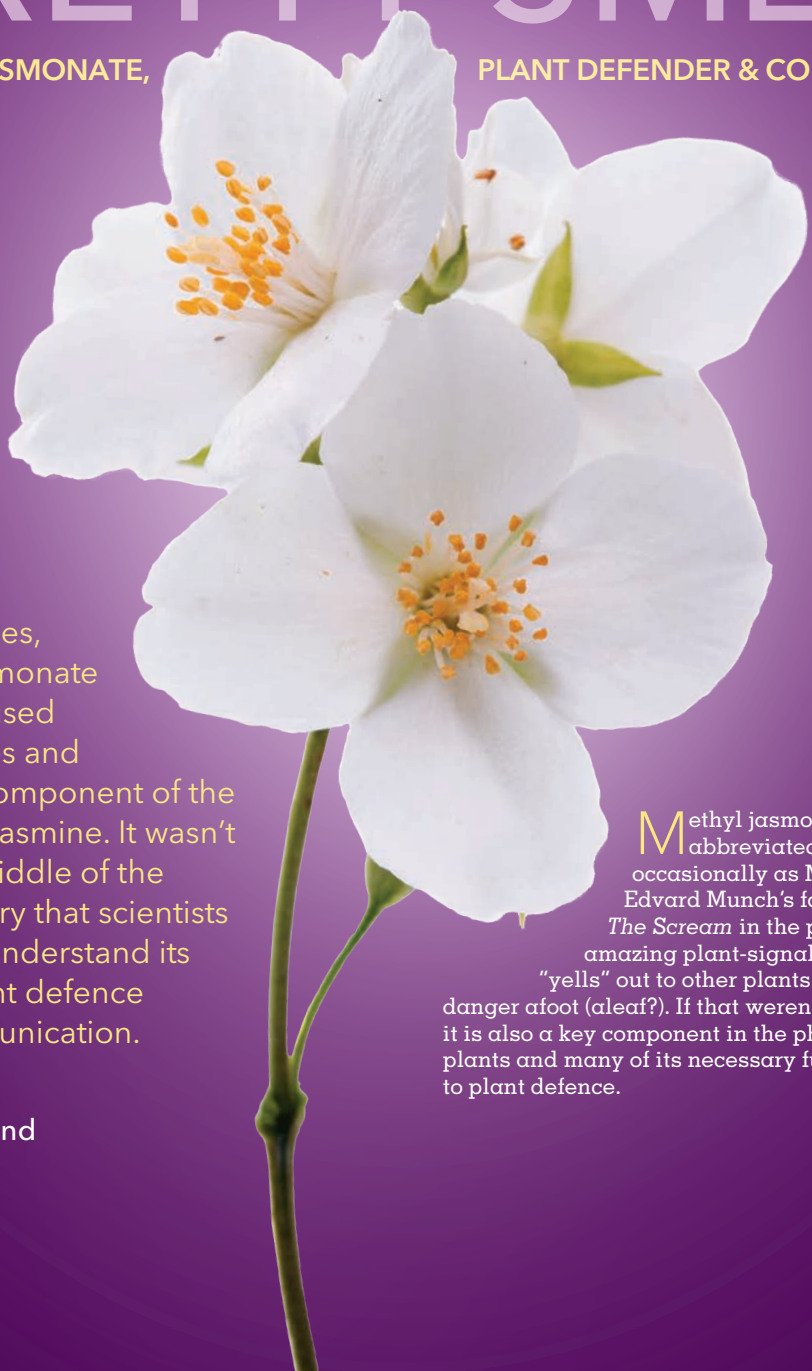
MORE THAN A PRETTY SMELL

METHYL JASMONATE, PLANT DEFENDER & COMMUNICATOR

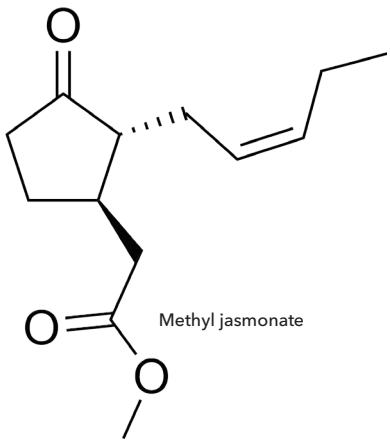


For centuries, methyl jasmonate has been used in perfumes and teas as a component of the fragrance jasmine. It wasn't until the middle of the 20th century that scientists began to understand its role in plant defence and communication.

by Chris Bond

Methyl jasmonate (usually abbreviated as MeJa and occasionally as MJ) is akin to Edvard Munch's famous painting *The Scream* in the plant world. This amazing plant-signalling compound "yells" out to other plants when there is danger afoot (aleaf?). If that weren't talent enough, it is also a key component in the physical defence of plants and many of its necessary functions unrelated to plant defence.

Let's get the biochemistry out of the way before we look at all the ways MeJa plays its many roles. Jasmonic acid (JA) is synthesised from a commonly found plant fatty acid known as linolenic acid. The release of linolenic acid within a plant leads to the production of JA and its derivative MeJa by way of the process cyclooxygenases. It is present in all healthy higher plant species.



Methyl jasmonate

METHYL JASMONATE AS DEFENCE MECHANISM

Methyl jasmonate is released when a plant is subjected to stressors. This stress may be induced by abiotic factors, such as wounding from an errant mower or damage from an ice storm, or it may be biotical in nature and caused by a predatory insect or pathogen. Whenever a plant is injured, the alarm is sounded. Methyl jasmonate is sent as a volatile organic compound (VOC) through the stomata. This airborne message is received by the stomata on neighbouring plants, signalling them to increase their own production of MeJa in preparation for whatever onslaught is about to be wrought. Amazingly, this signalling and reception can occur between plants of different species. A 1990 study at Washington State University showed this inter-plant communication between members of the *Solonaceae* (tomatoes, peppers, egg plants, etc.), *Fabaceae* (peas, beans, legumes, etc.), and *Artemisia* (wormwoods, sagebrushes, mugworts, etc.) species.

In plant predators, the effects of MeJa can range from an unpleasant digestive issue to causing cannibalistic tendencies. When MeJa is released within a plant, it causes the plant to produce other compounds known as protease inhibitors. These inhibitors cause negative, sometimes painful reactions on the invading plant pests. They may just make the plant taste "bad" to the pest, causing it to seek its meal elsewhere. In extreme cases, an abundance of MeJa will make a plant taste so horrific to a pest that it would rather eat other members of its species. A 2017 University of Wisconsin study that showed tobacco hornworms, normally herbivores, eating each other after sampling plant leaves with inflated levels of MeJa.

A 2001 German study using the same type of hornworms made another interesting discovery. It found that plants that had released MeJa in response to stress from herbivores were less likely to have those same predators lay their eggs on their leaves. In this particular study, plants that had elevated levels of MeJa had 91.7 per cent fewer eggs from predator species on their leaves than plants of the same species that had not released any MeJa.

A 1997 study conducted at Washington State University used another common pest, the fungal gnat. Several approaches were taken in an attempt to understand the complexity of the plant-signalling pathways. First, an analysis of mortality in mutant plants that had no natural ability to produce MeJa found that 80 per cent of the plants succumbed to predation by fungal gnat larvae.

"It is critical the plants absorb MeJa in order to develop and use its own defences to fend off invading insects."

> “In plant predators, the effects of MeJa can range from an unpleasant digestive issue to causing cannibalistic tendencies.”

After those same species of plants were treated with naturally occurring levels of MeJa, mortality rates dropped down to only 12 per cent. The researchers then wanted to determine if the MeJa itself was what killed plant predators. It had no effect on the fungal gnat larvae when used alone. So, it is critical the plants absorb MeJa in order to develop and use its own defences to fend off invading insects. Further, this study found that it was possible to block the wound-signalling abilities of MeJa in plants with an antisense gene, which can occur in mutant plants.

This study declared, “Jasmonate is both necessary and sufficient for plant defence.”

The ability to protect a plant from predators is not the only defence offered by MeJa. Other research has shown that foliar sprays of MeJa have antibacterial effects on plants. More research is still needed to draw positive conclusions, but it seems that the introduction of MeJa through plant stomata puts a plant on “high alert” status that can increase its ability to resist the effects of certain diseases.

A 1998 joint Canadian and American study looked at the disease response of plants affected with the fungal disease pythium. It found that JA, a component of MeJa, activated the genes that act in defence of plant pathogens as opposed to those that aid in the defence against insects. A particular defensive gene in the plant species *Arabidopsis* essentially created a protein with anti-fungal properties is equally “activated” by exposure to either a pathogen directly or by the presence of JA. Methyl jasmonate along with the compound ethylene (more on this in the next section) create a synergy in certain gene families within plants that create proteins for defence against diseases. Similar to the previously mentioned study, mutant plants that did not have natural levels of MeJa were highly susceptible to succumbing from pythium and those plants that either naturally had the ability to produce it or were given foliar MeJa treatments were able to successfully fight off or be less susceptible to the effects of the pathogen. Even more similar is that this study found that nothing happens when pythium is directly exposed to MeJa. The MeJa needed to be activated by the plant as part of its total defensive response in order to be effective against plant pathogens. A subsequent 2009 study looked at the susceptibility of corn to pythium. Similar to the *Arabidopsis* study, it found that the higher the levels of MeJa corresponded to higher level of immunity to pythium.

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“Unrelated to its defensive properties, MeJa is a hormone that plays a role in several aspects of plant development in several stages of a plant’s life.”

METHYL JASMONATE AS PLANT HORMONE

Unrelated to its defensive properties, MeJa is a hormone that plays a role in several aspects of plant development in several stages of a plant’s life. A technicality perhaps, but when it occurs as JA alone, and not the methyl ester MeJa, it might be more properly referred to as an intercellular signal as opposed to a true hormone. Methyl jasmonate aids in seed germination and root tendrilling of developing and mature plants. It plays a role in proper tassel development and maturation of ears in corn, as discovered in the 2009 study mentioned above. It is also involved in promoting tuber formation and the formation of storage proteins. It aids in flower development (specifically, anther development) and pollen production as well as seed and fruit maturation. The latter is likely due to its appearance in concert with the release of ethylene. Ethylene is a naturally occurring gas that is produced by ripening fruit, which increases the rate at which surrounding fruit ripens. Methyl jasmonate also plays a role in the dormancy of plants and seeds.

Too much of anything is, of course, not always a good thing. An abundance of MeJa within a plant can be detrimental to its proper development as well as that of its neighbours, acting as a growth inhibitor or restrictor. Plants exhibiting stress in the form of yellowing of leaves may in fact have levels of MeJa four times higher than that of a plant of the same species that has healthy, green foliage.

METHYL JASMONATE & CANCER CELLS IN HUMANS

The importance of MeJa as a defensive compound goes beyond the world of plants. It has been researched widely for many years as a viable treatment for cancer in humans. Success has been shown with the mitigation, suppression, metastasis, or otherwise inhibition of cancer cell growth in the treatments of prostate cancer, breast cancer, melanomas, and leukemia. It does this without the unwanted side effect of affecting normal human lymphocytes. These studies are fairly recent and many of them have been performed only on mice, but the plant stress hormone MeJa may yet prove to be part of an entirely new class of anti-cancer drugs. MY

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23 Years in Business

Hydroponic Generations already has beloved products in Australia and Europe where they are currently distributed. Now, it is looking for partners in Canada, US, and Asia. Owner Sandro Bombardieri explains how HY-GEN, one of Australia's longest existing nutrient manufacturers, got its start and how it has thrived since 1994.

What did you do before starting Hydroponic Generations?

After graduating from Curtin University with a bachelor's degree and post graduate qualifications in chemistry, I began working at the University of Western Australia in the botany department. I first worked in the plant genetics laboratory where I used advanced analytical techniques to examine genetic variations within an individual plant. Later, I moved into crops and pastures science where research involved aspects of plant nutrient and nutrient update variation.

How did you get into hydroponic and the nutrient business?

With a scientific understanding of plant nutrition and a keen interest in growing my own plants, as a hobby I decided to build some of my own hydroponic systems and make my own formulations. I was growing everything with great success. Friends who were also into hydroponics asked me to make nutrients for them. As time progressed I was fine-tuning some crop specific formulations. I approached my local retail store for some bits and pieces when the owner asked me if I could supply him some of my homemade nutrient to trial in his store. He supplied me with bottles to make some nutrients for him. I didn't think much of it at the time. After all, I was working at the university and it was just a hobby. Not realising that he had given the nutrients out to his best customers, I received a call from him asking me what I was doing different because it was performing better than anything else he had on his shelves. He asked me if I could make more and that he would pay me for it. Later, he asked me to make his shop brand of nutrient.

When and where did Hydroponic Generations begin?

In 1994 I registered Hydroponic Generations and created my own brand of nutrients called HY-GEN. I rented a 100-square-metre factory just outside of Perth in Western Australia.

What were the start-up years like?

I was still working full-time at the university and spent my nights and weekends making custom branded nutrients and HY-GEN nutrients for the retail market. The HY-GEN brand expanded nationally. As word-of-mouth travelled, commercial farmers started contacting me to help solve nutrient problems and to also supply nutrients. I was still working full-time at the university for some years mainly because I enjoyed scientific research and teaching.

How does your company philosophy translate to opportunities?

Educate growers to understand their plant nutrient requirements at all stages and provide the solutions to the real problems.

What did you first produce?

Hydroponic Generations first produced HY-GEN Hydro Grow & Bloom, two-part and single-part nutrients.

What were some of your struggles as you started the business? How did you overcome them?

Perth, Western Australia, is on the opposite side of the country than the bigger east coast markets, so logistics was the biggest obstacle while trying to remain competitive. It wasn't easy to make regular visits and keep in contact with clients and potential clients due to the distance and the time difference. So, we formed relationships with distributors who helped us maintain a presence while helping us solve the logistical challenges.

How did you gain market share and recognition?

The HY-GEN brand grew by word-of-mouth while Budlink became the number one market leading silica nutrient plant supplement. Budlink found its way into the UK/European market where sales have grown year after year. I started to receive pressure from customers since they knew that I'm a chemist and had the know-how to formulate high-performing quality products, which could perform better than expensive imports. As a result, we added a series of dual-purpose additives.

Has Hydroponic Generations moved or expanded since the beginning?

We moved from our small factory a few years later into a complex of factory units. Over the years, we progressively expanded taking over neighbouring units as they became vacant. Soon, we'll need to move to a completely new home because we just keep growing!

What is your current product line?

We currently manufacture HY-GEN Hydro and Coco nutrients, mineral supplements, and hybrid/organic-based additive supplements. We also produce our own calibration solutions, care solutions, and pH modifying solutions. As well, we manufacture custom commercial farm nutrients and additives.

"As a hobby I decided to build some of my own hydroponic systems and make my own formulations. I was growing everything with great success."

Where do you distribute?

We currently distribute nationally across Australia and into Europe. We're currently looking for partners in Canada, US, and Asia.

How many people now work for the company?

I must say I have the best team on the planet. We are more like family than anything. The six of us are focused on the same goals and outcomes for the company. We've recently had a new sales rep with 12 years of industry experience join us. This will help give us huge support and presence on the east coast of Australia.

What are some of your proudest moments since starting Hydroponic Generations?

- Expanding.
- People emailing us from across the globe telling how great and simple to use our products are.
- Being told that Budlink was ranked in the top 10 must-have products in *High Times* magazine. I didn't even know until customers told me.

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

Customers are the biggest asset and we wouldn't have lasted more than 23 years if our products weren't exceptionally high performing products. You can market as much as you want but the proof is in the longevity and long-term customer loyalty and demand.

What words of wisdom can you share about the business, the industry, or the future of the industry?

Stay focused on your vision and goals, shut out the noise, and run your own race! Last of all, be honest.

What makes your employees so awesome? How does your team bond?

We all work towards the same goals. It's not about work all the time. We socialise together and celebrate wins and milestones together.

Please feel free to include anything further you'd like to share.

Here's to another 23 years!!!

WHAT YOU PUT IN, **YOU GET OUT.**

If you've read *Maximum Yield* lately, you'll be familiar with author Rich Hamilton. What you may not know is that he is also the director of Machiavellian Media, which publishes, among other things, the popular Growers Guide series. We sat down with Rich to find out more about what he does when not writing for us.

What did you do before starting Machiavellian Media?

I have a long history (20-plus years) of working in the horticulture industry within a variety of different roles at various levels, specialising in the indoor/hydroponic market. Before starting this business and still today, I work for a major hydroponics distributor in the UK, Eden Horticulture.

How did you get into this industry?

I always had a keen interest in plants and gardening. I grew up messing around in my grandfather's greenhouse and seeing my own parents garden. I would help them out all the time, picking up the basics as I went along and seeing the literal fruits of their labour. Growing up in this kind of environment, it all felt very organic and natural to me as I got older to start taking on more responsibility and to follow my own interests in gardening. I got a real sense of achievement to discover new and exciting ways to grow different plants and fruit, as well as maintaining that bond and common interest with my close family. I had other jobs when I left school, but nothing really "got me." So, when I got the opportunity to combine my passion with a job at a local hydroponics store, I never looked back.

How did you start your company?

The idea for The Growers Guide books came to me about five years ago when I was managing a large hydroponic retail store. I suddenly realised that I had all this knowledge and was forever talking to customers, advising them and giving them tips and recommendations when they came into store. It struck me just how often I would get asked the same questions and how often we would get customers who were just starting out, who needed to know so much. Having read the hydroponic guide books that were available, it seemed like the right time to put out an easy-to-read, accessible, comprehensive guide covering everything from seed to harvest for the indoor grower.

What did you first produce?

The first book that I wrote was *The Growers Guide: Coco Coir and Soil*, showing how to grow in coco and soil using a hand-fed, run-to-waste system. I chose this as my first publication as it seemed a good system to start with, considering its popularity and ease of use. It also covers lots of the fundamentals of the whole indoor growing experience that you would need to know if you were to move on and use a different system.

What other books are in The Growers Guide series?

Currently, we have three books in The Growers Guide series: *Coco Coir and Soil, Bubblers DWC, and Organics*, which have all been published through Machiavellian Media. We have another book due out later this year based on passive watering systems. We currently have lots of other exciting projects in development, one being a series of indoor gardening audio books/guides.

Where do you distribute?

Throughout the UK via Eden Horticulture and online via Apple iBooks/iTunes.

What have the start-up years been like?

The business officially started last year when I published the first three books in The Growers Guide series. The business is still very young and is still evolving. It is all things on any given day, uncertain, daunting, exciting, and rewarding. That is part of the ride though and so far, I am enjoying it.

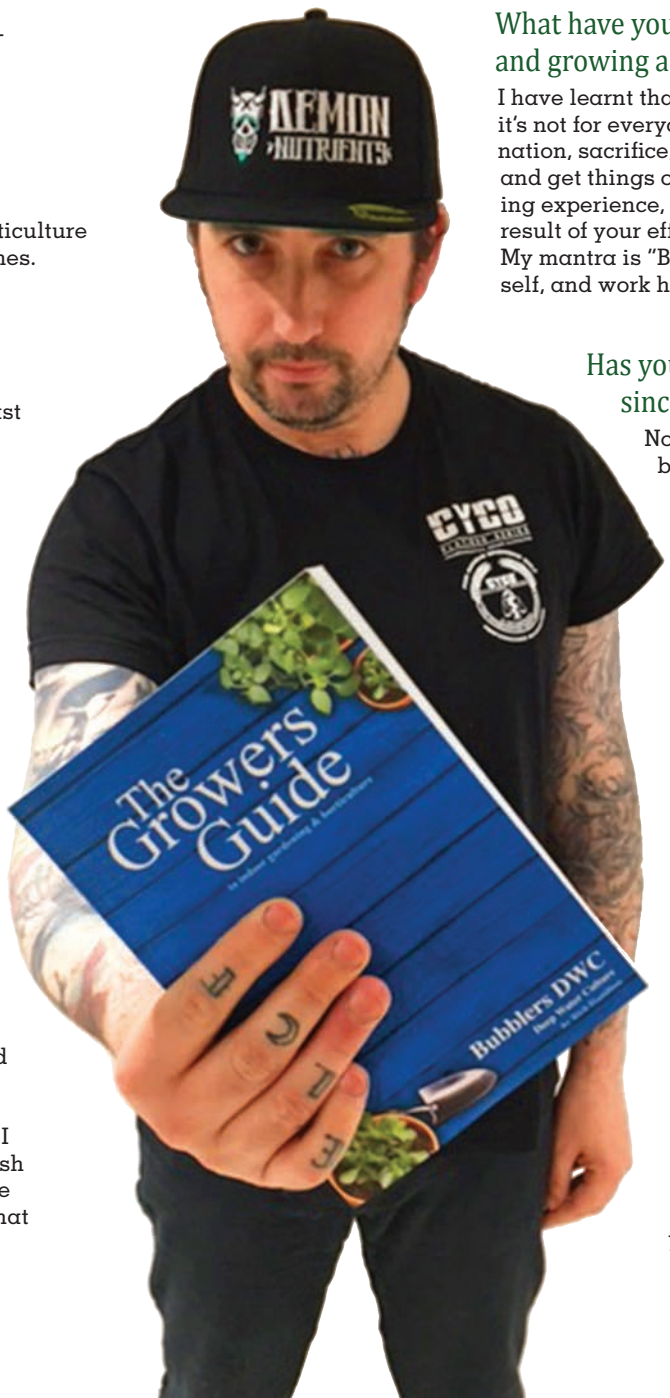
What were some of your struggles as you started the business?

My biggest struggle was trying to find a publisher for the book. After exhausting many avenues while trying to secure this, I decided to take a big step. Knowing little about book publishing, I decided to take the plunge and start my own publishing company, so Machiavellian Media was born. I have since raised funds to publish the first three installments of The Growers Guide. It's something that I am immensely proud of.

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

I have learnt that in this industry, there are many different opinions and characters. I have learnt that to build business and personal relationships effectively, you have to respect everyone's opinions, needs, and beliefs and most importantly, listen to them. To build a genuine rapport, you can't use a scripted sales pitch or be fake, as it will be spotted a mile off and you will never earn anyone's respect. I always try to take the time to get to know people, listen, and understand where they are coming from, which usually leads to some really interesting conversations, ideas, and points of views that I may not have considered before. It's a bonus for me also as it means I am always learning and gathering more knowledge.

> "I travel around visiting stores, attending trade shows nationally and internationally, and just trying to be a positive presence representing my brand and its values."



What have you learned about starting and growing a company?

I have learnt that it is bloody hard work and that it's not for everyone. It takes real passion, determination, sacrifice, and understanding in order to try and get things off the ground. It is such a rewarding experience, however, and seeing the end result of your efforts makes it all worth the while. My mantra is "Be true to yourself, believe in yourself, and work harder than everybody else."

Has your company expanded since the beginning?

Not as yet, but we had a new office built in the same location to accommodate an audio sound booth as well as a meeting area.

What are some of your proudest moments?

Without doubt, being published as a freelance writer in *Maximum Yield* around the world has been a real highlight. It is one thing to believe in yourself, but when you have recognition from an industry powerhouse such as *Maximum Yield*, it does reinforce those beliefs and removes any little traces of self doubt that you may have had in yourself.

Please feel free to include anything further you'd like to share.

Knowledge is power. If you want to be a better person, open your self up to learning, however young or old you are. MY

distributors

retail stores listed alphabetically by city 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 Place,
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
+61 (07) 3354 1588

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

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

Earth & Colour Vertical Gardens and Hydroponic Supplies
1/43 CorporationCircuit
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
+61 (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

Hunter Hydro
2/44 Alliance Ave.
Morisset NSW 2264
(02) 4972 6872

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

Hyalite Moorebank
6/376 Newsbridge Rd.
Moorebank NSW 2170
(02) 9824 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 6511

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 Cuttings
Shop 2/273 Anzac Parade
Kingsford NSW 2032
(02) 9663 0473

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 Close
Somersby NSW 2250
(02) 4340 0339

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

Home Grown Aquaponics
13/8a-8b Hartley Dr.
Thornton NSW 2322
(02) 4028 6388

Warrawong Hydroponics Centre
Shop 2B - 72 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
0478 735 165
darwinhydroponics.com

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
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
5/11 John Duncan Crt.
Varsity Lakes QLD 4227
(07) 5593 7385

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

HydroMart Hydroponics
4/12 Natasha St.
Capalaba QLD 4157
(07) 3823 3169 & (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
+61 (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 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
(61) 8 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) 82682636

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, S.A 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

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

A-Grade Hydroponics
60/148 Chesterville Rd.
Cheltenham Vic 3189
(61) 422 064 904

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

Bayside Hydroponics
5/9 Rutherford Rd.
Seaford, Vic 3198
(03) 9775 0495

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
045 996 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

Epping Hydroponics
10 Dilop Dr.
Epping Vic 3076
(03) 9408 4677
eppinghydroponics.com.au

Excel Distributors Pty Ltd
2/41 Quinn St.
Preston Vic 3072
(03) 9495 0083

F.L.O.W. Plants and Environments
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by Philip McIntosh

10 facts on...
STRIGOLACTONES

STRIGOLACTONES are a class of hormones with limited and somewhat unusual roles

STRIGOLACTONES (SLs) Are they hormones or are they not? It depends on where you find them, but they definitely affect plants.

THE NAME of the hormone comes from the plant genus *Striga* (witchweed), which, along with *Orobanche* (broomrape) is a root-invading parasite of other plants. Strigolactones secreted from the roots of host plants stimulate germination of *Striga* and *Orobanche* seeds.

DERIVED FROM carotenoids, SLs are terpenoids. Terpenoids, which are similar to terpenes, are very common organic molecules and there are many known structures, but only a few occur naturally in plants.

THE SPORES of some mycorrhizal fungi are induced to germinate by SLs and in other cases, SLs stimulate branching of fungal hyphae. Hyphae are the elongated thread-like cells typical of most fungi (other than yeasts).

UNLIKE OTHER hormones such as auxins, which have diverse and complex effects on plants, SLs have a more limited and specific suite of activities.

ROOT-EXUDED SLs not only stimulate germination of parasite seeds; in some cases, they act as a homing signal for root parasites to grow toward.

THE FIRST SL, strigol, was isolated from cotton root exudates in 1966. But, a phytochemical having its affect outside the plant body does not qualify as a hormone.

RESEARCH SUGGESTS that SLs do have hormonal activity though. Experiments have shown that SLs influence the development of axillary buds and inhibit the branching of stems.

STRIGOLACTONES released into soils also assist mycorrhizal fungi in initiating a mutualistic relationship.

TECHNICAL SEMANTICS aside, the most well-known effects of SLs take place not inside the plant body but in soil.

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