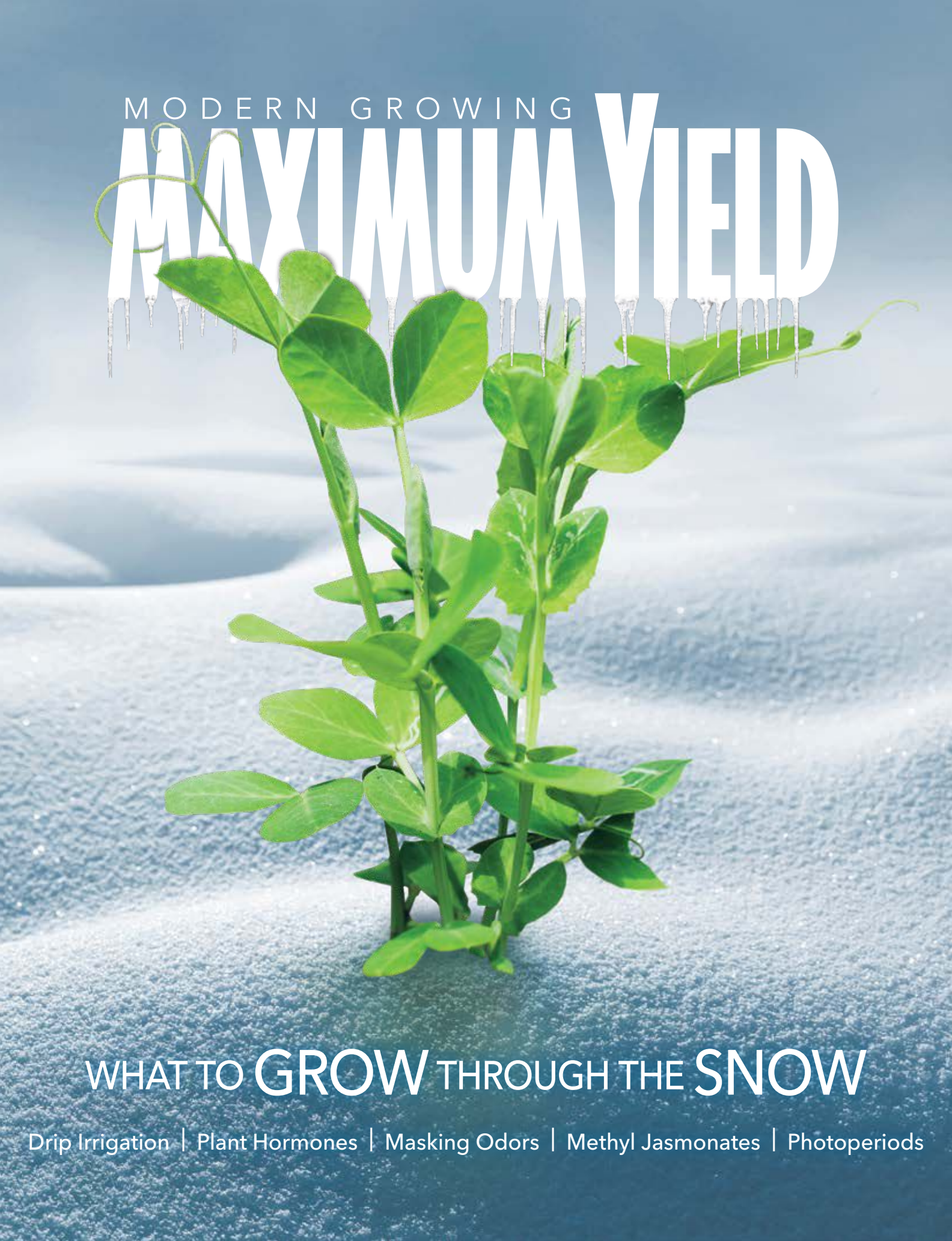
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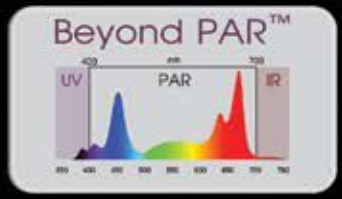

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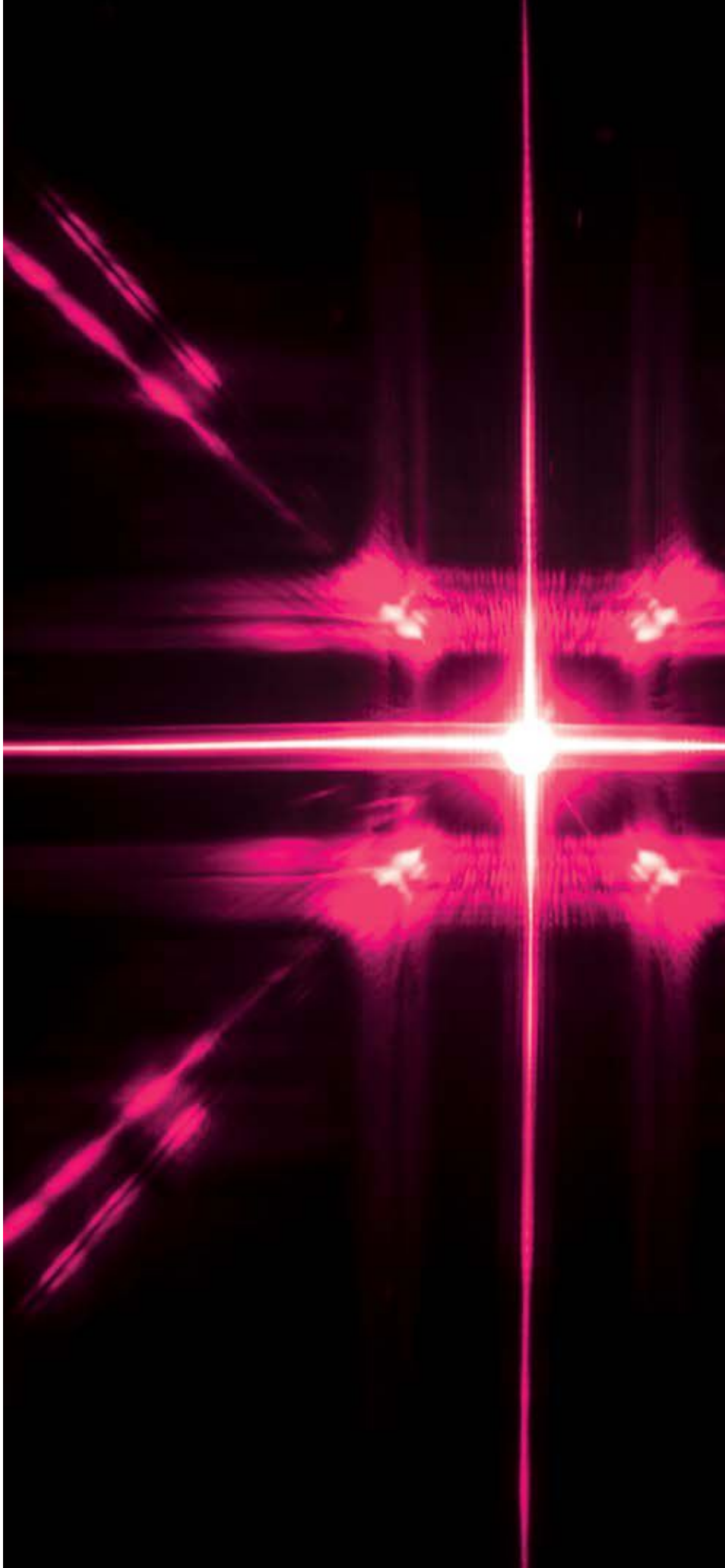

CONTENTS

First Feed

Tapped In

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CONTENTS

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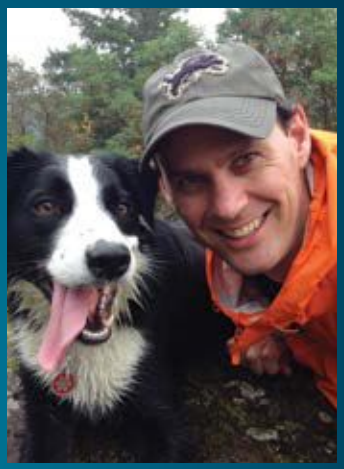

“Plants also communicate to us, if we as growers are paying attention.”

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 October issue of *Maximum Yield*, Philip McIntosh, in his “10 Facts On Jasmonates” (page 153), 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 titled “More Than a Pretty Smell: Methyl Jasmonates” on page 120, 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 signaling 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,” 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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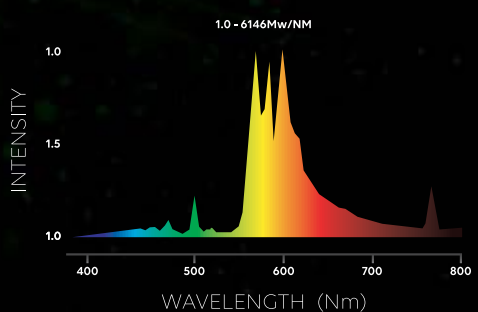

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WILEY GEREN is a passionate writer, teacher, researcher, and entertainment enthusiast. Graduated from Florida State University with a bachelor's degree in English along with a minor in business, he researches and writes gardening articles with *gardeninminutes.com* and technical/academic/creative pieces for Circa Interactive. He hails from central Florida where he continues to contribute meaningful, quality content alongside his regular Disney column, The MT Lott Expert.

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.

ERIC HOPPER'S past experiences within the indoor gardening industry include being a hydroponic retail store manager and owner. Currently, he works as a writer, consultant, and product tester for various indoor horticulture companies. His inquisitive nature keeps him busy seeking new technologies and methods that could help maximize a garden's performance.

PLUS:

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Sam Wilder, program manager of the Garden at AT&T Park, and Hannah Schmunk, manager of Food Education for Children, donate produce from the Garden at AT&T Park to families staying at Family House. Photo Credit: Karen Banks, director of the volunteer program at Nancy and Stephan Grand Family House.

via *@giantsgarden*

We've been saying this for years and will keep sayin' it! The goal is to be self-sufficient!

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In response to: *Is Controlled Environment Agriculture the Answer to a Global Food Crisis?* Via *Max_Yield*

Cococoir, perelite, earthworm castings, and mycorrhizal fungi.

@Coinex

In response to: *What Makes a Good Potting Mix?* Via *Max_Yield*

Grow Tip Tweets

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Via @HumicHarvest

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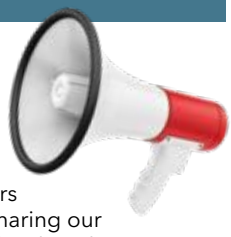

We'd like to give special shout-outs to Bee Happy Farms, Grow Masters, The Grow Hub, and The Growers Guide for regularly sharing our posts with their Facebook and Instagram followers. For a full list of shops that carry *Maximum Yield*, check out our distributors guide starting on page 141.

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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Game-changing issue, love it.

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In today's economy, it's tough to find any value in something that doesn't cost at least a little something. *Maximum Yield* magazine, however, has value and costs nothing. That is rare nowadays. Good for you, MY.

Michael G.

Coco coir is a natural product made from the inner fiber of the thick husk that surrounds a coconut. It's rot-resistant, durable, and lightweight.

Barbara Shaw
Maximum Yield, *October 2017*

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Q I'm a novice grower, but my cucumber plants are producing a ton of flowers—clusters of two or three big yellow blossoms with tight internodal spacing. It seems like a lot to me. Should I pinch some of them off? All of them? Should I be concerned about future pollination if I do?

Thanks for any advice you can offer,
Matt R.

A *Hi Matt,*

Cucumber plants that are healthy and growing vigorously under good conditions can develop an excessive number of flowers—far more than the plant can successfully carry through to fruit maturity—particularly, early in the plant's life. Often, if left to their own devices, the plant will naturally abort a number of small fruitlets, leaving only those that can be supported.

However, flowering/fruitlet pruning depends very much on the type of cucumber you are growing. The small Lebanese or snacker cucumber varieties produce smaller fruit, so growers typically allow two to three fruits to set at each node as the plant can easily support these. If growing the large, seedless, continental greenhouse types—sometimes called European, Japanese, or English cucumbers, and are the most commonly grown hydroponically—then all the flowers should be female as the plants are gynoecious (that is, they only produce female flowers as pollination is not required to set and produce fruit). In this case, the small fruitlets, which have flowers attached to the end, would be thinned to one per node. If you are growing the seeded American slicer or other similar large-fruited and seeded cucumbers, then the plants need both male and female flowers for pollination to occur. Often, early in the life of a seeded cucumber type, it will first produce a large number of male flowers. These are flowers that don't have the small cucumber fruitlet at the base as female flowers do. In this case, excessive male flowers can be removed until the first female flowers are seen. Then pollination can occur. For large-fruited, seeded cucumbers, ideally only one fruit per node should be allowed to develop. You can wait until after pollination has occurred and the small fruitlets have started to grow before selecting the largest fruitlet to grow in each node.

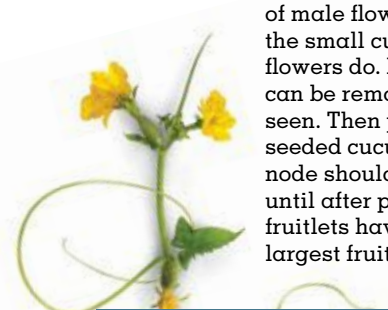
A quick side note: Often, not all the flowers will pollinate if there are multiple flowers in each node. (Also, some of these flowers will be male and naturally fall anyway.) If growing in a greenhouse or indoors, there also may not be any insects to carry out the pollination process. In this case you will need to transfer pollen from the male to the female flowers. Since this is a time-consuming process, most hydroponic growers prefer the seedless/gynoecious cucumber varieties that set seedless fruit without the need for pollination.

Overbearing can be a problem in many cucumber varieties when under good growing conditions. This can lead to the plant become exhausted and aborting flowers and fruitlets later on. So, to improve fruit size and keep the plant cropping for longer, the number of fruit is controlled with fruitlet pruning where required. Remember that initially, the first few fruitlets on the plant may wither and fall. This is a normal process for many varieties. The plant will set and carry fruitlets further up the vine once this has occurred and it's no cause for concern.

Good luck with the cucumber plants!

Kind Regards,
Lynette Morgan

Dr. Lynette Morgan holds a B. Hort. Tech. degree and a PhD in hydroponic greenhouse production from Massey University, New Zealand. Lynette is a partner with Suntec International Hydroponic Consultants and has authored several hydroponic technical books. Visit *suntec.co.nz* for more information.



PARTHENOCARPIC

Parthenocarpic cucumbers are hybrid plants that have been bred with emphasis on the incompletely dominant gene Pc, which allows these varieties to produce fruit asexually. They produce few or no seeds. Any seeds that do ripen will not be fertile. Parthenocarpic cucumber seeds must be sourced annually. Parthenocarpic cucumbers are nearly all gynoecious, meaning that they only produce female flowers. Not all gynoecious cucumbers are parthenocarpic, however.

– hunker.com

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Golden Gate Produce Market Completes $8M Transformation

The Golden Gate Product Market, the largest and busiest produce terminal in northern California, recently announced the completion of a major upgrade to the facility. The expansion comes just in time to cater for burgeoning growth. To recognize the completion of the project, Market and Vista Solar, the Bay Area firm that designed and managed the installation of the solar panels, hosted a celebration with customers and employees. The event featured remarks from U.S. Representative Jackie Speier, South San Francisco Mayor Pradeep Gupta, and Produce Board Member Steve Hurwitz, CEO and founder of Bay Area Herbs. "The project has taken four years from conception to completion," says Hurwitz. "The original facility was built 57 years ago and at the time, it was a state-of-the-art facility serving the needs of the fresh produce industry. A lot of things have changed since then in regards to food safety, cold storage, trucking, as well as the issues of climate change and other environmental concerns."

–freshplaza.com

Puerto Rico Farmers Face Total Loss From Maria

José Roig, 56, tried to stay positive as he surveyed his 150-acre coffee plantation clinging to the steep, storm-scoured hillsides near Puerto Rico's southern coast. Hurricane Maria's winds of more than 150 miles per hour ripped away nearly all the leaves on the once-lush tropical landscape, twisted tree trunks, and exposed Roig's shade-loving coffee plants to the sun. "What took 35 years to build was lost in 10 hours," Roig says. Puerto Rico's agricultural sector was decimated by the storm, and government officials agreed that a full recovery from Maria's blow will require federal assistance. Carlos Flores Ortega, Puerto Rico's secretary of agriculture, says the area around Roig's farm, near the southern port city of Ponce, is known for plantains, bananas, papayas, coffee, and citrus crops. He estimated the island lost 80 per cent of its crops.

–usatoday.com

Nation's Largest Commercial Hydroponic Greenhouse to Open

The nation's largest hydroponic commercial greenhouse will open in Monroe County, New York, Gov. Andrew Cuomo announced recently. Clearwater Organic Farms, LLC, will build a 15-acre, 650,000-square-foot facility to produce organic baby leaf greens at Eastman Business Park in Greece. The state-of-the-art facility is expected to be completed by the end of 2017. According to a release from the governor's office, the project will create 137 new full-time jobs, most of which will be in packaging, shipping, receiving, and warehousing; 55 of those jobs are reserved for veterans or those who are underemployed. Seeding, growing, harvesting, washing, packaging, and cold storage will all be done in the indoor facility. Sophisticated computer systems will control plant growing conditions, plant quality, and energy usage. The facility will use 90 per cent less water and 20 per cent of the land used to produce field grown alternatives, the press release says.

–democratandchronicle.com

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Florida Squash Recovering After Being Hit By Irma

Despite suffering the effects of Hurricane Irma, Florida squash growers are looking at a solid winter crop, though it will be late. "We lost 100 per cent of the squash in the hurricane, so while we're on time with our summer squash, our winter squash will be a little late because we lost everything in the ground," says Steve Veneziano of Florida-based Oakes Farms Inc. "We replanted hard squash five days after the hurricane, so we'll miss the Thanksgiving run, but we'll be there for Christmas." Oakes harvested its summer squash and is currently harvesting winter squash. In total, Oakes grows 700 acres of zucchini, 300 acres of yellow squash, 200 acres of acorn squash, and 275 acres of kabocha squash in south Florida. "We've really changed some of the ways of our farming practises—just a couple secrets with our growing practices to rebuild that soil health," says Veneziano.

–freshplaza.com

Eating Sprouts May Make Breast Cancers Treatable

New research suggests that eating sprouts can make aggressive breast cancers treatable. According to the study, the compounds present in cruciferous vegetables, such as sprouts, can turn off genes for ER-negative forms of the disease. All breast cancers are either estrogen receptor(ER)-positive or ER-negative. The tumors in ER-negative breast cancer are likely to respond less to hormone therapy than that of ER-positive, making ER-negative breast cancers typically very aggressive. Sprouts contain a compound known as sulforaphane. It turns off tumor genes that influence the development of cancer. Polyphenols present in green tea have also previously been shown to prevent and treat ER-negative breast cancer in mice. The researchers analyzed mice with ER-negative breast cancer after giving them the two compounds found in the foods. Results reveal that the mice that took the compounds found in cruciferous vegetables and green tea converted aggressive breast cancers into more treatable tumors.

–freshplaza.com

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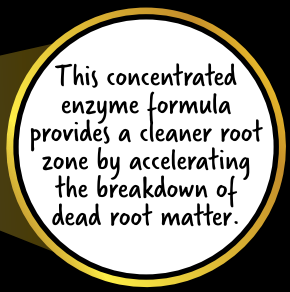
If enzymes are not listed on the label as active ingredients, there is no guarantee that the product contains enzymes.

3rd party lab tests validate each active ingredient before it's claimed on the label.



ARE CLAIMS TO BENEFIT THE ROOT ZONE ON THE LABEL?

If the label does not contain claims to positively affect the root zone, it may be classified as an external equipment cleaner and should NOT be applied to your plants or nutrient mix.

DOES IT PASS THE TISSUE TEST?

The tissue test is the easiest way to check if the enzyme formula contains cellulase. Pour some product into a jar and add a sheet of tissue paper. If the tissue disintegrates after 24 hours, then it contains at least one enzyme (cellulase) that benefits your root zone.

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Students Learn High-tech Gardening

Students at an Oceanside school in San Diego are getting a taste of high-tech agriculture through a school farm that includes plants grown without soil, or fertilized by fish. At Palmquist Elementary School, kids are learning how to germinate plants, manage irrigation, and use state-of-the-art farming systems. And they're producing food for their own cafeteria and local restaurants in the process. In the school greenhouse, Swiss chard, cilantro, strawberries, and watercress grow in hydroponic systems, using less water and space than conventional farming methods. Tearing off a leaf of watercress, student Keilah Goodwin noted that it tasted peppery. "I think it's a pretty interesting way of planting," says fifth-grader Devin Stadyx, 11, while working on a row of hydroponically grown chard. "You might want to know that none of this is dirt. It's rocks or water."

–sandiegouniontribune.com

Hydroponics Could Feed Moon Settlers

New data from the Japan Aerospace Exploration Agency (JAXA) has uncovered a 30-mile-long tunnel under the moon's surface, likely the relic of long-ago lava flows. This latest find appears to be both mostly intact and sufficiently large enough to potentially serve as a habitat for future lunar settlers. There are still a few challenges to be worked out though, most pressing of which is the question of supplies. Constantly shuttling food and water to the moon would be difficult, so settlers would need their own sources of sustenance. The moon likely contains water ice, which could be converted into drinking water and even fuel, but food production would require off-world agriculture. There are a few models for this, based largely on hydroponics, but it's a task that hasn't been seriously attempted yet.

–discovermagazine.com

Patent Filed on First Hurricane-resistant Greenhouse

Alquimi Renewables, LLC and its EPC division, Clarusys, announced recently that it has filed for US and international patents on the first hurricane-resistant commercial-scale greenhouse structures. The system was engineered specifically to address the challenges in agricultural production in high-risk climate areas such as the Caribbean and Pacific Islands, which are threatened each year by hurricanes and typhoons. The system will withstand up to Category 4 hurricane strength (Saffir-Simpson scale) with sustained winds up to 156 miles per hour. The greenhouse structure utilizes galvanized steel frames, double-walled polycarbonate panels, and the patented ground screw anchoring system. Additionally, a wind-deflection system and hurricane-resistant racking and tracking systems for the solar panels are integrated into the overall design. "For the first time in history, new technologies in greenhouse structural engineering… will allow us to develop commercial scale fresh food production in regions that have been limited to relatively small-scale outdoor farming," says Ralph Birkhoff, one of Alquimi's principal partners.

–freshplaza.com

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Fitzwilliam Geographer Wins Food Geographies Dissertation Prize

Cambridge graduate Hannah Gillie (Geography 2014) was recently awarded first place in RGS-IBG Food Geographies Undergraduate Dissertation Prize. Hannah's dissertation, titled "Neighbourhood to Agrihood: Exploring the extent to which urban agriculture can support inclusive redevelopment in Detroit," impressed the panel in terms of its scope, ambitions, and achievements, as well as the breadth of engagements she achieved with research partners. The Food Geographies Working Group aims to bring together geographers who study all aspects of food, from across the breadth of geography's sub-disciplines, and to raise the profile of geography as a key voice in food-related research, policy, knowledge, and action. In her study, Hannah answers the question, "Detroit may be America's hub of urban agriculture, but what does this mean for redevelopment in the city?" Hannah currently serves as president of the Cambridge University Geographical Society.

– fitz.cam.ac.uk

Labor Shortage in Ag Fueling Technology

A severe labor shortage in the agriculture industry drove much of the discussion at the 2017 Forbes AgTech Summit that was held in downtown Salinas this summer. The summit, now in its third year, is an annual event that brings together business leaders and entrepreneurs in agriculture and technology. In a panel discussion on the future of agriculture, Bruce Taylor, CEO of Taylor Farms, one of North America's largest fresh fruit and vegetable producers, says the matter is critical. "It's not a shortage of labor; it's no labor. For the most part, the second-generation folks here do not want these field jobs and the current labor force is aging. We have to create tools that lead to better jobs in our industry." Brian Antle, president of PlantTape USA, agreed. "It's no big secret … We have a huge need for labor and we are faced with a labor force reaching retirement age," he says.

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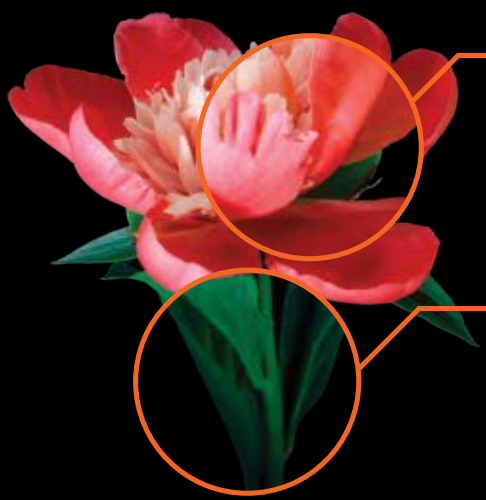

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SANlight S4W

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 color impression for comfortable working. Typical power consumption is 140 watts. Typical applications are powerful assimilation light and for all stages of growth

Arborjet Mn-jet FE

Mn-jet Fe offers a balanced source of micronutrients for alleviating interveinal chlorosis. The new formulation contains two per cent water-soluble iron, two per cent water-soluble manganese, one per cent soluble potash, 0.5 per cent water-soluble zinc, 0.1 per cent water-soluble copper, and 0.1 per cent boron. These are higher levels of micronutrients than comparable products. Mn-jet Fe may be applied as formulated or diluted with water. Its liquid formulation mixes easily into solution and may be applied through both micro- and macro-infusion equipment, or as a foliar spray for shrubs and groundcovers. Test treatments have shown Mn-jet Fe significantly reduces the impact of interveinal chlorosis in trees from just one treatment. Mn-jet Fe may be used at a 1x rate in the summer or up to 3x rates in the fall. Mn-jet Fe is available in one-liter containers and in case quantities. One liter treats 20 trees at the low rate.

Sun System 1 Etelligent Digital Lighting Controller

The Sun System 1 Etelligent Digital Lighting Controller enables the grower to control up to 400 fixtures. It features an industry-first ability to control both the Sun System 1 1,000W and Sun System 1 LEC 315W Etelligent ballasts, operating on separate channels, with the same controller. This two-channel controller allows daisy-chaining of up to 200 fixtures per zone. It enables complete control of your growing environment with timed on/off switching, sunrise/sunset, accurate temperature readings with dual thermal probes, and thermal-threshold auto dim-shutdown for additional protection. The complete kit includes one Etelligent Controller, one five-foot universal power adapter cable, two 16-foot signal wires with ferrites for connection from controller to ballast, and two 16-foot temperature probes. The Sun System 1 Etelligent signal wire for daisy-chaining is sold separately.

Aprilaire Humidity Control Systems

Aprilaire humidity control systems are tailored to the specific, tightly monitored applications required by indoor growers. Aprilaire has been an innovator and leader in climate control for 60 years, with a reputation for high-quality, reliable products. With equipment designed for both the growing and curing stages, Hydrofarm's line includes dehumidifiers ranging in size from 70 pints per day to 130 pints per day, humidifiers, touchscreen WiFi-enabled programmable thermostats, digital controllers, and more.

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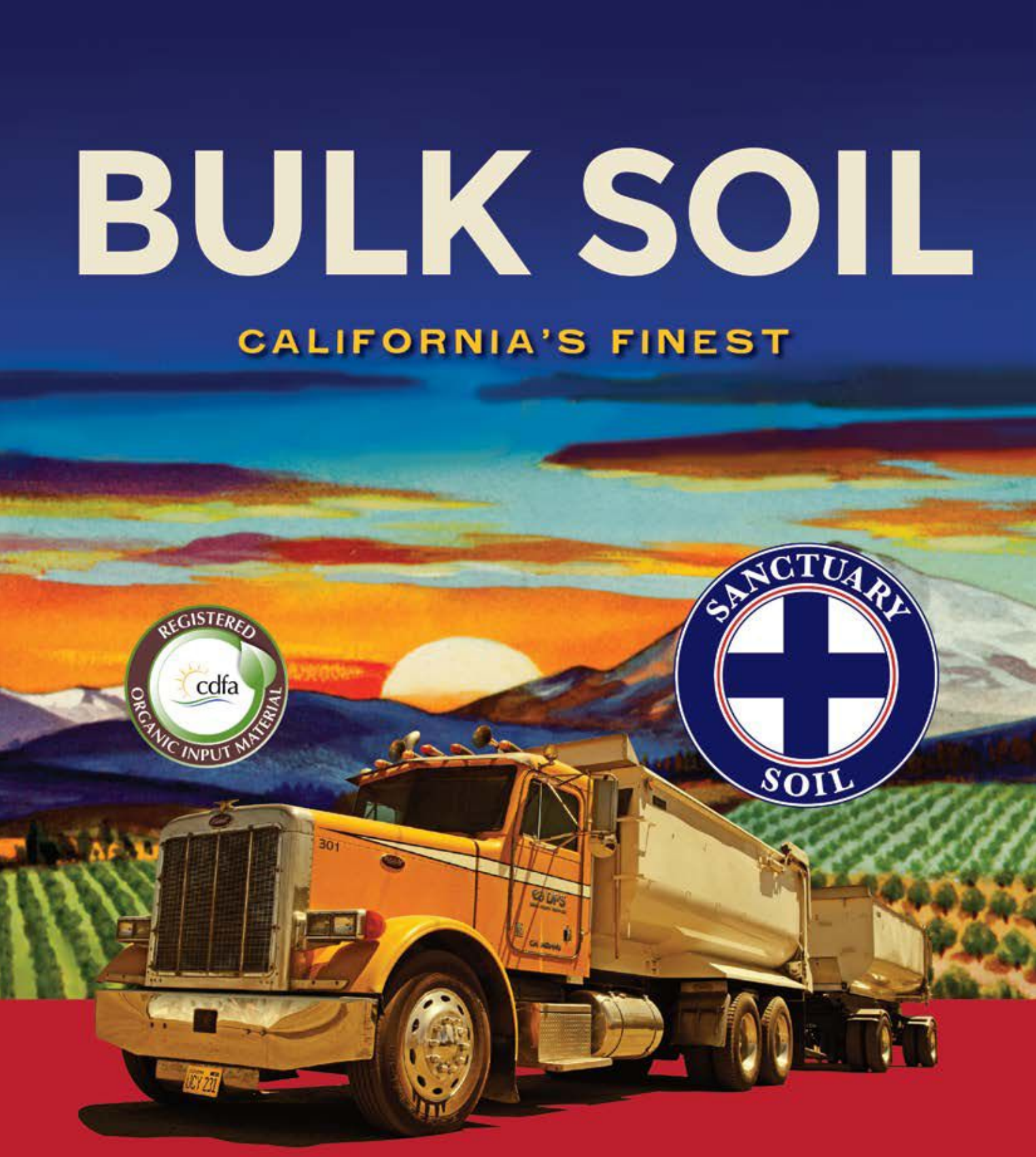

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Climate Control Solutions Ozone Pro System

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 sterilizing irrigation waste water for greenhouse flower and vegetable crops. The Ozone Pro systems are available for water flow rates from 10-1,000 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 fertilizer costs, and removes bacteria and recycles your nutrient water.

13Essentials Fertilizer

13Essentials is a balanced, nanoscale foliar fertilizer specially designed to increase the overall growth and health of your indoor and outdoor plants. It can be used as a seed germination activator in addition to its primary function as a foliar fertilizing spray. The unique formula contains silica as well as 12 other nutrients to maximize results yielded in soil, hydroponics, and in soilless media. 13Essentials is a safe, non-toxic formula derived from naturally occurring minerals. You will see the difference in quality, size, and health of your indoor/outdoor plants in just a couple applications. 13Essentials can benefit any indoor or outdoor grow environment. The company wants to be at the forefront of providing growers with a reliable, trusted, fast-performing product to produce high yield and quality produce, naturally.

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10 Week Flower										10ml		
12 Week Flower												10ml

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NovaGreen Soil Mix

Soil Mix is a unique blend of rich organic materials from humic acid, a natural wetting agent, 17 natural L-amino acids, and porous clay, plus 548 billion beneficial soil rhizobacteria in each pound of material. It can be incorporated into any soil or soilless media to increase organic matter and the cation exchange capacity (CEC). This will improve the general nutrient-holding capacity of the soil, making fertilizers more efficient. In addition, *Bacillus subtilis* will quickly populate the soilless media and subsequently colonize plant root hairs. This provides active communities of soil microbes that stimulate rooting and improve the nutrient availability and diversity of soil microbes. The humic, kelp, and L-amino acids provide additional food sources for soil bacteria and plants. The Soil Mix can be used for all type of plants, from initial seeding through sizing up, or applied as a side dressing for outdoor field crops. It contains a natural, highly effective wetting agent from yucca that helps penetrate even the toughest, compacted soils. The USDA has certified this product as Biobased, containing verified amounts of renewable biological ingredients.

SANlight P4W

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.

Xtrasun CMh 315W

The Xtrasun Ceramic Metal Halide (CMh) Ballast features low-frequency, square-wave technology designed specifically to run high performance 315W CMh lamps. With multi-aspect protection circuitry, internal RF shielding, and versatile 120/208/240V input voltage, the Xtrasun CMh Ballast operates silently and works remotely, up to 30 feet from the reflector. Comes with an eight-foot power cord.

Hydro-Enhance

This new product created from an old, proven formula passed on to our family is now available to you. Hydro-Enhance is a unique blend of beneficial microbes and a secret all-natural catalyst invented by James Francis Martin, a pioneer in beneficial microbes. There are many products containing microbes, but they don't have this secret catalyst. Hydro-Enhance delivers two essential ingredients for maximum growth: microbes and dissolved oxygen. But that's not all. Hydro-Enhance releases all the energy from whatever kind of nutrients you're using. It prevents salt build-up, promotes nitrogen breakdown, and ensures complete nutrient uptake. The secret to its amazing results is in the catalyst. When tested in a lab, the rate of reaction by microbes in Hydro-Enhance was 1,000 times faster than untreated microbes. It can be used in all grow mediums, from seed to harvest. Just add it to your normal feeding program. That's it; no guesswork.

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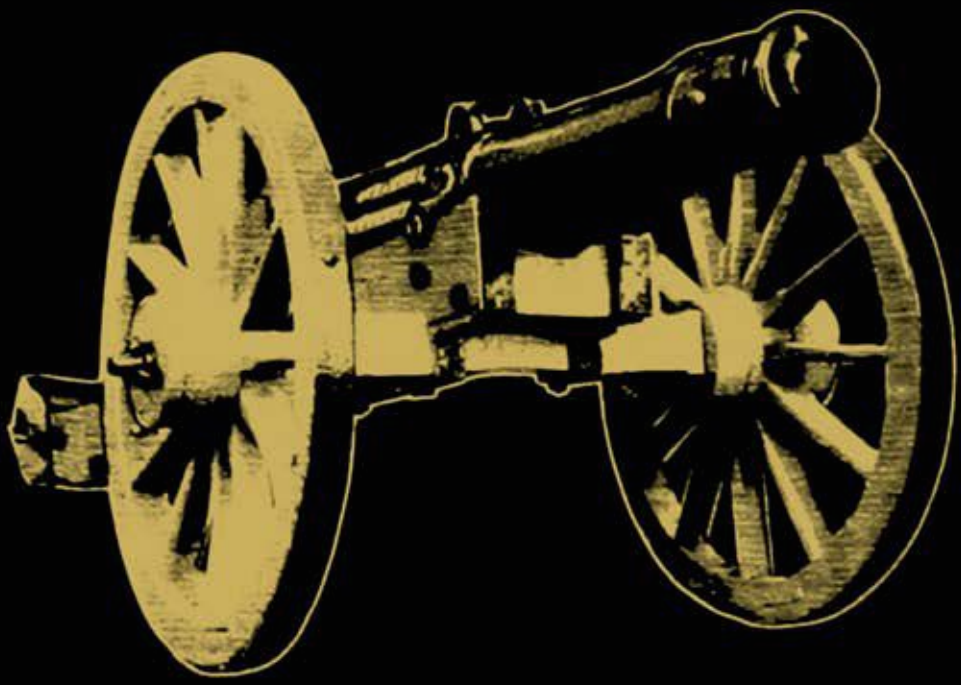

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TRAP Travel Bag

The TRAP Travel Bag is made in North America with high-quality materials. The bags are exceptionally crafted, durable, and weather resistant. At 10x6x6 inches, the TRAP Travel Bag is a great choice for those needing compact storage. It's the perfect size for storing all of your toiletries safely and discreetly while on the go. It is ideal for preserving the freshness of any perishable or dried goods. Lockable rubber zippers make this bag pet and childproof while concealing the toughest odors. Spot clean only.

Dr. Earth Three-part Liquid Fertilizer System

Dr. Earth is excited to release an easy-to-use and highly effective three-part liquid fertilizer system for heavy yielding organic gardens. Nitro Big, Pot of Gold, and Golden Bloom are OMRI Listed premium concentrates that provide readily available nutrition to hydroponic systems, soil, and soilless media alike. Available sizes range from pints and quarts to drums and bulk totes. For abundant harvests and spellbinding flavors, use each fertilizer according to the recommended dosage rate and optimal pH range. All Dr. Earth offerings are sustainable and have an array of prestigious certifications, including OMRI Listing, CDFA/OIM, and Non-GMO Project Verification. The three-part liquid fertilizers incorporate some of the most modern methods of sustainability to help feed crops of all varieties. Dr. Earth believes in healing the planet and growing amazing gardens that nourish communities.

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SANlight FLEX Series

SANlight FLEX Series is specially designed for space-saving applications. With protection class IP68, this series is also waterproof. Multiple FLEX modules are daisy-chainable and easy and flexible to install. They are extremely compact in size and available in multiple lengths. Sophisticated optics allow minimal layer spacing with maximum light distribution and homogeneity. The Flex Series offers precise light guidance into the cultivation area so no photon is wasted. It also has a warm, white-light color impression (standard spectrum) for comfortable working, and specialized spectra are available for selective plant growth manipulation. The typical power consumption is 10 watts for the FLEX 10 and 20 watts for the FLEX 20. Typical applications include multi-layer cultivation with a minimum spacing, inter-lighting solution for high growing plants, in-vitro cultivation, growth chambers, multi-layer rooting of cuttings, additional lighting to existing luminaires and as a standard substitute for fluorescent tube applications.

Sun System 1 Etelligent LEC 315W Ballast

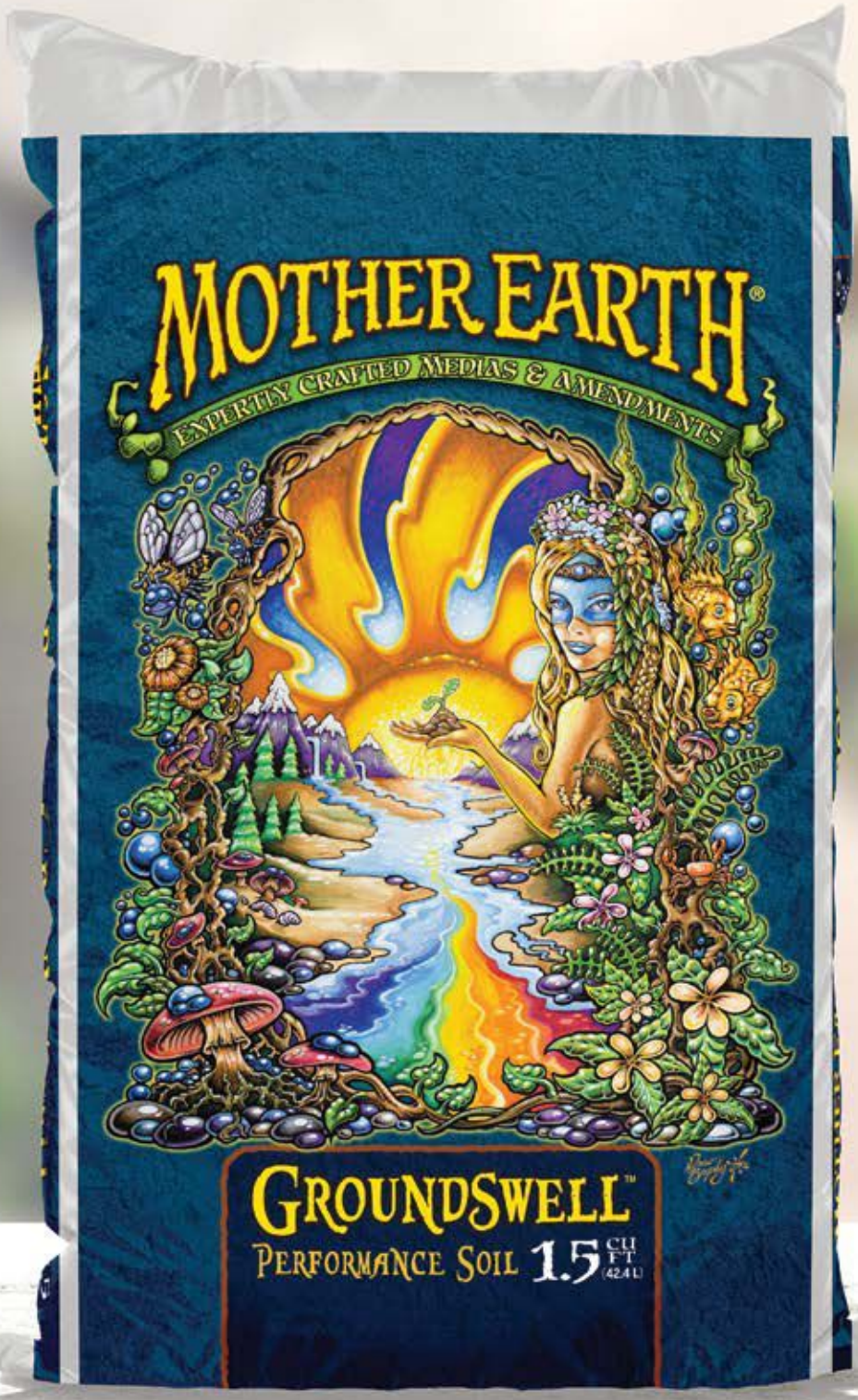
The Sun System 1 Etelligent LEC 315W Ballast is optimized for cutting-edge Light Emitting Ceramic (LEC) technology. This ballast has a thermally optimized, non-fan-cooled aluminum housing and operates on 50/60-Hz, low-frequency square wave, which makes this electronic ballast highly efficient. The Sun System 1 LEC 315W Ballast operates at 120V or 240V and has a rated life of 50,000 hours. It operates a 315W ceramic metal halide lamp (ANSI: C182) at 50 per cent, 60 per cent, 70 per cent, 80 per cent, 90 per cent, and 100 per cent. This ballast includes a prewired lamp cord receptacle that is compatible with all Sun System LEC-brand reflectors. The ballast features controller–compatible signal ports for on/off/dimming functions, as well as an ambient thermal temperature probe. A 15-foot Etelligent signal wire and a 6.5-foot convertible smart volt dual ferrite power cord with 120V and 240V plugs is included. The ballast is compliant with both FCC Article 18 Part A and FCC Article 18 Part B as tested by an independent US testing lab in a true-as-used configuration.

Revelry Supply Navajo Maroon Line

Revelry Supply has just introduced a new Navajo Maroon pattern to its line of premium odor-absorbing and water-resistant luggage. All seven of Revelry Supply's backpacks and bag designs are now available in the striking motif, alongside the original Revelry colors: black, navy blue, green, crosshatch grey, and light grey. The entire collection features Revelry Supply's custom system of protective layers and a dual carbon filter for odor absorption and water resistance. They're rugged, made of top-quality materials with outstanding attention to detail, and are now also available in Navajo Maroon.

Ameri-Coco Coir Products

EnRoot Products introduces Ameri-Coco bagged coco coir products. No coir busting required with these convenient 1.5-cubic-foot bags of expanded coir. It's as easy as 1, 2, 3: Open, pour, plant. Available in three formulas to satisfy your growing needs. Brown Pearl combines pure washed coco coir with perlite, providing maximum air porosity. With low EC, it can be used straight from the bag. Colombo Jumbo is 100 per cent pure washed coco coir, ready to add to your own blend or used straight out of the bag. It has an EC less than 0.7. Root Kandy is our buffered coir product for the lowest EC possible. Root Kandy is washed in a calcium nitrate solution, removing excess salts and guaranteeing fantastic results. The EC is less than 0.5. The pH of all coir products ranges from 5.5 to 6.5.



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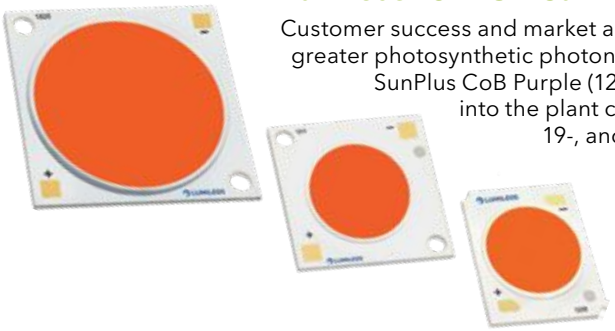
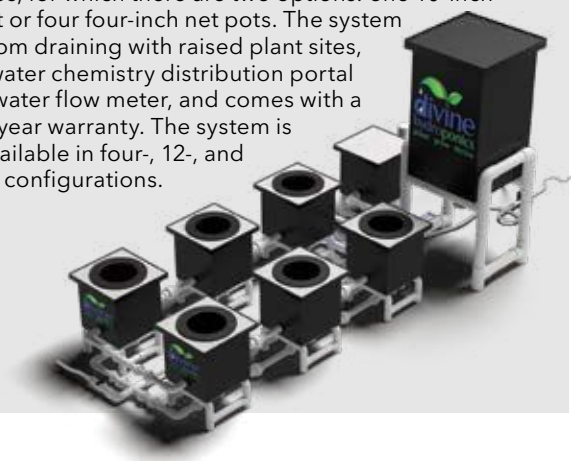


Customer success and market adoption of the LUXEON SunPlus 35 Purple and the need for even greater photosynthetic photon flux (PPF) in a single device led to the development of the LUXEON SunPlus CoB Purple (12.5 per cent blue). Greenhouse lighting requires deep penetration into the plant canopy, which is achieved with a directional CoB. Available with 15-, 19-, and 32-millimeter light emitting surfaces, the SunPlus CoB Purple can maximize PPF to as high as 350 micromoles per second. The CoB portfolio complements the LUXEON SunPlus 20 and 35 Lines, which offer a variety of colors to optimize the spectrum for greenhouse applications. The CoB form factor also means that standard optics, holders, and drivers are available to help manufacturers accelerate time to market of their fixtures.

Divine Hydroponics Paradise Six-site System

Deep water culture hydroponics has been reinvented. The Paradise Six-site System by divine hydroponics was engineered with the grower in mind, with the goal to make it easy for anyone to plant, grow, and thrive. The patent-pending innovations include the ability to easily expand the plant rows and/or number of sites, adjustable plant spacing (18, 24, and 36 inch), and three points of circulation (the most in the industry). It's also easy to assemble, drain, flush, and clean. The system features a bottom-draining reservoir and double Mylar-insulated site tops, for which there are two options: one 10-inch net pot or four four-inch net pots. The system is bottom draining with raised plant sites, has a water chemistry distribution portal and a water flow meter, and comes with a seven-year warranty. The system is also available in four-, 12-, and 18-site configurations.



South Cascade Organics SLF-100

SLF-100 is the only 100 per cent organic, OMRI Listed, and Clean Green Certified enzymatic formula designed with system health in mind. SLF-100 can effectively break down salts, proteins, lipids, calcium, and any other organic residue that, if left unchecked, could result in system issues. The goal with SLF-100 was not to produce an enzymatic product that would target one specific material but to provide a well-rounded product that would tackle many different obstacles. It is effective in all phases of the growing cycle and is compatible with all nutrients, fertilizers, and rooting compounds. Thanks to a proprietary blend of naturally occurring enzymes, SLF-100 is pH neutral in concentrated form and has no added sugars or NPK.

Vitaponix VitaCal

Calcium (Ca) is a vital element for plant cell integrity. Acting as a secondary messenger, it is necessary for the reduction of intracellular oxidative stresses and essential for cell signalling and functioning. Calcium is immobile in plants and used up to alleviate stresses, resulting in a deficiency that, though not visual, significantly reduces the potential of the plant for yield and quality. Technology Calcium (Tecal) is an innovative Ca product containing an integrated patented technology for inducing calcium absorption. It works synergistically by blocking the inhibition of Ca absorption by cellular substances and by increasing the cytosolic Ca, which is redeposited in the plant's calcium stores, including the vacuole. Tecal effectively increases Ca absorption, resulting in the strengthening of plant cell walls and an increased tolerance to abiotic and biotic stresses. Calcium abundance by foliar application of Tecal improves cell functionality and optimizes plant physiological processes for growth and development, resulting in increased fresh produce yield, quality, and shelf-life.

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WHAT TO GROW THROUGH THE SNOW

by Wiley Geren
& Bryan Traficante

Just as evergreens keep their summer color while under a blanket of snow, some vegetables and flowers can thrive while buried under the white stuff.

Snow and gardens are not known for being compatible. Snow is a symptom of freezing temperatures, a known gardening inhibitor. However, a snowy winter does not mean a gardenless winter. There are vegetables and flowers that prefer colder seasons and will grow in snow. Flowering plants are especially beautiful because they add color to the two-dimensional palate of winter. While there are disadvantages, gardeners with the correct plants and knowledge can harness the power of snow.

The Advantages and Disadvantages of Snow

Contrary to the obvious perception, snow can be a benefit to your garden. Even the hardiest garden plants can't stand hard frosts or frozen ground. When a freeze occurs, root systems can be compromised and plant cells can freeze until they burst. Without protection, plants will quickly turn black and wither in the face of temperatures 32°F and lower. Winter also brings cold winds, which whisk away nutrients and moisture. Fortunately, Mother Nature provides a natural insulator: snow.

"A layer of snow insulates the plants and ground from radical drops in temperature."

Gardens don't handle rapid variations in temperature well, and evening out those transitions is a helpful defense. A layer of snow insulates the plants and ground from radical drops in temperature. It also prevents moisture from escaping. Also, the insulated "warm" soil melts ground-level snow, feeding the plants.

However, there are downsides to snow. Buildups of snow are heavy and too much will weigh the plants down, snapping stems or breaking leaves off. Snow timing can be a critical factor as well. Plant growth syncs with the changing seasons. When temperatures warm, the plants begin the process of waking up. However, if some late snow comes through during this process, then it might do more harm than help (remember, plants do not like rapid variations in temperature). Lastly, snow conceals the presence of garden pests like moles and voles. While everything looks calm on the surface, pests are under the snow, feasting on your roots and stems.

Vegetables and Other Plants That Can Grow in the Snow

- **SPINACH:** It may not produce leaves during snowfall, but the plant will bear the snow and continue to grow. Varietals such as Savoy do well and can be identified by their wrinkled leaves.
- **COLLARDS:** Blue Max varietals can survive in 0˚F, making collards some of the most freeze-tolerant plants there are.
- **TURNIPS:** Through the miracle of science, turnip flavors convert from spicy to sweet during the snowy months. Sugar is a natural anti-freeze, so turnips produce more of it to survive temperatures down to 10˚F. Hakurei varietals are known for being hardy and simply need insulation, which may be provided by the snow.
- **CAMELLIA:** An evergreen plant, the camellia brightly blooms from fall to spring. As long as they are protected from heavy winds and have access to the sun, they will grow brightly through the snow.
- **FIRETHORN:** Green leaves with orange/yellow berries, the firethorn is a beautiful addition to a snowy garden. When spring arrives, white flowers will bloom from them as well, ensuring a dash of white remains even after the snow leaves.

It's important to note that all plants and vegetables can use some assistance. Just because they can survive through cold weather and snow doesn't mean they have to. Mulching, ground-level irrigation, and greenhouses greatly increase your garden's growing power during cold seasons, and they can be implemented quickly and affordably. Snow on the ground doesn't mean your garden is done for the season. It means a new rotation of plants and vegetables are ready to be planted and a new gardening strategy is ready to begin. MY

UNDERSTANDING DIFFERENT GROW LIGHTS

by Chris Bond

Cost, available grow space, and the type of crops being grown all factor into which type of light will best suit a grower's needs. Chris Bond provides insight into the wide variety of grow lights available on the market today.

Most indoor plant growers are aware that plants need different types of light for good growth and high yields. We, as human beings, see light in the wavelengths that comprise the visible spectrum (remember Mr. ROY G BIV?). Plants use light in this range, but also need the light that occurs at both higher and lower wavelengths: ultraviolet (UV) and microwaves. It is an oversimplification of the concept, but in general, plants need more light from the blue side of the spectrum during their seedling stage and when developing foliage and require light from the orange to red side of the spectrum while in blooming and fruiting phases.

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When considering the different types of grow lights available on the market, understanding efficiency, both in energy consumption and photosynthetic benefits, is key. Knowing the difference between different types of grow lights, their features and benefits, as well as their limitations can help the grower to decide which will work best for their growroom set-up and situation.

HPS

High pressure sodium (HPS) lights have been a common choice among indoor growers for many decades and are still the most common type of grow light used in the commercial greenhouse industry. They emit lights mostly in the yellow to red range of the spectrum, 565-700 nanometers (nm). For reference, yellow light occurs at wavelengths between 560 and 590 nm, orange at wavelengths between 590 and 625 nm, and red at wavelengths between 625 and 700 nm.

HPS lights usually last for spans of time around 10,000 hours (though bulbs should be changed after 18 months of use even if they have not been used for the full 10,000 hours as the quality and quantity of light diminishes over time) and burn between 25 and 30 per cent efficiency. The remaining energy emitted from the bulbs is released as heat, making the surface of these bulbs extremely hot (some studies have shown surface temperatures of HPS lights as high as 842°F). HPS lights should not be placed in contact or very close to crops as they will burn the foliage. For safety reasons, they should not be in contact with anything flammable such as some types of shade material or paper.

It should also be noted that in most large, commercial growing facilities like greenhouses, they are used as a supplement to the natural light. Growers that opt to use HPS light as the sole source of artificial light are not giving their plants anything useful from the blue range of the spectrum.

"**HIGH PRESSURE** sodium (HPS) lights have been a common choice among indoor growers for many decades and are still the most common type of grow light used in the commercial greenhouse industry."

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HID

High-intensity discharge lights (HID), also known as gas or discharge lights, are commonly manufactured as metal halide (MH) or sodium vapor lights (HPS lights are also HID lights, but they are excluded here since they were discussed above). These work by passing electricity through a gas-filled tube. High-intensity discharge lights offer the brightest light of any lights discussed in this article, so they offer the added benefit of allowing crops to be easily inspected. They were used by growers for many years since they are about 10 times more efficient than traditional incandescent lights, which are inefficient, burn hot, and offer little in the way of blue light.

High-intensity discharge lights, while more efficient than incandescent lights, still emit a lot of heat. Among the HID light choices, HPS lights are roughly equivalent in terms of energy efficiency compared to MH bulbs, but they are more efficient in their photosynthetic value. Metal halide bulbs offer better light on the blue side of the spectrum than HPS do. High-intensity discharge lights also require large, bulky, and often costly fixtures to operate them, though the bulbs themselves are relatively inexpensive. They are not typically the grow light of choice for most hobbyist growers or growers who operate in relatively small growrooms. The technology, however, is old by today's standards and most current research is being directed towards light emitting diodes (LEDs) and sulfur plasma technologies.

> "**HIGH-INTENSITY** discharge lights offer the brightest light of any lights discussed in this article, so they offer the added benefit of allowing crops to be easily inspected."

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> "**LIGHT EMITTING** diodes have the capability of having their spectra manipulated to efficiently capture the nuances of the emitted wavelengths."

If HID lights are a practical or more economically viable solution in a certain situation, a combination of both MH and HPS lights may be advisable if the crops being grown are blooming or fruiting crops as opposed to foliage crops like edible greens. These can be operated at the same time or alternated, depending upon the stage of growth; better results will likely result by using both in tandem. Though HID bulbs are not interchangeable with one another, conversion lamps have been available for some time, which allows you to achieve the spectral output of an MH lamp in an HPS fixture. Also, there are double-ended MH lamps that have been recently introduced to the market that can be used as a direct replacement in a compatible HPS fixture.

LEDs

Light emitting diodes have become the grow light of choice for many professional and hobbyist growers alike. These products can emit light in wavelengths ranging from 250 nm to more than 1,000 nm. Most plants require wavelengths of light ranging from the blue section of the spectrum at about 450 nm to the far-red end of the spectrum at about 730 nm at different times of their development. Light emitting diodes have the capability of having their spectra manipulated to efficiently capture the nuances of the emitted wavelengths.

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"**OF ALL** the possible options in grow lights, the sulfur plasma light is touted to emit light in frequencies and wavelengths closest to that of the sun."

These lights are also favored because of their long life and efficiency. They have been shown to last more than 50,000 hours, with efficiency usually ranging from a low of 38 per cent to a high of more than 50 per cent. They are also extremely useful for growers because some LED lights can emit light in specific ranges of wavelengths to support plants during their vegetative and blooming phases. Light emitting diodes do not require the addition of any kind of reflector, as the light is directly emitted towards the plants and not dispersed like other types of grow lights.

A 2014 study conducted by researchers at Purdue University showed that LED lighting was more effective for development of commercially viable bedding plants than HPS lighting. This study included popular annuals such as geraniums, impatiens, petunias, salvia, and others.

The main obstacle for growers is the relative high cost of LEDs. The cost of LEDs, however, is dropping as they continue to be produced in higher volumes by more manufacturers. A current study released this year in the journal *HortScience* cites that it still costs five to 10 times as much to set up a new LED grow light system as compared to a new HPS system.

Another drawback of LED lighting is one of its selling points. Because far less light is lost or scattered with LED beams, it is not necessarily the best choice of lighting for larger operations. These lights can be thought of as more surgical while HID lighting is designed for saturation. Small grow operations will likely see more benefit with a switch to LEDs than their larger counterparts.

Sulfur Plasma

Sulfur plasma lights are the new kid on the block in the world of grow lights. Their high cost will keep them out of the hands of the casual grower for a while until market factors kick in based on their effectiveness for supporting plant growth. Many units currently sell for thousands of dollars each.

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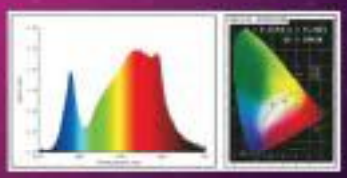

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"REMEMBER THAT all plants still need a daily period of darkness to complete their normal cycles."

The amount of peer-reviewed literature on this new technology useful for the layman is scant, so it is difficult to glean an unbiased review of their performance. Of all the possible options in grow lights, the sulfur plasma light is touted to emit light in frequencies and wavelengths closest to that of the sun. It is the only grow light that emits lights via microwaves. Its efficiency has been reported by some European researchers as high as 70 per cent.

Final Considerations

Don't forget about the inverse-square rule when placing your grow lights. The amount of light that is scattered or lost grows exponentially larger the higher the lights are suspended over the crops. Every time you double the distance between your light source and your plants, they receive one-fourth of the amount of light than when you started. This is important when considering a type of grow light that produces a lot of heat, which needs to be kept away from crops to avoid burning of foliage.

Ultimately, whichever light is chosen for optimal growth, remember that all plants still need a daily period of darkness to complete their normal cycles. The amount of darkness a plant experiences provides cues to the plant regarding when to flower or when to produce vegetative growth (photoperiodism). MY

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by Eric Hopper

Streamlining Your Growroom's Ventilation System

A good ventilation system is vital for a successful growroom. Here's how to make sure you have what you need to achieve maximum yields.

An indoor garden's ventilation system is just as important as its lighting system or nutrient regimen. The ventilation system is responsible for maintaining the atmospheric conditions (temperature, humidity, and CO_2 levels) within an indoor growing space.

Temperature, humidity, and CO_2 levels all directly affect photosynthesis and, therefore, the way a plant grows and develops. When these variables are kept in the desired range, a plant's ability to photosynthesize will not be compromised. Like other key contributors to a successful indoor garden, consistency of the ventilation system is important to providing the optimal conditions for accelerated plant growth.

In a hobby indoor garden, the ventilation system may consist of little more than intake fans, exhaust fans, and recirculating fans. For more advanced garden set-ups, the ventilation system could also include air conditioners, dehumidifiers, and CO_2 enrichment equipment. Regardless of whether a gardener implements a basic or more advanced ventilation system, the basic functions of the ventilation system remain the same: to provide uniform temperature and humidity levels within the desired range and to supply the plants with CO_2 for photosynthesis.

"Recirculating fans are another valuable tool for creating uniform atmospheric conditions within the growing space as they help to 'mix' the temperature and humidity of the garden's environment."

Fans

The optimal temperature range for most indoor gardens is 72-80°F. In growrooms with enriched CO_2 levels, the optimal temperature range is a little higher (80-85°F). The pieces of equipment used in the ventilation system will help a grower maintain temperatures in these ranges. The most common piece of equipment in any ventilation system is a motorized fan. For a small indoor garden with a low heat signature, a single fan could make up the garden's entire ventilation system. An exhaust fan could remove the excess heat from the growing area while drawing fresh air into the garden space. The fresh, cooler air would help lower the temperature of the growing space and contain CO_2 for the plants to "breathe." Larger growing spaces or gardens with more grow lights would need multiple fans to regulate the temperature, humidity, and CO_2 levels. Using motorized fans for both the intake and the exhaust is common in medium-sized growrooms. In this type of set-up, the fans work together to evacuate air within the grow space and replenish it with fresh air. Atmospheric controllers with built-in thermostats and humidistats allow growers to automate motorized fans within the growroom and to provide more consistent atmospheric conditions. Recirculating fans are another valuable tool for creating uniform atmospheric conditions within the growing space as they help to "mix" the temperature and humidity of the garden's environment.

"The most common piece of equipment in any ventilation system is a motorized fan."

Air Conditioning

One of the most common devices used in a modern indoor garden is an air conditioner. More specifically, a mini-split air conditioning system. These types of air conditioners are very efficient at removing excess heat and maintaining optimal temperatures and humidity conditions. Of all the devices used to control the atmospheric conditions in an indoor garden, an air conditioner gives growers the most control. There are many makes and models of air conditioners on the market, so it can be a little overwhelming for a new indoor horticulturist. When shopping for an air conditioner for an indoor garden, a grower needs to pay close attention to the machine's BTU rating. British thermal unit (BTU) is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. Don't let the definition of BTU confuse you. Instead, just think of BTUs as a way to quantify heating or cooling equipment. In other words, a grower can use a BTU rating to find the appropriate size air conditioner for his or her garden.

Sizing Air Conditioning Equipment for an Indoor Garden

To adequately cool his or her indoor garden, a grower will need to consider the five major factors that influence the size of an air conditioner. Those factors are the dimensions of the growing area, the lighting equipment, the ballasts of the lighting equipment, the CO_2 equipment, and any remaining electrical accessories used in the garden.

Room Dimensions

When sizing an air conditioning system for an indoor garden, the first thing a grower should note is the size of the space that needs to be cooled. Although the heat created by the lighting system and other garden equipment will need to be considered to determine the required cooling load, the size of the space in cubic feet will determine the minimum BTU requirements for the air conditioning equipment. This minimum size can be determined by using a general BTU chart for room size.

General BTU Chart for Room Size

Cubic Feet	BTUs
1 - 1,200	5,000
1,200 - 1,600	6,000
1,600 - 2,000	7,000
2,000 - 2,400	8,000
2,400 - 2,800	10,000
2,800 - 3,200	12,000
3,200 - 3,600	14,000
3,600 - 4,000	15,000
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4,800 - 5,600	20,000
5,600 - 6,400	22,000
6,400 - 7,200	25,000

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"In most indoor gardens, the lighting system creates a lot of excess heat that needs to be addressed."

Lighting System

In most indoor gardens, the lighting system creates a lot of excess heat that needs to be addressed. This is why it is so important to consider the lighting equipment when figuring out the required cooling load. After a grower determines the required BTU based on the cubic feet of the garden space, he or she can determine the additional BTUs that will be needed to offset the heat created by the garden's lighting equipment. A good rule of thumb for finding this value is to multiply the total lighting wattage by 3.5. For example, if a grower has 10,000 watts of lighting equipment, he or she will need an additional 35,000 BTUs (10,000 x 3.5 = 35,000) on top of the BTUs required for the size of the garden space.

Ballasts

The ballast(s) used in the lighting system also need to be considered when sizing cooling equipment. If a grower uses a remote ballast, which operates at a distance from the lamp itself and removes the ballasts from the actual growroom, no further cooling loads within the garden space will be required. However, if the ballasts remain in the same space as the garden, they will need to be added to the calculation when determining the required BTUs for cooling. The best rule of thumb for ballasts is to multiply the total wattage by 2.5. This number will be added to the required BTUs for the room size and the required BTUs for lighting equipment. For example, if a grower has 10,000 watts of lighting equipment and is operating the ballast within the growing space, he or she will need an additional 25,000 BTUs of cooling (10,000 x 2.5 = 25,000).

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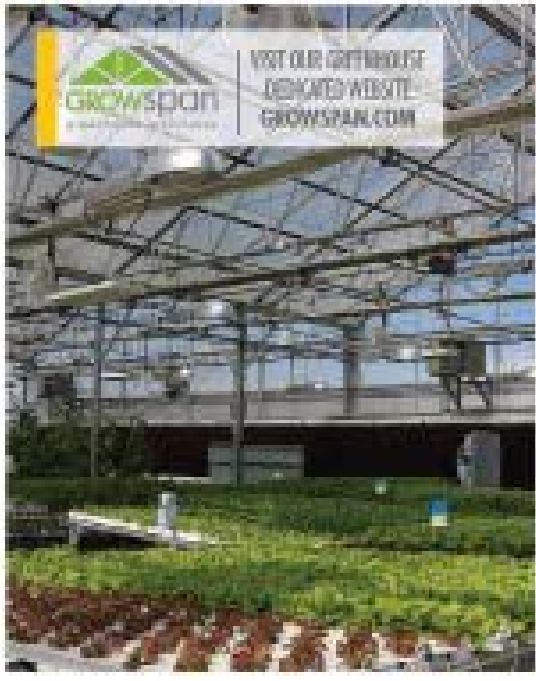

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CO_2 Burners

Some indoor horticulturists utilize CO_2 burners to enrich the environment with CO_2. These burners add heat to the growing space and need to be considered when making calculations for cooling equipment. The BTU output of a CO_2 burner will depend on the size of the unit and how many burners the unit has. A very basic rule of thumb is to add 10,000 BTUs of cooling for every CO_2 burner with two burners. However, CO_2 burners sold for indoor horticultural use normally include a chart listing how many BTUs they put off. It is important to keep in mind that most CO_2 burners do not operate continuously but, rather, sporadically. To put it another way, the BTU rating on a CO_2 burner is only applicable when the unit is operating. This time of operation may range from one hour to 12 hours per 24-hour cycle.

Other Electrical Equipment

Every piece of electrical equipment used in an indoor garden—air pumps, atmospheric controllers, fans, dehumidifiers, etc.—add a small amount of heat to the environment. In most cases, these pieces of equipment are negligible and will not have a dramatic effect over the required cooling loads. However, when making calculations as to the required BTUs for cooling, it is always a good idea to go with a slightly higher BTU than a slightly lower one. In other words, by choosing an air conditioner that has a BTU rating that is slightly higher than the requirements calculated from the room size, lighting system, ballasts, and CO_2 burners, a grower can rest assured that any additional electrical equipment used in the garden will be covered. It is always best to error on the side of caution.

"These burners add heat to the growing space and need to be considered when making calculations for cooling equipment."

The ventilation system of an indoor garden is the heart and soul of atmospheric control. The temperature, humidity, and CO_2 levels of an indoor garden directly influence the plants' ability to photosynthesize. When the atmospheric conditions of an indoor garden are kept consistently in the optimal range, and if lighting and nutrition are in check, the plants will have the ability to grow at an accelerated rate. Motorized fans and air conditioners are the main tools used by indoor growers to achieve the atmospheric conditions most conducive to heathy growth. Hobby growers can usually get away with a couple of fans to control heat and humidity, while commercial growers will most likely need to incorporate air conditioning systems. One of the most difficult aspects of sizing an air conditioner for an indoor garden is calculating all the contributing factors that create additional heat. By considering the room size, the wattage of the lighting system, and the heat created by CO_2 burners, an indoor gardener can more accurately determine the amount of air conditioning he or she will need to provide the optimal atmospheric conditions. Regardless of the size or type of indoor garden, the basics of a ventilation system will always remain the same: to control temperature and humidity and to provide the plants with CO_2 for photosynthesis. When these basic principles are met, a horticulturist will be rewarded with more consistent yields and a higher return on investment. MY

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WHAT LIES BENEATH:
GROWING SUBTERRANEAN CROPS IN HYDROPONICS

by Dr. Lynette Morgan

Bulb, tuber, and root crops may not receive as much attention as vine-ripened tomatoes and fresh aromatic basil, but hydroponic specimens of these versatile crops are surprisingly diverse and well worth planting in your indoor garden.

We tend to treat potatoes, onions, carrots, and similar root and tuber crops as cheap commodity vegetables, but they have far more potential than most growers realize. With the increasing globalization of food, root and tuber crops are finding new markets. As usual, hydroponics allows for excellent ways of experimenting with something a little different. Apart from providing super fresh veg for the table, diversifying into subterranean crops offers the opportunity to acquire a few new skills and the anticipation of the bounty to be unearthed at the end of the season.

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Which Crops to Grow?

Edible root, tuber, and bulb crops incorporate a wide range of plants, the most familiar being potato, sweet potato, onions, shallots, garlic, carrots, parsnips, radish, turnip, and beets. Also included in this category are several yam species, oca, ulluco, elephant garlic (which is a type of leek), ginger, turmeric, horseradish, salsify, rutabaga, Jerusalem artichoke, and taro. While some of these plants are simply too large for the average indoor garden or have rather specific day length requirements, many others are well-suited to growing in containers and thrive under hydroponic nutrition. The simplest crops to begin with are the baby gourmet versions of carrots, turnips, radish, and beets. These can be sown directly into the surface of media beds, lightly thinned if required after germination, and grown through to a small, succulent baby stage. (In particular, the sweetness and crispness of hydroponically grown baby carrots plucked from the bed and eaten immediately are far superior to any stored vegetable.) Baby root and bulb vegetables grown in this way have a very short shelf life and are thus ideal for pick-and-eat meals that prevent any loss of flavor.

Tuber Crops

Tuber crops such as potato and sweet potato perform extremely well in hydroponics; however, the most productive use of an indoor garden space is with the more unique varieties. These include heirloom types, which are typically lower yielding than modern commercial varieties but can produce a plentiful yield of gourmet tubers under hydroponic production. Growing purple skinned and fleshed potatoes provides an added antioxidant boost as well as a unique color, which is retained after cooking. Other varieties, particularly older types, offer some great flavor profiles and different textures that are not available commercially.

When selecting seed tubers for hydroponics, ideally choose only certified planting stock as these tubers will be disease-free. Note that this may not always be an option with heirloom suppliers, however. Seed tubers can be planted directly into a hydroponic grow bed, but for more reliable results and a quicker time to harvest, tubers are typically "chitted" or pre-sprouted before planting. This involves storing the tubers in a warm place until shoots have started to form from the "eyes" or dormant buds on the surface of the seed potato. Once these are seen, the tubers can be placed on a cardboard tray in the light to let the shoots develop to a length of two or three inches. Seed potatoes with several shoots may be cut to provide two or three new plants (each section must have at least one new shoot). The sprouted potato tubers are then planted into the hydroponic growing substrate with the shoot pointing upwards at a depth of approximately five to six inches. Shoots will emerge from the substrate surface within a week or two and the plant develops new foliage rapidly.

"**FOR** more reliable results and a quicker time to harvest, tubers are typically 'chitted' or pre-sprouted before planting."

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Oca tubers (also called yams) are planted into a hydroponic system once they have sprouted new shoots.

Sweet potato, which requires a longer growing season than potatoes, can be sprouted by placing them on a tray with a layer of clean, damp sand or perlite under warm growing conditions. Eventually, the buds on the tubers will form many shoots, each with a few roots at the base. These shoots can be peeled from the tuber and planted out to produce a sweet potato plant.

Potato and sweet potato can be grown in large pots, beds, containers, or bato buckets. They can also be planted into potato bags. These flexible bags have a flap in the front wall that can be opened once the plant has reached a suitable stage of development, and young, small potatoes extracted from the root zone without damaging the plant. This allows for a successive harvest of tubers as the plant continues to develop. The removal of small tubers during the growth phase induces the plant to continue forming more potatoes, with a final harvest occurring once the crop tops start to naturally die back. Another option is to grow tubers using aeroponics so the root system can be viewed inside the misting chamber and crops removed when of a sufficient size. Tubers will also grow and produce well in nutrient flow technique systems, provided the dimensions of the channel are sufficiently large enough to accommodate the sizable root system and tubers that will develop.

Root Crops

Carrot, parsnip, radish, turnip, and beet all develop a thickened tap root, which is the main edible portion of the plant. While these crops can all be grown to full or even super size in hydroponics, they are more often grown rapidly and harvested as baby gourmet veg. For this purpose, selection of the correct cultivar is vital. Seed suppliers have impressive ranges of varieties to choose from. For example, carrot cultivar Adelaide F1 is a true baby variety that forms a blunt root and matures early and is well-suited to hydroponics. Another option with root crops is to grow unusually colored types, such as purple, white, or yellow carrots; black or white radish; rainbow or pink and white striped beet; and golden, cream, or purple turnips. These all add great variety to baby root vegetable mixes and dishes.

Growing root crops for harvest at an immature stage doesn't require an overly deep bed or container system. Seeds are sown directly into the surface (small, difficult-to-handle seeds like carrot can be purchased in pelleted form, which is ideal for hand sowing small areas) and then thinned to the correct spacing after germination has occurred. As an alternative, seed tapes can be used to obtain the correct spacing without the need for thinning. These are paper tapes with seeds imbedded along the length. The paper breaks down as the seedlings develop, leaving plants at the ideal spacing. Quick-to-germinate types such as radish only take a few days to emerge, whereas carrots and parsnips are considerably slower and can take up to three weeks. If growing a range of different root crops, these are best kept in separate containers or rows due to different rates of development.

"**WHILE** these crops can all be grown to full or even super size in hydroponics, they are more often grown rapidly and harvested as baby gourmet veg."

Bulb Crops

Onions and garlic are the most commonly grown vegetable bulb crops. Even with these plants, diversity exists with color, form, and flavor. In an indoor garden with limited space, growing small cippola-style or cocktail onions such as Barletta or milder-flavored shallots is often a good option.

With onions, bulbing is induced by the number of hours of light each day. Long-day onions require 14-16 hours of light, intermediate onion cultivars need 13-15 hours, and short-day cultivars require 12-14 hours. So, selection of the correct cultivar for the number of hours the lights are run per day in an indoor garden is critical for bulb formation. Most seed suppliers provide the information for each cultivar. Onion seeds are slow to germinate; however, these can be planted out as sets, which are young, well-developed plantlets that significantly reduce production time.

Many types of bulbing onions are suited to growing in hydroponic gardens.

Unusual Subterranean Crops

Within the tuber, bulb, and root crops, there are some lesser-known plants that provide an interesting alternative for hydroponic production. These include ulluco, a small, colorful tuber originating from South America, and oca, one of the many species of yam. Both ulluco and oca are relatively small plants well-suited to hydroponics. They are grown in a similar way to potatoes, with the tubers pre-sprouted under warm conditions, then planted out into a growing bed where vegetative growth occurs rapidly. Both need a long growing season to form tubers. Ulluco has the advantage that its foliage can also be steamed and eaten as a fresh vegetable similar to spinach.

"SELECTION of the correct cultivar for the number of hours the lights are run per day in an indoor garden is critical for bulb formation."

Small button or cocktail onions make a great addition to the range of edibles grown hydroponically.

Garlic can be grown hydroponically provided the correct day length is provided to induce bulb formation.

Substrates for Subterranean Crops

Growing root, tuber, and bulb crops hydroponically requires a little more attention to the physical properties of the substrate than many other plants. The rapidly expanding carrot and parsnip tap roots can become deformed if the growing medium contains large, hard particles. For perfectly tapered roots, a finer grade of coconut fiber is ideal. Baby beet, turnip, and bulb onions perform well in combinations of fine-grade vermiculite and granulated coconut fiber, which allow for perfectly rounded specimens to rapidly develop under high-density planting. When growing bulb, tuber, and root crops in deep beds or containers, a layered substrate is often the most successful. This consists of a coarse, free-draining substrate in the bottom third of the growing bed for feeder roots to develop into, with a finer, softer medium in the top two-thirds to support the edible portion of the plant. This ensures optimal drainage while maintaining sufficient oxygenation around the roots and a finer surface substrate layer for perfect tuber or bulb formation.

Nutrient application for root and tuber crops needs to be evenly distributed. Drip irrigation systems need to be well-designed, with drippers placed at regular intervals and a slow and frequent application rate. This way the nutrient solution thoroughly wets the growing surface, which is vital during the early stages of growth. Aeroponics, with frequent misting of the root system, is another method of nutrient application suited to tuber crops. Nutrients for root crops require a well-balanced formulation. Most general-purpose nutrient concentrates are suitable. EC levels are dependent on the stage of development. For most tuber, root, and bulb crops, these are typically run at 1-1.4 $mScm^{-1}$ in the early seedling stage and up to 2-2.2 when approaching maturity. Optimal pH levels are 5.8-6.2.

"GROWING root, tuber, and bulb crops hydroponically requires a little more attention to the physical properties of the substrate than many other plants."

Diversifying into a few tuber, root, or bulb crops is an exciting way of extending the range of edibles in an indoor garden. They don't need to be dull or mundane as there now exists an exciting range of highly colored, unusual, and heirloom types to choose from. Obtaining the right substrate, ensuring uniform application of nutrients, and dialing in the correct growing environment all ensure the success of these subterranean crops. MY

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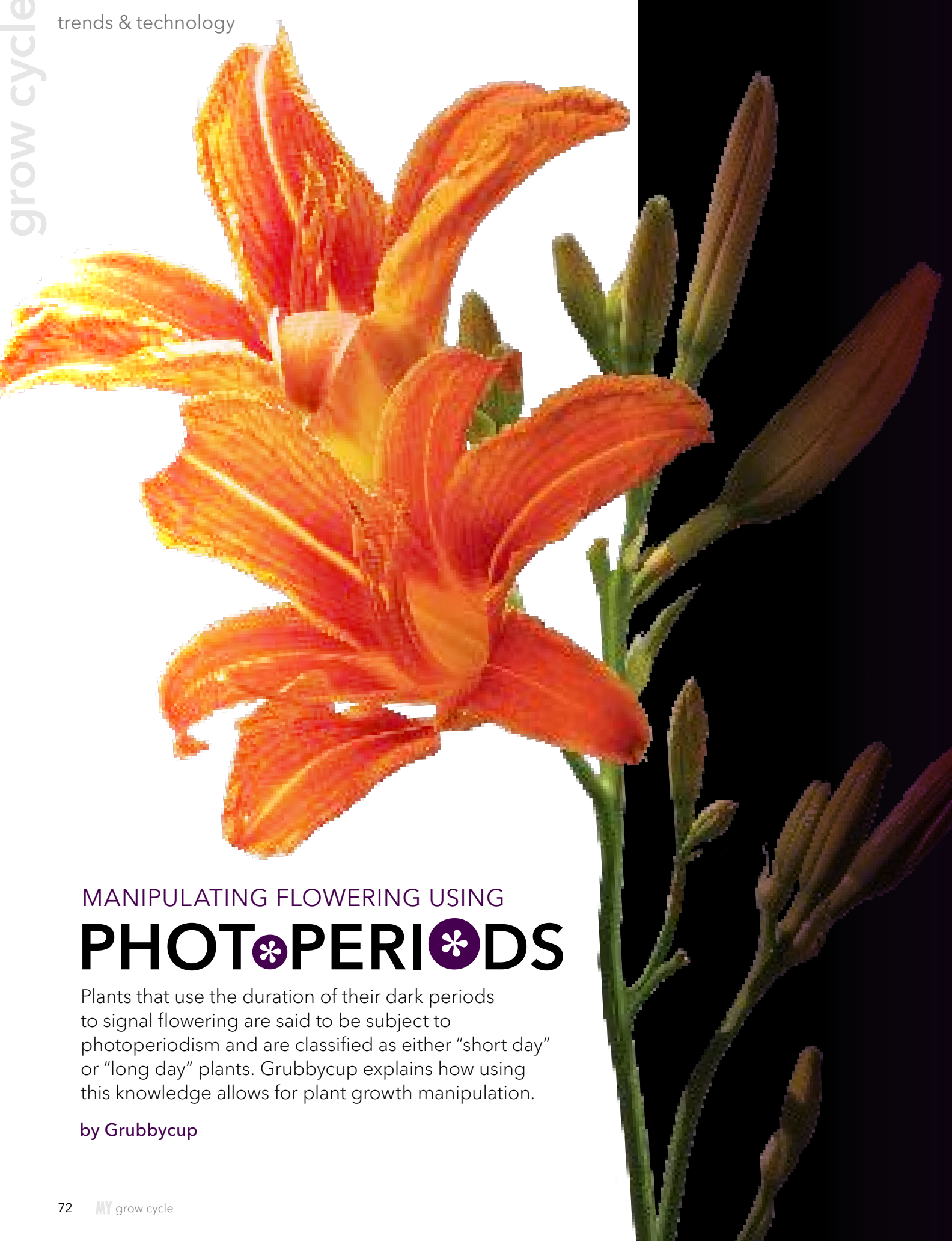

MANIPULATING FLOWERING USING

PHOTOPERIODS

Plants that use the duration of their dark periods to signal flowering are said to be subject to photoperiodism and are classified as either "short day" or "long day" plants. Grubbycup explains how using this knowledge allows for plant growth manipulation.

by Grubbycup

In photoperiodistic plants, specialized photoreceptors called phytochromes keep track of how long the plants have been in the dark. Phytochromes switch back and forth between two states. In one state, the phytochrome is sensitive to red light (Pr), and in the other it is sensitive to far red light (Pfr). In the case of short day plants, far red light absorbing phytochromes will slowly switch to being sensitive to red light when in darkness. The ratio of Pr:Pfr will indicate how long the plant has been in the dark. If a lot of the far red light has converted into red light, then the plant has been in uninterrupted darkness for a long time and will trigger flower development.

However, these changed phytochromes will revert back to the far red light state in the presence of light. While the conversion of far red light to red light in darkness takes many hours, the switch back from red light to far red light happens in a matter of minutes. Even a brief interruption of the dark period is all that is needed to raise far red light levels high enough to interrupt the flower trigger in long night (short day) plants.

OUTDOORS VS. INDOORS

When using the natural outdoor seasons without artificial lighting, there is little effective difference between thinking "short day" and "long night". In outdoor gardens, spring, fall, and winter all have longer nights than the short nights of summer. Short day/long night plants bulk up during the growth stage during summer, until the longer nights (not the shorter days) of fall trigger flowering. If these plants are set outside too early in the spring when the nights are still long, they can take the cue from the long nights to start flowering (in mild enough climates, this can allow for a spring harvest as well).

Part of the reason for the importance of the solstices and equinoxes to outdoor gardens is that the solstices mark the longest and shortest days (nights) of the year, and at the equinoxes, day and night are approximately the same length (12 hours each).

Indoors, lighting schedules are at the pleasure of the gardener. To keep a short day (long night) plant in growth, timers can be set to allow only a few hours of darkness, or even none at all. While the usual schedule for such plants includes a long-lit period followed by zero to six hours of darkness, any combination of light and dark can be used as long as there isn't a long (12-ish hour) continuous dark period. It would even be possible to keep a short day plant in growth with only four hours of light a day (one out of every five hours), but the plants wouldn't get very big on only four hours of light a day. On the other side of the spectrum, 24 hours of light can be used, although any dissipation problems can be exacerbated by leaving the lights on continuously. Eighteen hours of light is a commonly used compromise.

When the indoor gardener decides it is time to initiate flowering of short day plants, the dark periods are increased to 12 hours or so. Electric timers can be helpful in turning off lights (and back on again) at the appropriate times since remembering to do it every day by hand can be tedious and prone to errors, though either method will work if done with regularity.

> "By triggering flowering earlier, harvests may be moved earlier in the season, potentially avoiding harsh fall weather and allowing for flowering under the brighter summer sun."

GREENHOUSES

Greenhouses can use a similar tactic with the use of blackout covers. Nights are artificially lengthened by using an opaque cover to block the sun for enough additional hours to cause flowering. By triggering flowering earlier, harvests may be moved earlier in the season, potentially avoiding harsh fall weather and allowing for flowering under the brighter summer sun. Conversely, artificial lights in an otherwise naturally lit greenhouse can be used to break up the long nights to maintain vegetative growth during the otherwise flower-inducing fall, winter, and spring months.

Understanding the rules under which photoperiod dependent plants flower can allow a gardener to customize lighting schedules to fit a given need while still maintaining control of the timing of flowering. MY

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-liter bottle will have enough mush in it to make up one liter 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.

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

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 stabilize 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 fertilizer.

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.

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.

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

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 flavor 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.

> “You can buy compost tea as a dry mix or a concentrated liquid, both of which you then dilute.”

Apply compost tea whenever you spot signs of disease or undernourishment, such as wilting, failure to flower, discolored 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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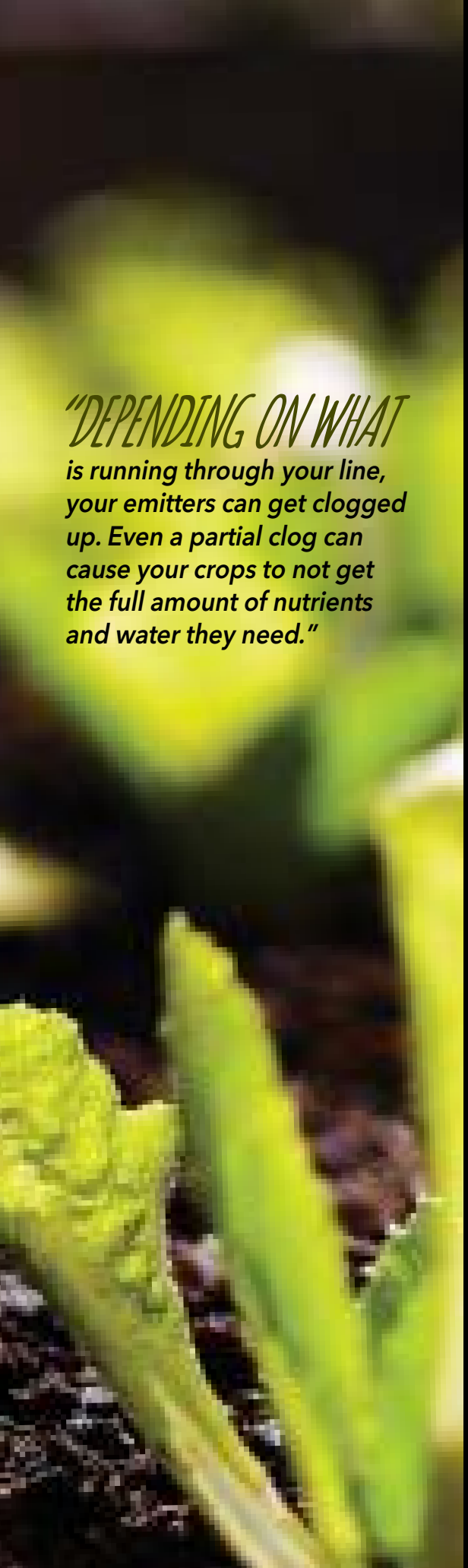
GIVE YOUR DRIP IRRIGATION SYSTEM SOME TLC

by Shannon McKee | You know the saying—an ounce of prevention is worth a pound of cure. This is particularly true for the care of your drip irrigation system, which is often not on the top of the to-do list.

Caring for your drip irrigation system is probably on your to-do list somewhere, but it's often not seen as something that's vital to your set-up until something goes wrong. (A drip irrigation system breakdown that results in your plants being damaged from lack of water is certainly something you'll notice.) However, a little TLC in the form of preventive maintenance throughout the growing season can help you stop these breakdowns from happening. Following these tips, you'll keep your system clean of debris and bacteria while keeping the pieces and parts in optimal condition.



"DEPENDING ON WHAT is running through your line, your emitters can get clogged up. Even a partial clog can cause your crops to not get the full amount of nutrients and water they need."

Visual Inspection

One of the first steps you should take is to visually inspect all the components of your drip irrigation system. Do you notice anything that seems like it's getting worn or doesn't look as it should? These are the parts that you're going to want to replace sooner rather than later. After all, that worn tubing may start leaking water out into areas that aren't benefited by it, costing you money and wasting water.

Cracks and Leaks

Any cracks or leaks you find should be fixed right away. With tubing, you can repair or replace just a section, or replace the whole thing, depending on the severity of the damage. It's possible that if you repair a section, it could need replacing again in a short time. It may be easier to repair during the season and replace at the end of the season, but it's all up to you and your set-up.

Algae and Bacteria Buildups

The inside of your drip irrigation tubes can look like a science project gone bad. They can be green and slimy from a buildup of algae and bacteria. Not only does this look gross, but it can also increase the potential for clogs occurring in your lines when some of it breaks off and goes through the tubes. Adding a commercial bacteria and algae control agent is one way to battle this ongoing issue. You could also do a daily rinse of chlorine in your lines. Two parts per million at the end of the cycle for the day is enough to work on the bacteria and algae without causing it to damage your set-up.

Emitters

One of the most important components of your system is the emitters, which is where the water is released to your plants. Depending on what is running through your line, your emitters can get clogged up. Even a partial clog can cause your crops to not get the full amount of nutrients and water they need. Magnesium and calcium salts are often culprits here. You should rinse your emitters out as best you can, but they may require a deeper cleaning. Soaking them for a few hours or overnight in a vinegar and water solution is often a great way to get them clear. This may be an additional chore for your end-of-year flushing tasks.

Filter

The next part that you should inspect is your filter. Screen filters and disc filters should both be checked and cleaned periodically. Screen filters often get clogged easier and can sometimes be difficult to clean. Disc filters, in comparison, offer better filtering and easy backflushing in addition to being harder to clog.

Deep Clean

At the end of your growing season, you should consider doing a deep clean on your system. You'll want to flush the lines with a phosphoric, sulfuric, or nitric acid solution. The lines should be flushed for about an hour using your preferred acid. It may take longer if you have a buildup in your system. Overnight soaking may be necessary for a really stubborn buildup. After you've flushed the lines with the acid, you should follow up with flushing the lines with water to remove the acid from your drip irrigation system.

Remember to use caution when working with any acid. Use the proper safety equipment to protect your skin and face. Also, be sure that you don't pour water into acid as this can cause the acid to splash out of the container. Instead, add the acid to the water.

Your drip irrigation system takes care of you and your crops, so it only makes sense to give it some TLC throughout the growing season. Don't take it for granted and it should keep running smoothly. It's better to find a small problem during your visual inspection and maintenance during the year than to ignore it until a big problem arises.

put the SOIL FOOD WEB to work in your garden

by Monica Mansfield

Mother Nature doesn't have to think twice when she creates perfect soil, but we do. It is a lengthy, intricate process but once accomplished creates healthy, vibrant plants. Monica Mansfield provides some pointers on developing the soil food web in your garden.

There is soil and then there is dirt. They look alike to the untrained eye; however, there is a huge difference between the two. Dirt is made of silt, sand, and clay. It contains the minerals that we want our plants to eat, but dirt alone will not feed a plant or help it grow. Soil will. Soil is dirt that is teeming with life. Bacteria, fungi, nematodes, protozoa, arthropods, and earthworms are the tiny critters that convert those minerals into forms that plants can use.

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The Soil Food Web

The soil food web is an ingenious nutrient cycling system designed by nature. Everything is connected in the soil food web. Nothing goes to waste and everything has multiple functions. Look at the forest. No one fertilizes or waters there, yet it is lush and green. This is the soil food web at work.

This intelligent system works perfectly when it is supported by the soil's environment, starting with the root system. All of the action happens in the rhizosphere. This is why nature does not like bare soil. No roots, no soil life. The root exudates are made up of sugars, carbohydrates, and protein, much like a sweet dessert in the microbial world. Bacteria and fungi can't get enough of them.

Then, the nematodes, protozoa, and arthropods come along and eat up the bacteria and fungi, turning them into waste that is chelated and readily available for plants. Even better, this waste contains all the essential macronutrients and micronutrients that the plant needs, instead of the select few they might receive from a bottle. These microorganisms act as storage units for nutrients. Without them, these valuable vitamins and minerals would wash out of the soil into our groundwater.

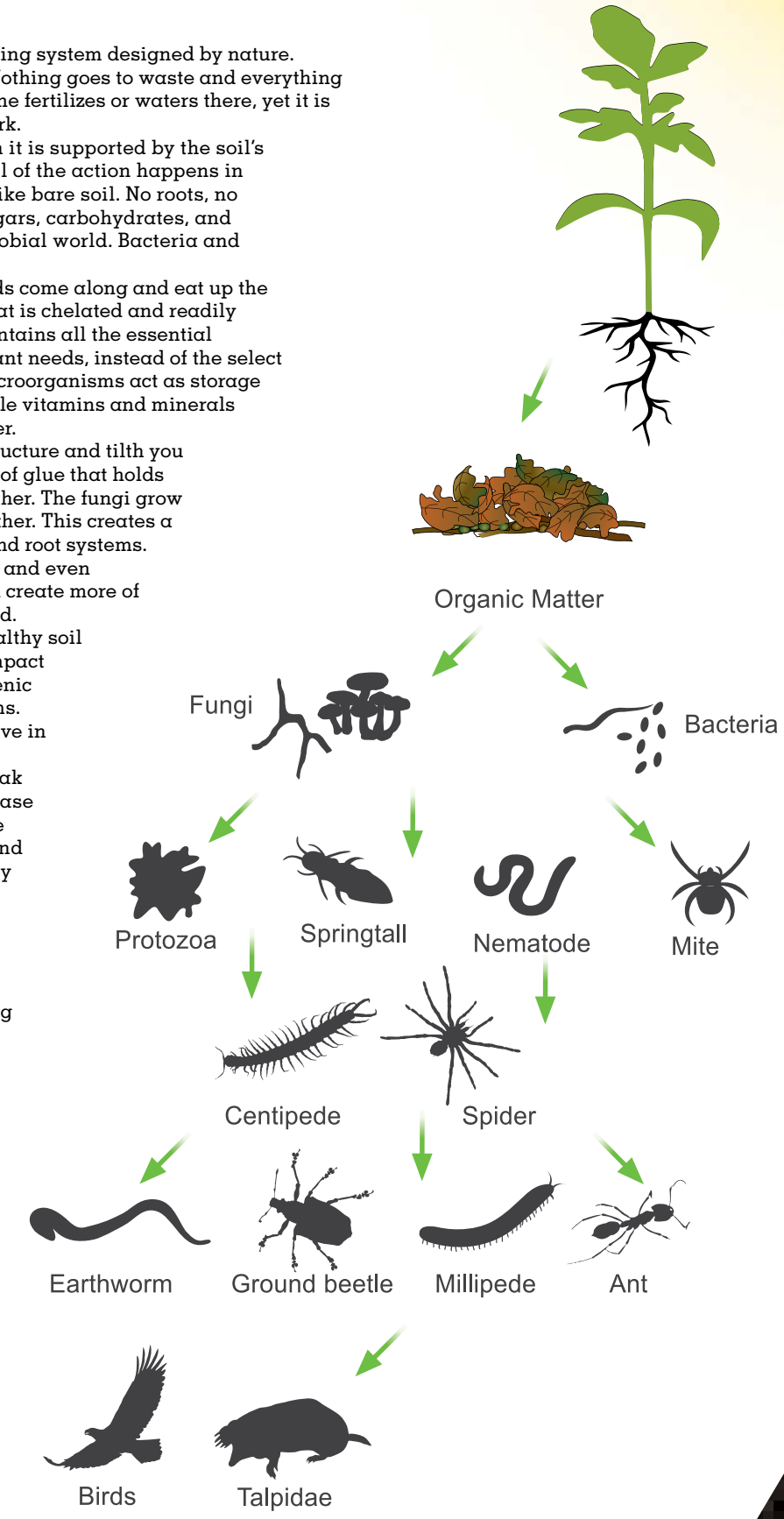
The bacteria and fungi also create the soil structure and tilth you find in healthy soil. The bacteria create a kind of glue that holds all the silt, sand, clay, rocks, and pebbles together. The fungi grow filaments that bind these soil aggregates together. This creates a structure that holds space for oxygen, water, and root systems. Earthworms, protozoa, nematodes, arthropods, and even mammals can now tunnel through the soil and create more of these pockets because the soil is not compacted.

Aerobic, oxygenated soil is essential for a healthy soil environment. In fact, once the soil starts to compact and go anaerobic, you will start to see pathogenic bacteria and fungi move in and create problems. However, these pathogens simply cannot survive in well-oxygenated soil.

In modern agriculture, we till the soil to break up the compaction, bring in oxygen, and release nutrients. Unfortunately, when we do this, we are also harming members of the food web and breaking up the soil structure that the biology has worked so hard to build.

The ratios of microorganisms in the soil also play a role in its pH. The biology creates the chemistry. Too many bacteria will create an alkaline environment, but mycorrhizal fungi will release acids and balance the soil, keeping it in a range between 5.5 and 7.0. Healthy, balanced soil needs both mycorrhizal fungi and beneficial strains of bacteria to thrive. Additionally, different plants need different ratios of fungi to bacteria. For example, grasslands do well with bacteria-dominant soil, whereas old growth forests need fungi-dominant soil.

In current agricultural practices, we tend to create unhealthy soil environments where pathogens flourish, then try to clean up the mess, which ultimately makes the situation worse. In fact, the very products we go to for help contain salts that harm the soil biology. We use these products because our soil is already unhealthy and we are dependent on them to do the jobs that the soil life would normally do.



When the soil environment is aerobic and full of life, pathogens cannot survive. When the soil biology grows, so do your plants. You will not get pests and disease because they cannot survive in your soil, and your plants will be too healthy for them to eat anyway.

Believe it or not, garden pests and diseases have a very important job. They are nature's cleanup crew. They get unhealthy plants out of the way so the healthy plants can grow. They don't attack healthy plants.

"THIS INTELLIGENT SYSTEM works perfectly when it is supported by the soil's environment, starting with the root system."

How to Build Healthy Soil

If our goal is to build rich, healthy soil full of beneficial microorganisms, there are certain practices we should and should not do. Keep in mind that not doing the should-nots doesn't create healthy soil, but it will stop us from destroying our soil further.

We should not till our soil. Although it may initially unleash a burst of nutrients from all of the microorganisms dying, you are killing the very microorganisms that create the nutrient cycling system. Over time, tilling will deplete your soil instead of building it. Historically, this is why we have rotated fields to plant, or have even had to move farms once the soil—or more accurately, the soil biology—dies. If you manage your soil properly, the biology in your soil will do the tilling for you. There is no need for you to break your back tilling in amendments every spring.

Also, overwatering and excessive soil compaction will both lead to an anaerobic environment in your soil, which is ideal for pathogens, so best to avoid those.

Now, for the things we should do. These are the practices that create a healthy soil food web.

Consider using organic fertilizers, pesticides, and herbicides. Some chemicals can be full of salts that kill the biology in the soil. If your soil doesn't have the microorganisms storing the nutrients in their bodies, about 80 per cent of the fertilizers will wash through the soil to the groundwater anyway.

You may need to use additional fertilizers or pest control methods for a few years while you build up your soil. Fish emulsion and bone meal will add to the soil instead of depleting it. Pure, cold-pressed neem oil is a completely natural pesticide and fungicide that is very effective without harming beneficial insects or soil life.

We should use compost tea. It is one of the fastest, most effective ways to add life to your soil. Compost tea is full of beneficial bacteria and mycorrhizal fungi that will attach to your plants' root systems and start eating their exudates. Once your microbial colony grows, it is sure to attract nematodes, protozoa, arthropods, and earthworms.

We should also add organic matter to our soil as much as possible. Add layers of compost and mulch. When you prune, drop the leaves on top of the soil. Leave weeds on top of the soil, as long as they don't have seeds. Organic matter is food for microorganisms, and when they are done digesting it, you are left with nutrient-rich humus.

"HEALTHY BALANCED SOIL NEEDS both mycorrhizal fungi and beneficial strains of bacteria to thrive."

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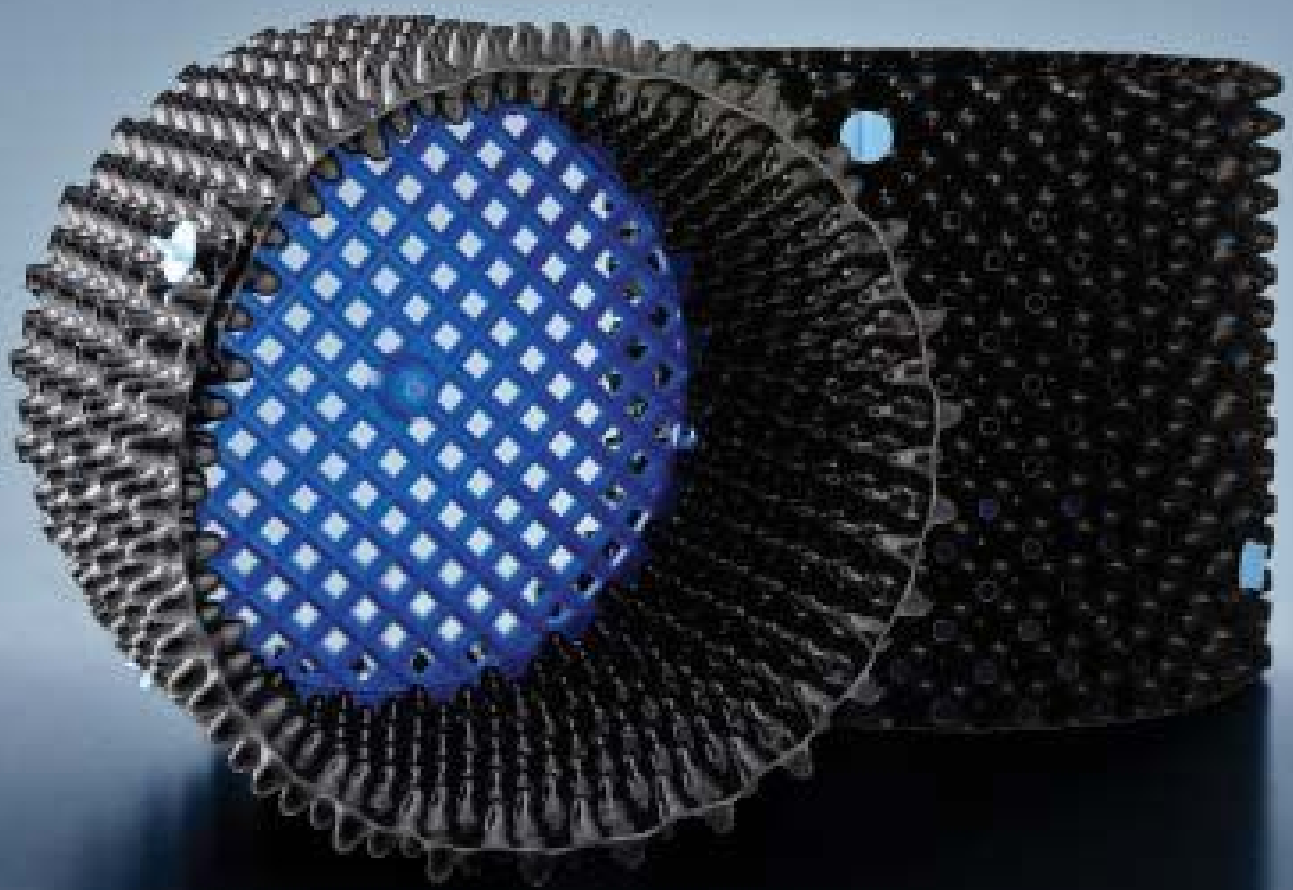

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"All good things take time, and BUILDING SOIL BIOLOGY is no exception."

Mulch has additional benefits. It will prevent soil from compacting, hold moisture to be released in times of drought, and prevent erosion. Ideal mulches include shredded leaves, straw (not hay, unless you want the seeds that come with it), and even wood chips. If you use wood chips, be sure not to till them into the soil or else they can tie up nitrogen as they decompose.

We should plant an understory in our garden. The understory should be made up of short, perennial plants with large root systems, such as creeping thyme or sedum. This way, they never overpower the other plants in your garden, yet their root systems will encourage soil biology and prevent the soil from compacting. If you plant a variety of seeds for this purpose, one will always pop up, regardless of differences in weather from year to year.

When you want to sow seeds or plant a start, just remove the understory plants in that area and dig a hole. The soil in that spot is already bursting with life and has plenty of oxygen, so your seedling will quickly grow taller than the understory.

We have been taught that these plants would steal nutrients from our crops, but when you are building your soil food web, these plants and their root systems are actually providing the biology that will feed your plants without the use of fertilizers.

It will take a few years to build your soil, even if you follow these practices to the letter. All good things take time, and building soil biology is no exception. It may take three to 10 years to create a thriving ecosystem in your garden, but you will start seeing progress even in the first year. Your job now as a gardener is to manage your soil. Check on it. Make sure the conditions are right for the soil biology you want to attract, and then let the soil food web do your work for you. MY

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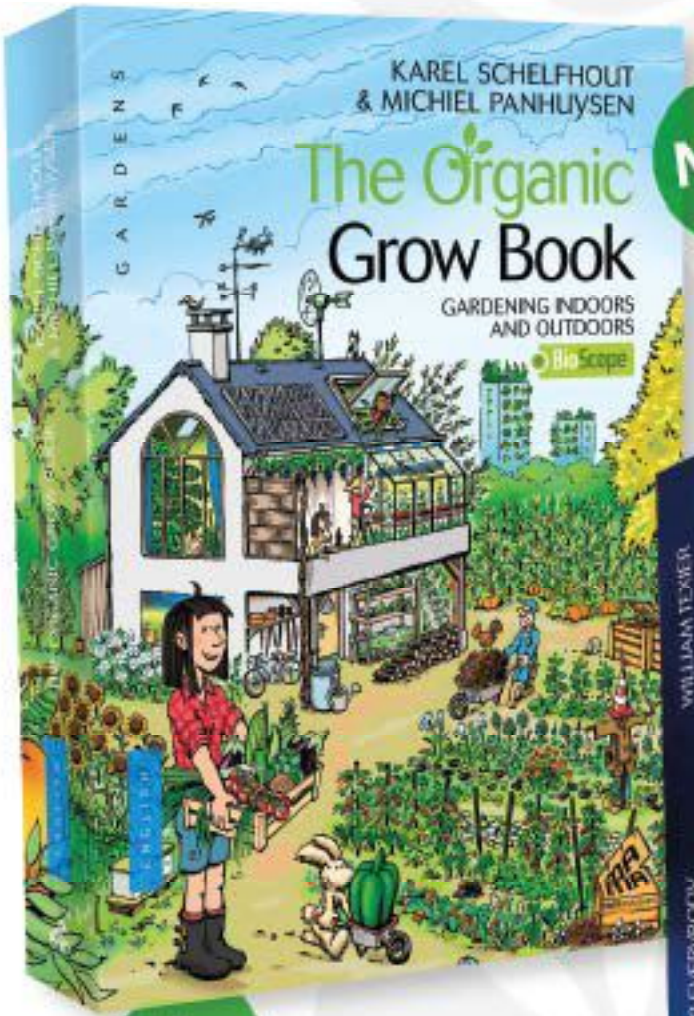

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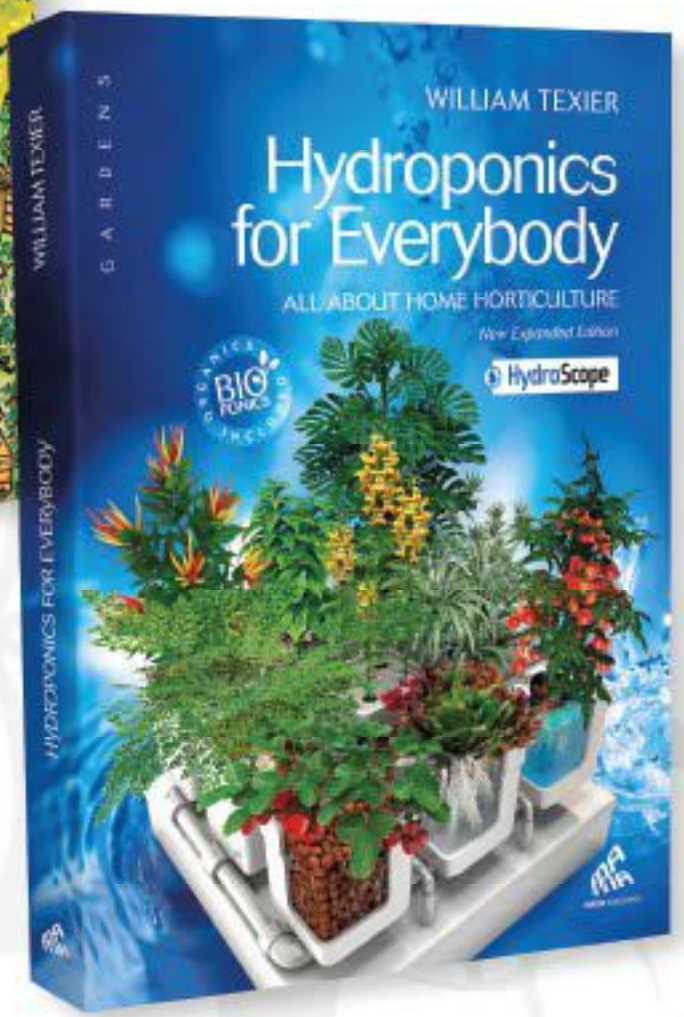

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Breathe Easy:

ADDRESSING AIR QUALITY ISSUES IN A GROWROOM

by Kent Gruetzmacher

Though a bit less glamourous than lighting, mediums, and nutrients, your growroom's air quality is vital to a successful crop. Kent Gruetzmacher delves a little deeper into why and how you should find the perfect balance of your indoor garden's air temperature and humidity levels.

The primary factors that contribute to the success or failure of an indoor garden are light, grow mediums, nutrients, and air quality. When troubleshooting an indoor cultivation operation, it is an all-too-common mistake for novice gardeners to focus on the first three elements and neglect the last. However, finding an ideal equilibrium of air quality—mainly concerning temperature and humidity—is essential in the propagation of quality and bountiful harvests. With meticulous attention to detail, indoor growers can create artificial environments inside growrooms that help alleviate concerns with airborne pathogens while ensuring efficiency with irrigation and nutrient uptake.

As the indoor gardening industry continues to evolve, it brings with it an ever-expanding assortment of technological advancements that assist in air quality maintenance. Most notably, there are a variety of digital atmospheric controllers on the market today. These devices automatically control all variants related to air quality in an indoor garden. They accomplish this feat by electronically communicating with every piece of equipment in a growroom that dictates temperature and humidity.

Whether an indoor grower chooses to regulate the air quality in their room with less-sophisticated apparatuses, such as timers, or opts for novel environmental controls, the end game is the same: ideal growing conditions for plants. With these notions in mind, here is a brief overview of common air quality issues seen in growrooms as well as some potential solutions.

TEMPERATURE AND HUMIDITY

The proper regulation of temperature and humidity in a growroom is the most important consideration to make in ensuring quality air for a garden. Generally, if a garden's temperature and humidity levels are off, the situation will render all other troubleshooting efforts regarding air flow issues and disease useless.

> "WITH METICULOUS ATTENTION TO DETAIL, INDOOR GROWERS CAN CREATE ARTIFICIAL ENVIRONMENTS INSIDE GROWROOMS THAT HELP ALLEVIATE CONCERNS WITH AIRBORNE PATHOGENS WHILE ENSURING EFFICIENCY WITH IRRIGATION AND NUTRIENT UPTAKE."

Maintaining ideal temperatures in a growroom can prove to be a challenge due to a variety of factors, including day and night cycles within the room and outdoor temperature fluctuations. Also, different geographical locations pose different problems with temperature control in a growroom. However, most indoor growers find excess heat to be the largest obstacle to overcome in temperature regulation. For the most part, indoor gardeners should strive for a temperature range of 75-80°F with the lights on (day). Along this line of thought, growers should strive to avoid extreme temperature drops when the lights turn off (night) as this instability can retard growth and cause issues with dew point and pathogens.

Depending on the locale of an indoor garden, most air-quality issues come about as an excess of humidity. Moreover, if one is running a hydroponic system, the presence of standing water in tables and reservoirs greatly increases the relative humidity in a room. There are a variety of reasons as to why cultivators must maintain proper humidity levels in their growrooms. For the most part, properly balanced humidity in a garden helps plants combat airborne pathogens and ensures appropriate nutrient uptake. To illustrate, both powdery mildew and botrytis thrive in poorly ventilated, humid conditions. Also, if immersed in overly humid conditions, plants tend to pull water directly from the air instead of through their root systems. This phenomenon can cause issues with both overwatering and malnutrition. Air quality issues relating to excess humidity can be rectified with proper ventilation and air exchange as well as with dehumidifiers.

"MAINTAINING IDEAL TEMPERATURES IN A GROWROOM CAN PROVE TO BE A CHALLENGE DUE TO A VARIETY OF FACTORS INCLUDING DAY AND NIGHT CYCLES WITHIN THE ROOM AND OUTDOOR TEMPERATURE FLUCTUATIONS."

MACRO AND MICRO AIR EXCHANGE

Macro air exchange involves the consistent control of ambient air quality in a growroom throughout a crop's lifecycle. To this end, expert gardeners recommend that the air in a growroom should be entirely exchanged every one to three minutes for optimal growth and vigor.

There are a couple different equipment options available that can be utilized to ensure efficient air exchange in a room: intake/outtake systems and air conditioning (AC). When properly used, these tools can help ensure proper balances of both temperature and humidity.

The use of an intake/outtake air-exchange in an indoor grow is the most traditional, and affordable, method for maintaining an optimal equilibrium of air quality in a growroom. Essentially, these rooms are equipped with large inline fans that pull humid, hot air out of the room through ducting and pull fresh air into the room. If properly balanced, and depending on the season and geography in question, this system should rectify most issues with heat and humidity.

The use of mini-split and industrial AC units in regulating air quality issues is on the rise within the indoor gardening community, due primarily to an upsurge in sealed room growing. With the sealed room methodology, it is essentially up to the AC unit to pull humidity from the air and regulate temperature. However, these growrooms necessitate the use of a CO_2 injection system to supplement the CO_2-rich air that is brought in with the traditional intake system.

Finally, micro air flow refers the movement of air within a growroom that functions independent of the macro air exchange system in place. Generally speaking, micro air flow in a growroom is regulated by way of wall fans. These fans ensure that air from intakes, AC systems, and CO_2 devices is evenly distributed around the growroom. Moreover, they resolve issues with "dead air" pockets within indoor gardens. Dead air pockets leave portions of a garden's canopy susceptible to pathogens due to lack of air circulation.

Controlling air quality in a growroom is a carefully balanced affair. It requires a harmonious balance of equipment, infrastructure, and troubleshooting. Most importantly, these components must work in unison to address temperature and humidity levels in a garden. Once these core elements are addressed, cultivators can comfortably move forward alleviating less-pressing concerns with dead air pockets, CO2, etc. In the end, proper air quality will allow plants to utilize nutrients and light more efficiently, adding overall value to an indoor cultivation operation.


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Understanding PLANT HORMONES

Thankfully, plants employ a fraction of the hormones your unruly teenagers have, but the ones they do have play an important role in how they function and grow. Chris Bond takes a closer look at how these chemicals interact and how they affect your plants.

by Chris Bond

Plants, just like humans and all other living things, make hormones to fulfill their natural functions. Unlike humans, who produce about 50 different types of hormones, plants only produce five. These five classes of hormones—known as the classical five—are produced in various parts of a plant to serve either at the site of their production or elsewhere in the plant. Naturally occurring plant hormones and hormone types are: auxins, gibberellins, cytokinins, ethylene, and asbscisic acid. Some of their functions overlap, and some are quite unique. All, however, are needed for a plant to maintain health and produce viable flowers, seeds, or fruits.

The complexities of the interactions these five plant hormones have are still not fully understood, though large portions and sequences are known. The combination and levels of each hormone are different for each plant species and at each different stage during their respective developments. For example, auxins, gibberellins, and cytokinins are all synergistically involved in the setting of most fruits. Individually, each may be able to initiate the process but cannot see it through to completion without the assistance of the other two hormones. Abscsisic acid is thought to also play a role in fruit development, but its exact role in the process is not yet known for sure. In other interplays, abscisic acid is produced in concert with ethylene even though their purposes are contradictory in regard to fruit ripening and drop.

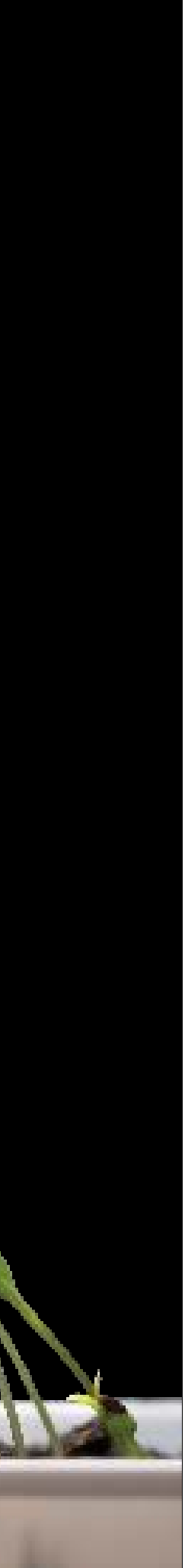
Do Plants Really Have **HORMONES?**

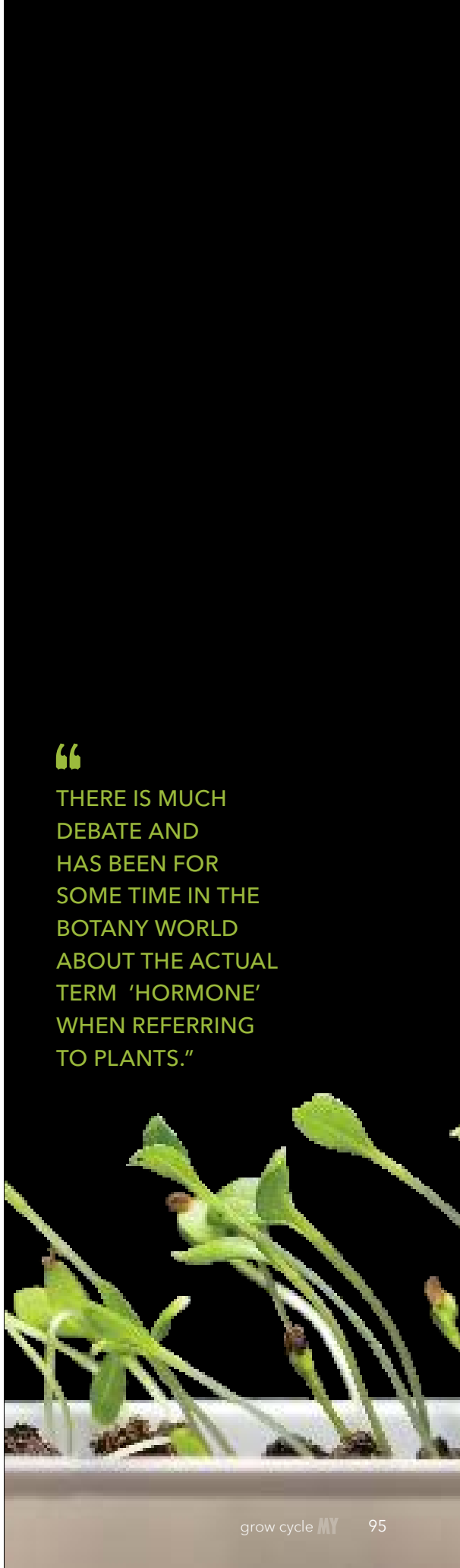
There is much debate and has been for some time in the botany world about the actual term "hormone" when referring to plants. While no one reading this is likely to pound their fists on their breakfast tables demanding to know why this has not yet been resolved, there are several compelling reasons as to why this clash exists. Some botanists and plant scientists suggest that the term "plant growth substance" is more apt. The rebuttal to that phrase is that "substance" is too vague a term. Those that want to do away with calling them hormones argue that, unlike hormones in mammals, plant hormones often serve contrary functions that don't have a parallel in the animal world. For example, a plant will produce both a substance that will cause it to grow and a substance that causes it to go dormant or even die. There is not such a conflict of roles in the world of animal hormones. These researchers claim that scientists are trying to make these substances fit the mold or definition of animal hormones based on their roles, and they just are not the same thing.

For the purposes of this article, the term "hormone" will be used in the traditional sense regarding their functions and roles within plants. We will have to let the academics fight out the merits of their semantic choices, but until then, "hormone" it is.

AUXINS

Most people, whether consciously aware or not, have seen and can recognize the effects of the auxin hormone in plants. It is responsible for the phototropic tendency in plants to grow toward the light. It performs this task to allow for maximum photosynthesis. It achieves this by moving throughout the plant towards the sections that are receiving the least amount of light. In these areas, the plant cells are then enlarged, which aids in the plant's ability to elongate and bend toward the available life-giving light.





"THERE IS MUCH DEBATE AND HAS BEEN FOR SOME TIME IN THE BOTANY WORLD ABOUT THE ACTUAL TERM 'HORMONE' WHEN REFERRING TO PLANTS."

> IF A PLANT NATURALLY LACKS GIBBERELLINS, IT WILL BE DWARFED IN STRUCTURE AND STATURE. SOME COMMERCIAL PLANT GROWERS INTENTIONALLY BLOCK GIBBERELLINS FROM BEING PRODUCED OR RECEIVED IF A DWARF PLANT IS DESIRED."

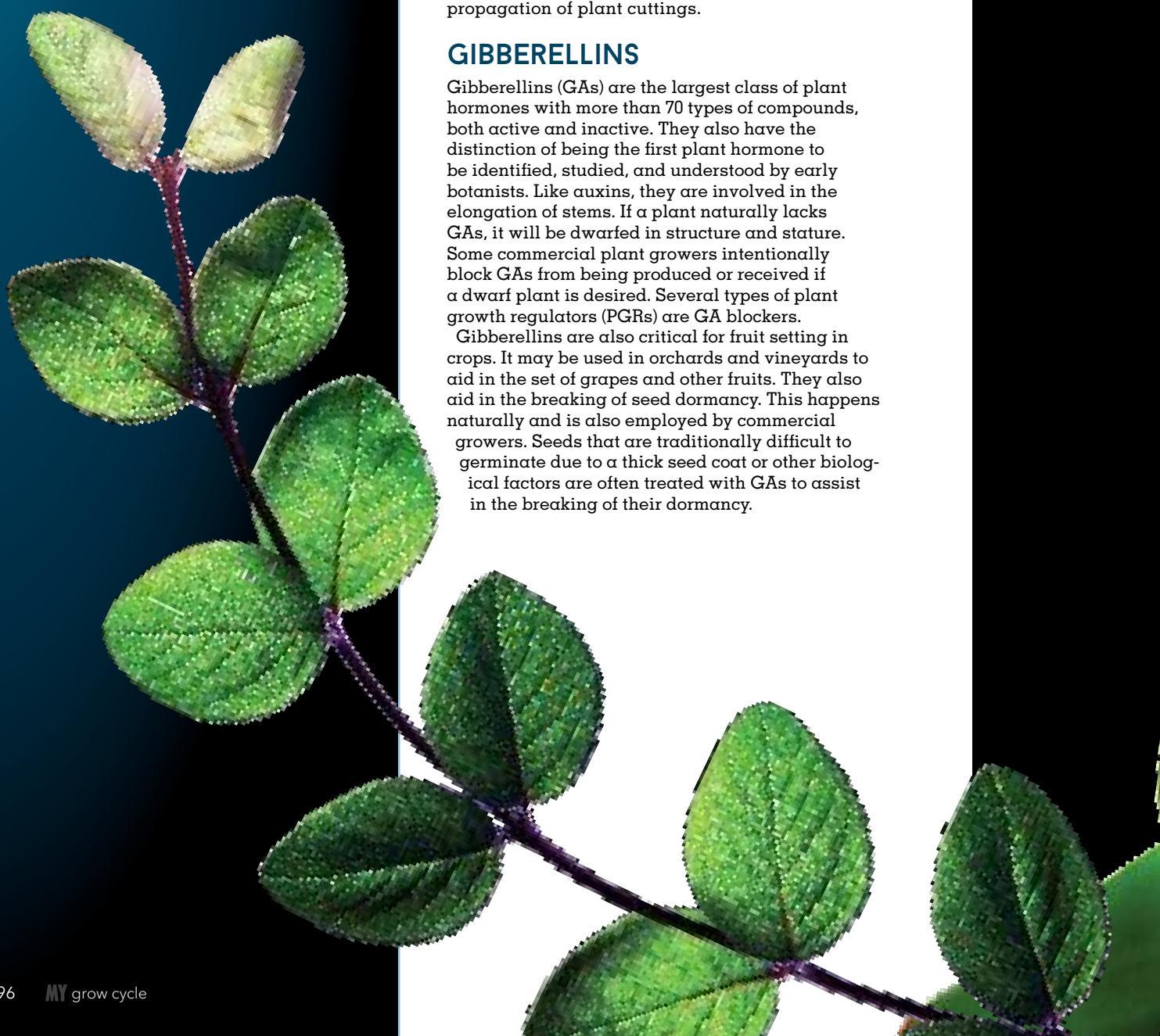
Anyone who has ever trimmed a plant or shrub has also seen the effects of this plant hormone. Auxin is responsible for stem elongation at the tip of the stems. This tendency of a plant to keep growing up is called "apical dominance." When these tips are pruned or even unintentionally broken, the plant then grows outward causing a stockier, usually better and stronger branched plant.

Most auxins that are commercially used are synthetic, due to the higher costs associated with naturally occurring auxin. They are used for both promoting growth as well as killing it. On fruit trees, synthetic auxins are used to treat pruning sites for sucker growth to prevent their return as well as to prevent the setting of fruit. They are also the primary compound in many popular herbicides. They cause uncontrollable cell growth, like a cancer, in plants and cause them to essentially grow themselves to death. This is how 2,4-D works so well for controlling broad-leafed weeds. On the flip side, other types of synthetic auxins are the primary component of rooting hormones for the propagation of plant cuttings.

GIBBERELLINS

Gibberellins (GAs) are the largest class of plant hormones with more than 70 types of compounds, both active and inactive. They also have the distinction of being the first plant hormone to be identified, studied, and understood by early botanists. Like auxins, they are involved in the elongation of stems. If a plant naturally lacks GAs, it will be dwarfed in structure and stature. Some commercial plant growers intentionally block GAs from being produced or received if a dwarf plant is desired. Several types of plant growth regulators (PGRs) are GA blockers.

Gibberellins are also critical for fruit setting in crops. It may be used in orchards and vineyards to aid in the set of grapes and other fruits. They also aid in the breaking of seed dormancy. This happens naturally and is also employed by commercial growers. Seeds that are traditionally difficult to germinate due to a thick seed coat or other biological factors are often treated with GAs to assist in the breaking of their dormancy.



CYTOKININS

These plant hormones (CKs) are responsible for aiding in cellular divisions and maintaining plant metabolic activity. It is found within plants wherever there is a site that is actively growing, such as at leaf tips. Commercially, CKs are used when propagating with tissue culture. As they are involved in the action of setting fruit, they are also utilized as a fruit growth regulator. Unlike both ethylene and abscisic acid, CKs prevent senescence in leaves.

ETHYLENE

Ethylene may be the most well-known of the plant hormones; it is the only gaseous plant hormone that is produced (it's a hydrocarbon). It is responsible for the ripening of fruits, both naturally and intentionally. In cases where crops, particularly fruits like bananas, are picked or shipped before maturation, they are usually artificially ripened via natural or synthetic ethylene compounds.

A synthetic form of ethylene known as Ethephon is used widely in commercial nurseries and plantations. This hormone is used on much of the world's pineapple, rice, coffee, cotton, and other staple crops to achieve uniform and quicker ripening. It is also the most common component of most commercial PGRs, especially for plant seedlings. It is additionally used for leaf and fruit abscission, where a controlled leaf or fruit drop is desired for commercial purposes.

ABSCISIC ACID

Abscisic acid (ABA) inhibits cellular growth, unlike CKs which promote it. It functions to assist with plant processes such as seed dormancy and takes the controls of a leaf's stomates during the process of wilting. Abscisic acid is the outlier of the commercial plant hormone world. There are no synthetic compounds available, and its high cost, coupled with its lack of a commercial purpose, mean that this is the only plant hormone not used artificially at one time or another in commercial plantations, greenhouses, or nurseries.

"OTHER IDENTIFIED PLANT HORMONES INCLUDE JASMONATES (SUCH AS METHYL JASMONATE), SALICYLATES, BRASSINOLIDES, AND STRIGOLACTONES."

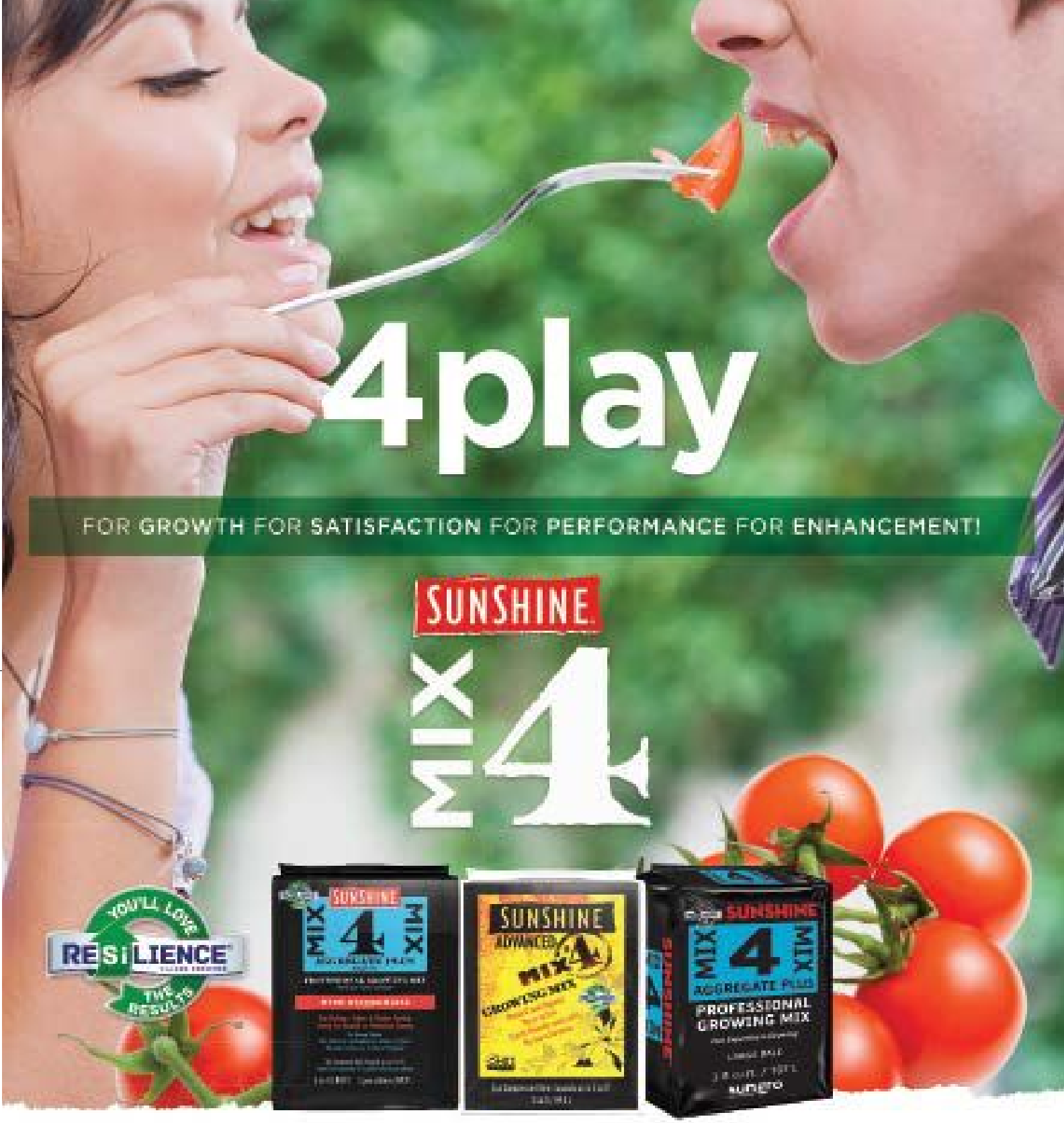
> “LIKE JASMONATES, STRIGOLACTONES ARE COMMUNICATING HORMONES, BUT THEY SERVE THE ROOT SYSTEM OF PLANTS.”

Other Plant HORMONES

There are far more plant compounds produced naturally that perform various functions within plants than just the classic five. It is highly likely that even more will be discovered as researchers continue to look at the myriad interactions of these hormones. Other identified plant hormones include jasmonates (such as methyl jasmonate), salicylates, brassinolides, and strigolactones.

Jasmonates are involved in many regulatory functions of plants but are most unique in their ability to aid in a plant's defense against wounds by producing substances that are unpleasant or harmful to pest insects. It is also thought to send signals to other plants, which in turn increase jasmonate production themselves. Salicylates also play a role in defense. They are a “first-aid” mechanism for plant infections. Their release can help a plant to reserve some of its nutrition and energy stores during its recovery. First discovered on rapeseed, a brassica, brassinolides also aid in helping a plant through stress, but are also thought to play roles in conjunction with the five major hormones in leaf and fruit development. Like jasmonates, strigolactones are communicating hormones, but they serve the root system of plants. They are critical in the relationship between the root system and mycorrhizal fungi development. In parasitic plants, strigolactones aid in the germination of seeds to establish dominance over the host plant.

On a final note, florigen, not mentioned above, was thought to be a mystery plant hormone responsible for seasonal flowering in some species. While still not completely debunked, it is now thought to be the result of synergy between other plant hormones and not a unique hormone unto itself. MY



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Smell Ya Later: Masking Odors

By Rich Hamilton

Love 'em or hate 'em, you should consider your neighbors when growing indoors. After all, you don't want to be known as that person with the smelly house.

When growing in an urban environment, considerations need to be taken to account for other people and families living in close proximity. One of these considerations is smell. While tomatoes, strawberries, and chilies have a relatively light smell, herbs like lavender, rosemary, and basil produce stronger smells you may wish to clean out if living within a built-up area. Another good reason to remove these odors is to stop insects and pests from detecting and homing in on your grow. The last thing you would want is pests infesting your indoor garden. In such an environment, they can thrive and reproduce at an alarming rate.

> "ANOTHER GOOD REASON TO REMOVE THESE ODORS IS TO STOP INSECTS AND PESTS FROM DETECTING AND HOMING IN ON YOUR GROW."

With modern hydroponic equipment being as good as it is these days, most odors and bacteria can be scrubbed out by passing contaminated air through a carbon filter. However, depending on the quality of the carbon, the filter, the air movement, the humidity of the air being moved, and the plants you're growing, there can be some bacteria and odor remaining.

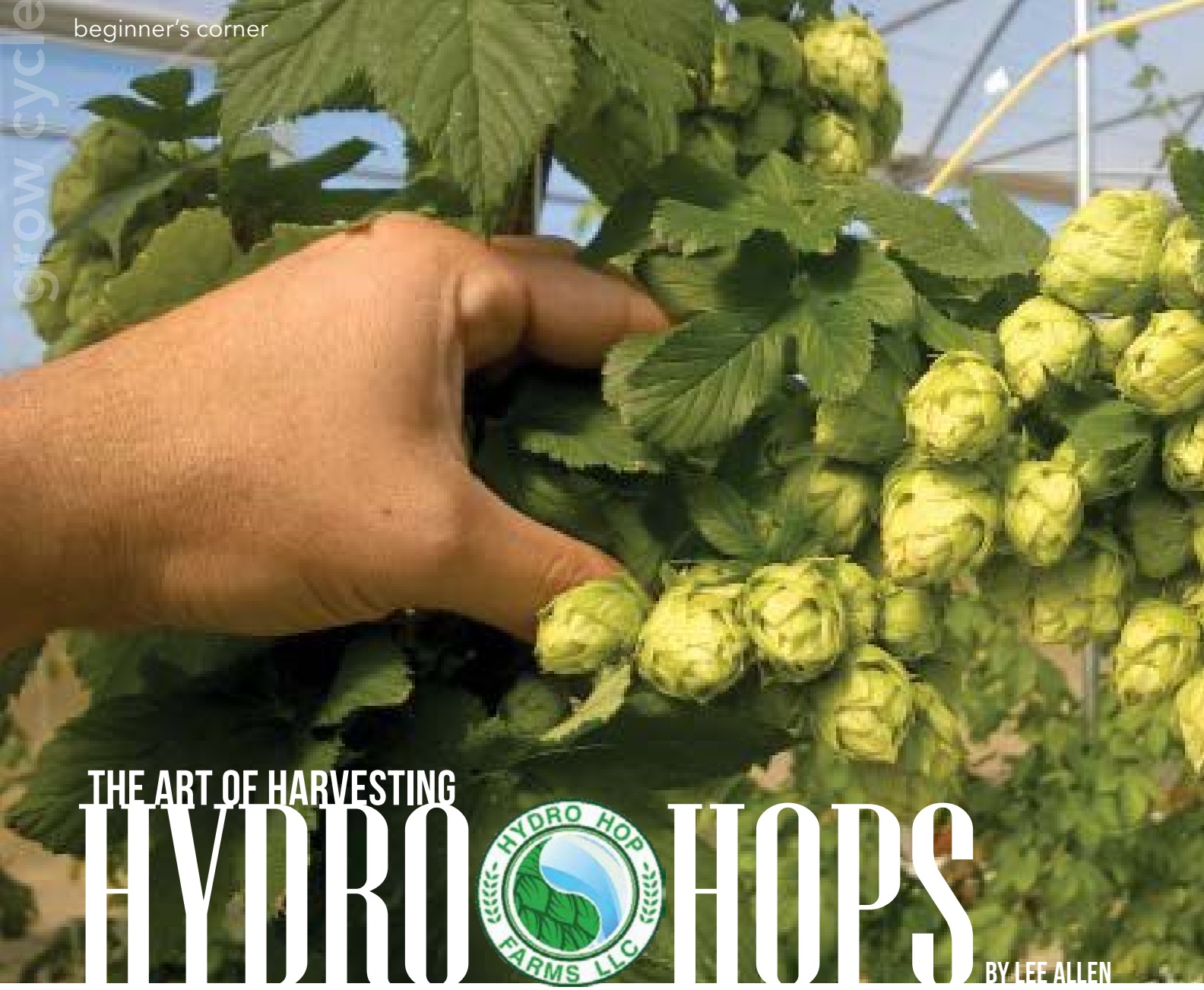
So, how do you get rid of these leftover, unwanted odors? One option is to use an ozone generator. Ozone generators work by producing ozone (O_3) out of oxygen gas (O_2). Ozone is very unstable, so it quickly breaks down back into oxygen. As it does this, it sterilizes the extra oxygen molecule, removing any bacteria and odors. One of the negative effects is that ozone generators produce their own odor, which smells kind of like a swimming pool. Some also say that ozone generators can affect your health. Personally, I find that they give me a sore throat and headache, but I know lots of people that swear by them and have no problems.

Option two is to mask the remaining odors with sprays, gels, wax blocks, and other products. They work by somewhat encasing the bad bacteria and odor that is already airborne. This masking restricts the underlying smell as it coats the unwanted odor with a new, fresh layer of smell. Think of it as layering a green coat over a red sweater; the red sweater is still there, but you can't really detect it anymore.

Masking odors doesn't eradicate or replace bad smells, so this method isn't foolproof. If you don't fully cover the odor, people will still be able to detect it. Even if you do a decent job, animals with better senses of smell, like dogs, will still be able to detect the odor you are trying to conceal along with the cover-up odor (this combination of two out-of-the-ordinary smells makes it very easy for them to detect an indoor grow). As for humans, the strong, distinct scents used to cover up unwanted odor can in turn act as an indicator of an indoor growing environment. This is fine if you are tiring to conceal your grow from pests, but if you want to go undetected by the human nose, it basically swaps one problem for another.

So, what is the definitive answer to getting rid of bad odors? Combine your options. If your air outtake is going directly outside, I would suggest pulling the dirty air out of your growing environment first through a carbon filter, then through an ozone generator, and then over a masking smell block. If your outtake is going back in to a living environment and you're sensitive to ozone generators, I would cut out that step and put another carbon filter at the end of the outtake in the living area instead. This way the air is pulled out of your growing environment via a carbon filter, which cleans it, then passes through an odor masking block or gel, which covers any leftover smell, and then is pushed back through a separate filter.

There you have it. If you want clean odor- and bacteria-free air from your growroom, remember these mantras: Clean it, kill it, mask it; or clean it, mask it, clean it. Simple recipes for sweet-smelling success!



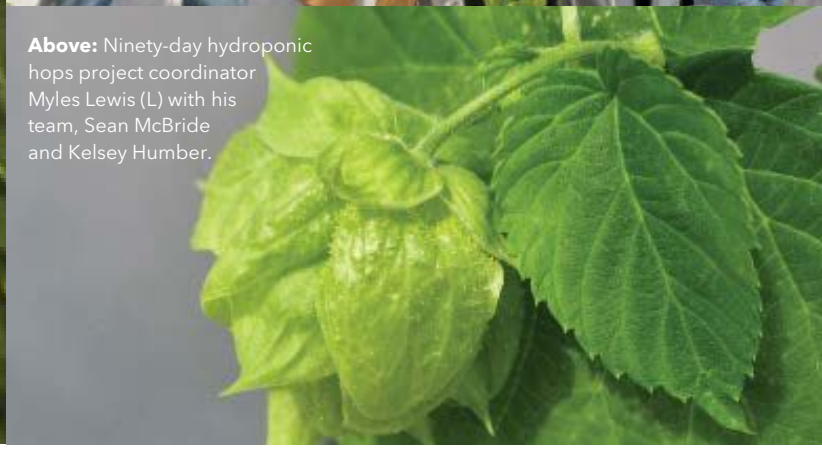
THE ART OF HARVESTING HYDRO HOPS

BY LEE ALLEN

Hydroponic hops aren't new, but growing them in nutrient-rich solutions is. As demand from the beer industry for a reliable source of fresh hops increases, efforts are being made to produce hydro hops that are as good and more reliable than field hops.

The old From Our Field to Your Fork slogan has some competition—From Our Greenhouse to Your Glass—as the concept of growing hops hydroponically gains industry traction.

While the Pacific coastal states of California, Oregon, and Washington were early trendsetters in field production because of favorable climate, good soil, and a supply of irrigation water, other growers—hydroponic hop farmers—are appearing in several new states following the path of the first commercial hop production in Massachusetts in 1648.



Above: Ninety-day hydroponic hops project coordinator Myles Lewis (L) with his team, Sean McBride and Kelsey Humber.

The folks at *BeerAdvocate* note that while hydroponic growing techniques have been around since the early 17th century, growing hops in a mineral-rich nutrient solution is a recent endeavor, one they think will impact the beer industry, especially the craft beer brewers.

"In the world of beer, one ingredient reigns supreme," they report, "and that's hops." Getting them fresh and frequently from the field has been problematic, but the harvesting of hydroponic hops, grown under species-specific horticulture techniques, can be done in perpetual production according to HydroHop Farms in Colorado.

"We have designed and developed methodology to overcome the single hop harvest per annum in field-grown conditions. Our Hoponics research model of perpetual production allows the ability to grow three to five crop cycles per year." HydroHop harvests several varieties for wet-hop brewers using fresh product, hops that have been harvested less than 24 hours before. One brewer lauded the indoor efforts, noting the fresh hops were sticky and smelled great with no leaf burn found on outdoor-grown hops.

Colorado State University (CSU) horticulture professor Dr. Bill Bauerele leads that university's research program focused on controlled environment hydroponic hop production. "January 2016 was our first crop. Now we're doing five to six crops a year," he says.

Housed in a 40x80-foot greenhouse, Bauerele has some 3,200 square feet of growing space to experiment with an initial six or seven species of the 130 cultivars that are currently commercially available. "There's some funding for hops breeding, but USDA has no federal grant monies for hops production, and at one point in our set-up, we ran out of money. As an army of one, we moved forward slowly and after a year and a half, have built a nice system with environmentally controlled watering and individual plant nutrient injections."

As an open-field farmer before becoming a researcher, Bauerele says, "People don't realize how much work is involved here. Hops are a physically demanding plant and I've never worked this hard in my life."

"WORKING out of an 1,100-square-foot greenhouse, the trio got to explore what was, for them, the unknown. Selecting some 15 different varieties of hops, 100 plants found new homes in peat substrate and the race was on."

A common problem to the handful of hops adventurers taking a leap into the unknown is exactly that, the unknown. "Much of the available literature dates back to the 1950s and 1960s and the growing techniques described pertain to field production. Hydroponics isn't going to replace that, but wet hop beers that are brewed directly off the vine within 24-48 hours, breeders are interested because of the multi-cropping freshness. They'll pay a premium price and that helps offset the capital costs of setting up the necessary infrastructure to conduct research and production."

The newest kid on the block is a 90-day-wonder named Myles Lewis, owner of Arizona Vegetable Company and a researcher at the University of Arizona's Controlled Environment Agriculture Center (CEAC) in Tucson—known for its vertical-grow tomato production.

In June, Lewis got the opportunity to build a short-term, low-cost, what-do-we-have-to-lose 90-day hydroponic hops experiment. "We knocked out our first product in short order, pondered some of our lessons learned, then planted a second crop in September with the intent of moving forward beyond that," he says.

Although the interest has been there for some time, "A whole bunch of variables came together at the correct time and we said, 'We've got critical mass, let's do it.'" Utilizing a mere $18,000 in start-up funding, Lewis and two plant science students moved forward. "It was challenging because none of us had ever grown hops and although we received a lot of informal advice, we were basically flying blind."

While growing hydroponic greens is his usual forte, Lewis says, "In my mind as a grower, hops production is just another crop offering and the way we're growing them is very similar to growing traditional high-wire tomatoes using Tomahooks, tomato clips, gutters, and drippers. It's reminiscent of tomato production in a large-scale greenhouse, not reinventing the wheel, but adapting known technology, inserting a new crop into an existing system, and figuring out the variables that play into that."

Working out of an 1,100-square-foot greenhouse, the trio got to explore what was, for them, the unknown. Selecting some 15 different varieties of hops, 100 plants found new homes in peat substrate and the race was on.

"Let's just say there were a couple of malfunctions that will become more humorous as time goes by," Lewis admits. "Like an operator error that almost destroyed the project on day one by overwatering the crop. Then, a mechanical failure of some of our pumps. And toward the end of the first harvest, a pest management problem involving some severe white fly and spider mite infestations."

Initially, the pilot project had to establish whether or not it would even get off the ground. "We needed to determine if this dog would hunt," is the way Lewis describes it. "We sat there day by day, looking at the flowers, wondering if they would flower, cajoling them to do so. Like a lot of research, it's all a crap shoot."

The initial harvest in mid-August bagged up 3.7 pounds of aromatic hops and the expectation is that the Phase II yield will be much higher. "The neat thing about these plants is that they're a multi-year plant, not a one-shot like an annual where you get one crop and it's done. Hops are like a fruit tree where every year you get a bigger harvest. We're working under the assumption that production increases dramatically after the first year and that drives the importance of keeping the program going now that we have an established library of plants. We'll continue to seek industry support to continue it, but this train is rolling and I have no intention of stopping now."

Lewis's predecessor at CEAC, Colin Clark at HydroHops, says, "My first attempt to grow hydroponic hops was in the University of Arizona CEAC club greenhouse, where we wanted to see if we could get a handful of plants to survive. They did and I took that experience with me to Colorado and scaled it up to over 2,000 plants in a 5,000-square-foot greenhouse."

As co-owner and head grower, Clark set out to provide beer brewers with a quality of hop higher than that of traditional growing methods, a variety of strains providing wet hops offered in an extended growing season.

"Hydro Hop Farms LLC is currently harvesting its fourth season, proving that hops can be grown successfully in a hydroponic greenhouse using artificial off-season lighting to produce hops of superior quality and oil content. Going into current season five, our main challenge is to make this a more profitable venture."

Labor and harvesting equipment are two of the major cost factors to be considered and resolved. "It currently takes someone about an hour to harvest just over a pound of dry hops and while hard harvesting is okay for small niche growers, scaling things up for greater production requires mechanical harvesting as well as some tweaking over the way we space and grow our plants," Clark says.

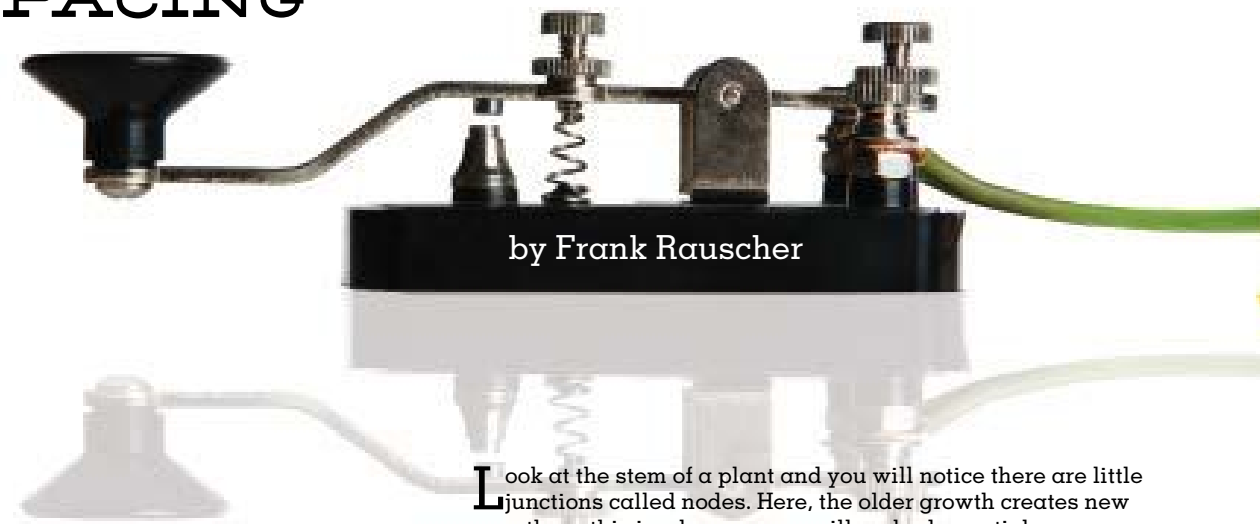
> "PEOPLE don't realize how much work is involved here. Hops are a physically demanding plant and I've never worked this hard in my life."

Like many start-up operations, many hands make work lighter and Clark says hydroponic hop greenhouse growers need to help each other. "We need to share research, share knowledge, and share our passion. Our company motto is, 'We're not here to make a dollar, we're here to make a change.' The future holds good things for controlled environment growing; we just need more educated workers, enthusiastic entrepreneurs to keep the ball rolling and prove to the consumer and the investors that controlled environment agriculture can and should be a respected part of the commercial agricultural industry."

Adds CSU's Bauerele, "Despite the setbacks we've encountered in our research experiments, I'm not giving up on this because it's doable and the growing commercial interest from a number of large North American growers supports that theory." MY

MORSE CODE FOR PLANTS:

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 photosynthesize 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 vigor 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 vigor. That's because one goal of every grower is to maximize their plants' rate of photosynthesis and thus maximize 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 photosynthesize properly and produce short internode regions in dimly lit locations. As such, knowing your crop is important. Being able to recognize 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 vigor 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 recognize 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.

by Frank Rauscher

SECOND TO NONE:

Secondary & Micronutrients

Most growers have a handle on primary nutrients and macronutrients, but how is your understanding of the lesser known secondary and micronutrients? As Frank Rauscher explains, these, too, are important for plant health and vigor.

Understanding essential plant nutrients and their role in the garden is the quest for every grower. To be a successful grower, knowing the difference between primary and secondary nutrients is as important as knowing why nutrients are categorized as macro and others as micro. There are nutrients that are required by plants in larger quantities (referred to as macronutrients) and others that are needed in trace or much smaller quantities (micronutrients). Though many may assume all macronutrients are considered primary, there is yet another divide within this group—that of primary and secondary macronutrients (Fig. 1). Some of the essential nutrients come from the air and water, while the rest come from the soil or grow media and from fertilizers added to that media.

"MOST soils supply some of these 'lesser' nutrients, but very often some are missing. With other grow media, these nutrients will likely be missing completely."

from air and water	*from grow media and fertilizer*	
Carbon (C)	*Primary:*	Zinc (Z)
Hydrogen (H)	Nitrogen (N)	Copper (Cu)
Oxygen (O)	Phosphorus (P)	Iron (Fe)
	Potassium (K)	Manganese (Mn)
	Secondary:	Boron (B)
	Suphur (S)	Chlorine (Cl)
	Calcium (Ca)	Molybdenum (Mo)
	Magnesium (Mg)	Cobalt (Co)

Fig. 1

The idea of certain nutrients being more important than others is misleading. Though the amount of these nutrients varies between plant genuses and species, these nutrients are all required to some degree for plant health and vigor. As a crop's yield increases, so is the uptake of almost all essential nutrients. We can look at leaf tissue analysis to get a better idea of how much of the essential nutrients a plant actually needs. The chart below (Fig. 2) is reflective of a cereal crop similar to barley.

nutrient measured in per cent	*low*	*sufficient*	*high*
Nitrogen (N)	1.25	1.75 - 3.0	3.0 - 4.0
Phosphorous (P)	0.15	0.26 - 0.5	0.5 - 0.8
Potassium (K)	1.0	1.5 - 3.0	3.0 - 5.0
Sulfur (S)	0.1	0.15 - 0.40	0.40 - 0.8
Calcium (Ca)	0.1	0.2 - 1.0	1.0 - 1.5
Magnesium (Mg)	0.1	0.15 - 0.50	0.50 - 1.0
nutrient measured in PPM	*low*	*sufficient*	*high*
Zinc (Zn)	10	15 - 70	70 - 150
Iron (Fe)	15	20 - 250	250 - 500
Manganese (Mn)	10	15 - 100	100 - 250
Chlorine (Cl)	3.0	4.5 - 25	25 - 50
Cobalt (Co)	1.7	2.5 - 25	25 - 50
Copper (Cu)	2.3	3.7 - 25	25 - 50
Boron (B)	3	5 - 25	25 - 70
Molybdenum (Mo)	0.01	0.03 - 5	5-10

Fig. 2 Plant Tissue Analysis - /Growth Stage Whole Plant

Note: *Requirements for macronutrients is listed in per cent, while micronutrients are ppm (or 1/10,000 per cent)*

Source: *Manitoba Provincial Soil Testing Laboratory, 1987.*

"CALCIUM improves the absorption of other essential nutrients by the root system, as well as facilitating their translocation within the plant."

When researching nutrient requirements, one will find many sources that have documented the primary macronutrients, but then the available information drops off for the others. Most soils supply some of these "lesser" nutrients, but very often some are missing. With other grow media, these nutrients will likely be missing completely, which is no problem if the grower provides nutrients that make up for this. Be sure to read the label of your preferred nutrient products to make sure your plants are receiving what they need.

Since there is no shortage of information on primary macronutrients, let's look at secondary macronutrients and what they do for a plant. These are sulfur, calcium, and magnesium.

SULFUR

Sulfur is integral to every living plant cell. It is required for synthesis of various amino proteins and acids as it is required during the process in which nitrate nitrogen is converted to amino acids. Sulfur is a key nutrient for photosynthesis and crop winter hardiness. Obviously, sulfur is vital to plant health and yield.

Sulfur is supplied to plants from the soil by organic matter and minerals, but it is often present in insufficient quantities. Most of it is tied up in the soil itself and not available to the plants until converted by bacteria to sulfate. During this mineralization process, acids are created in the soil and help bring down soil pH. This pH adjustment is very helpful in soils that typically face high pH issues. High pH will cause many nutrients to become bound to soil particles and remain unavailable for plant uptake. After this process, as a sulfate, it is mobile and is often leached through the soil and away from the plant.

When diagnosing malnutrition, sulfur deficiency and nitrogen deficiency are often confused. Symptoms of both deficiencies may appear as plants with poor growth, and often as a general yellowing of leaves. Sulfur, then, is not mobile within the plant. With sulfur deficiency, yellowing symptoms often first appear in younger leaves, whereas with nitrogen deficiency, the yellowing appears on the older leaves first. In less severe situations, visual symptoms may not even be noticeable.

CALCIUM

Calcium is often an overlooked essential nutrient, though it carries a very important load in plant growth. Soil fertility programs are developed for many high-yield and high-quality crops. When calcium takes a back seat, not only does yield suffer, but plant health and many other factors are influenced. Peanut and tomato growers are probably the most likely exceptions to this problem as they generally emphasize good calcium nutrition for their crops.

Calcium improves the absorption of other essential nutrients by the root system, as well as facilitating their translocation within the plant. It can activate a number of plant growth enzymes and helps to convert nitrate taken up by the plant into forms needed to produce proteins. Calcium is vital for cell wall formation and healthy cell division as well as improving disease resistance.

In the soil, calcium can replace hydrogen ions on the soil surface when it is added during fertilization, and it can increase the soil water-holding capacity. Microorganisms need calcium to perform the process of converting crop residue into organic matter. At the same time, calcium aids in releasing nutrients and helps enable nitrogen-fixing bacteria on the roots of legumes to capture atmospheric nitrogen and convert it into a form that the plant can utilize.

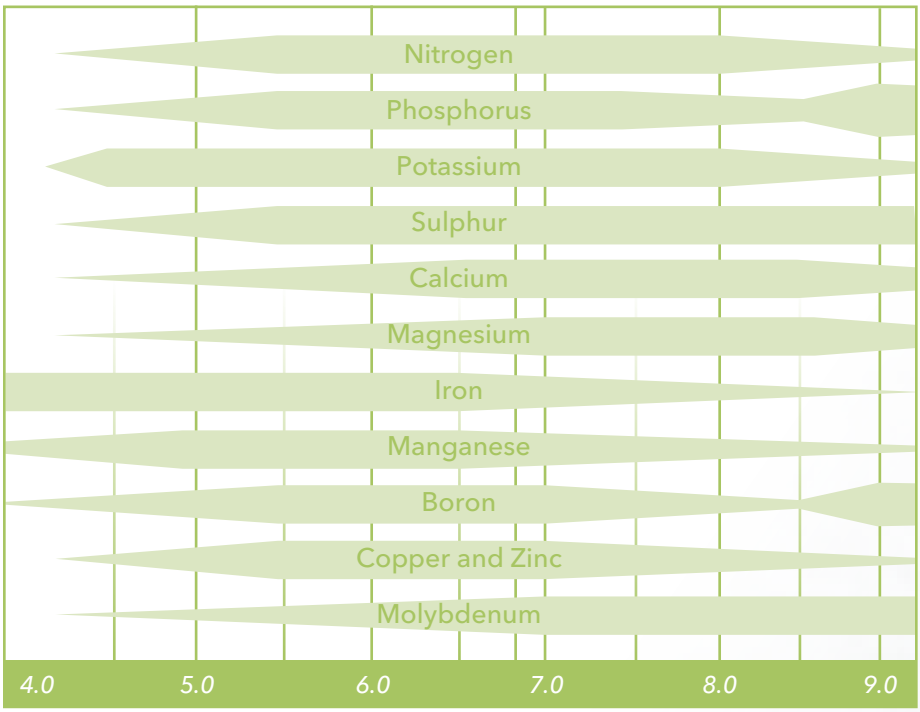


Fig. 3

"WITH hydroponic growing, many grow mediums do not naturally contain secondary nutrients and micronutrients, so attention to these 'lesser' nutrients is critical."

MAGNESIUM

Magnesium is very important for plant health as it is key in a plant's ability to produce and retain chlorophyll. The energy required for plant growth comes from photosynthesis and this process only occurs because of chlorophyll. Without chlorophyll, plants cannot manufacture food and life as we understand it would cease to exist. Magnesium is also important for various plant enzyme systems. Stunted growth is often the result of magnesium deficiency. Magnesium is usually available naturally in most soils and is often overlooked as an important nutrient that may be needed for the health and vigor of a crop. Magnesium becomes available within the soil by weathering processes on other natural minerals. Magnesium availability to plants is subject to soil pH.

Magnesium becomes subject to removal from soil when that soil is sandy or has a low pH (is acidic). Some crops will use and remove much more magnesium than others. Sugar beets and corn are two crops that use larger amounts of magnesium.

The ratio of calcium to magnesium availability is important. For soils with a cation exchange capacity (CEC) higher than about five ME per 100 grams, it is often a good idea to maintain the soil Ca:Mg ratio at about 10:1. For sandy soils (which leach more rapidly) having a CEC of five ME or less, it's generally best to maintain the ratio at about 5:1.

Outdoor agriculture has long focused on the primary macronutrients to maintain and improve plant health and yield. This has generally been successful as soil naturally provides most of the essential nutrients, though there are exceptions in this practice due to climate and location. With hydroponic growing, many grow mediums do not naturally contain secondary nutrients and micronutrients, so attention to these "lesser" nutrients is critical. As our outdoor growing acreage continues to come under nutrient stress due to crop utilization, and as we grow more of our food using hydroponic methods, we will need to make certain our fertilizers contain a complete balance of all the essential nutrients that plants need. For additional information, scan the QR code.

crop circles

by Shannon McKee

Benefitting from crop rotation

You don't have to be a commercial farmer to benefit from crop rotation. Some simple planning for your home garden will keep the soil healthy and the environment happy for years to come.

Not every gardener thinks about next year's crops when dealing with where to plant this year's crops. Some have this idea that crop rotation is only for big commercial farms. Others may think that they just don't have enough space for rotating their crops. The truth is that every garden can benefit from crop rotation when it comes to the positive effects that this rotation has on the fertility of your soil.

SOIL FERTILITY AND CROP ROTATION

Scientists are still learning more about the soil, and how people impact it in agriculture. Food science is a vital field that's making new discoveries all the time. Often these studies are done in places where food harvesting may be less than optimal to help find ways for farmers to improve their sustainable farming methods.

> “The truth is that every garden can benefit from crop rotation when it comes to the positive effects that this rotation has on the fertility of your soil.”

One such study was done in West Africa over a 14-year period that determined crop rotation increased the yield and added more nitrogen to the soil. This evidence points to how everyone should be aware of how they use their natural resources.

BEING SUSTAINABLE

One of the most important considerations today in how we use our ecosystem is sustainability. The way that the bulk of our crops have been produced for the past few decades involves large agricultural farms where the exact same crops are grown year after year. This takes a huge toll on the soil, as these crops are always needing the same nutrients to be used and the pests that attacked the soil are more than likely going to come back again and again. To battle these issues, farmers use large amounts of fertilizers and pesticides to get the crops to grow. Over time, this system just isn't sustainable because of the damage that occurs to the surrounding water and soil.

Crop rotation is just one practice in sustainable farming that offers better benefits for the world as a whole and your little piece of it. By planting a diverse group of crops and changing up where each is planted, you'll be helping the soil to be more fertile for the following years in addition to providing some natural pest and disease control.

NITROGEN AND CROP ROTATION

Nitrogen is one of the most important nutrients that exist in your soil. Crop rotations with nitrogen-fixing crops can help put nitrogen back into your soil naturally. Legumes and some cover crops are a great opportunity for nitrogen to be added to the soil. This makes your soil healthy and can increase your yields, and can also help reduce your garden's carbon footprint. The manufacturing of nitrogen fertilizer uses natural gas and increases your carbon footprint without even realizing it.

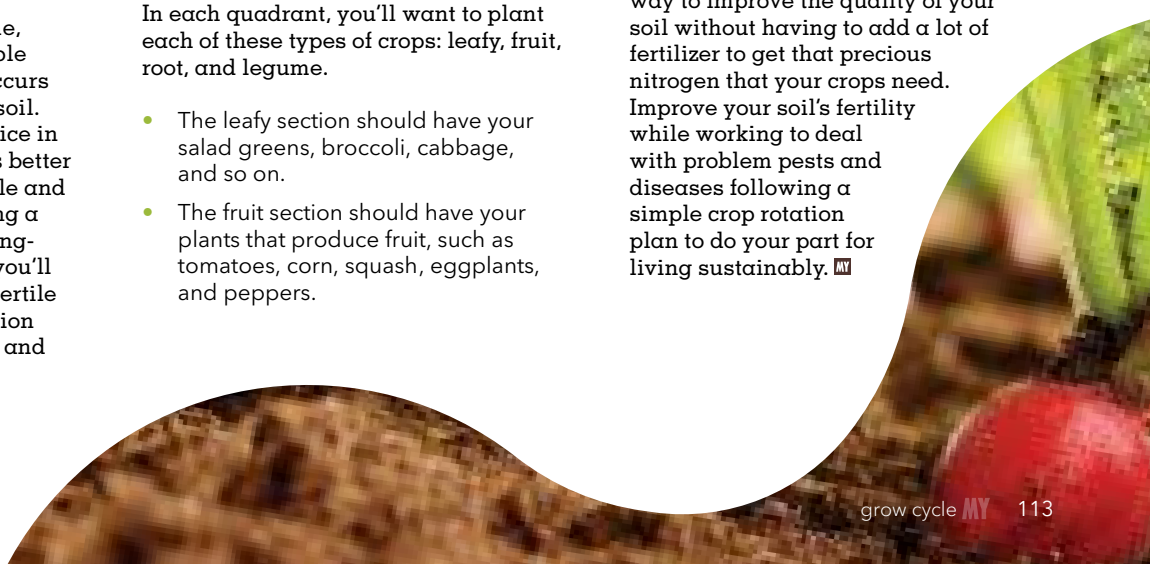
SIMPLE CROP ROTATION

Even the simplest crop rotation schedule can help to ensure that your garden is growing at a sustainable rate where you shouldn't have to add a large amount of fertilizer or use a lot of pesticides. The simplest way to rotate your crops is to designate four quadrants. In each quadrant, you'll want to plant each of these types of crops: leafy, fruit, root, and legume.

- The leafy section should have your salad greens, broccoli, cabbage, and so on.
- The fruit section should have your plants that produce fruit, such as tomatoes, corn, squash, eggplants, and peppers.
- The root section should have your plants that have edible roots, such as carrots, turnips, radishes, onions, and garlic.
- The legume section should have your beans, peas, and peanuts.

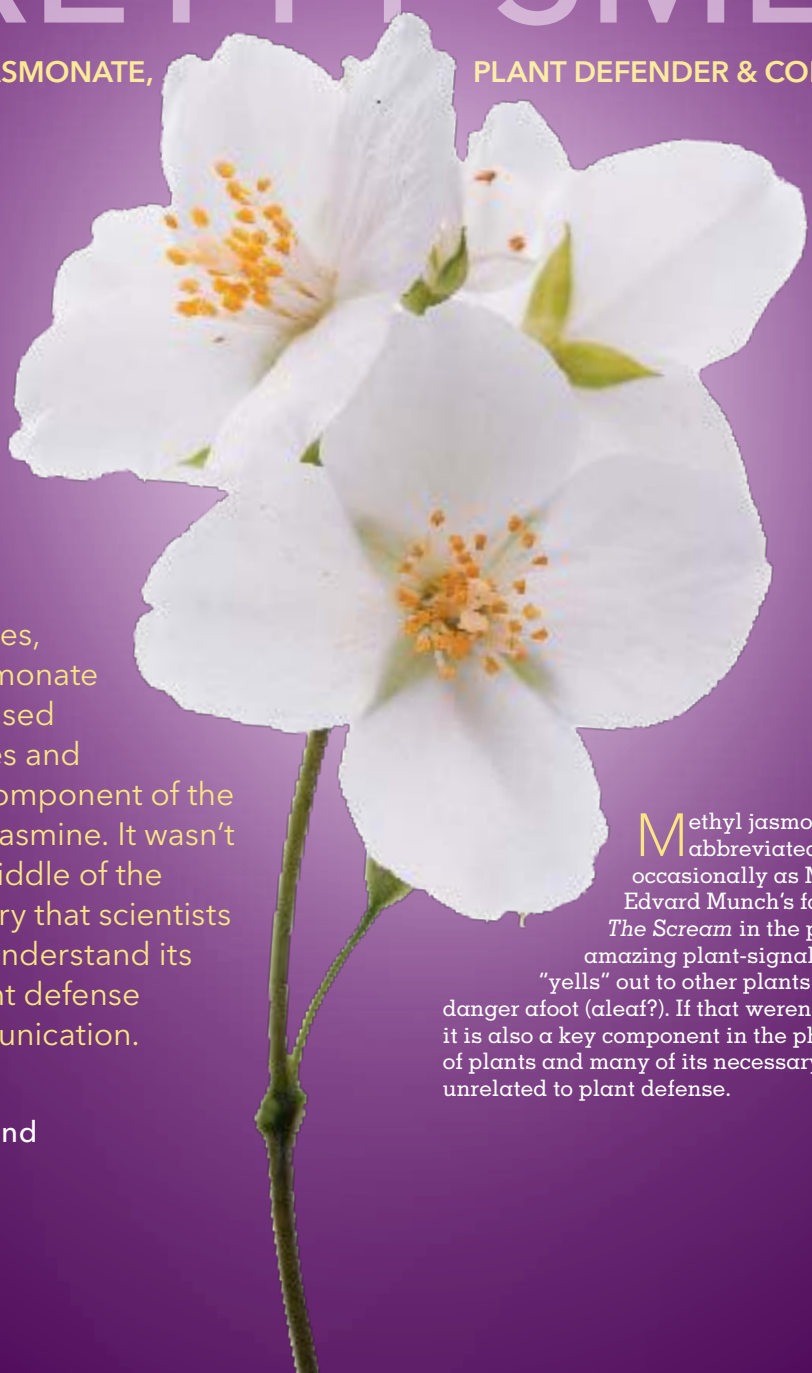
In the first year, you'll want to put each group in their own garden section. For example, start with with leafy greens in quadrant one, fruits in two, roots in three, and legumes in four. Then, in the following year, you'll want to move each back a quadrant. That means the leafy greens would be in four, the fruits in one, the roots in two, and the legumes in three. Keep going through this schedule over the coming years until they get back to their original position. At that point, you can start over again.

Creating a crop rotation in your backyard garden is an excellent way to improve the quality of your soil without having to add a lot of fertilizer to get that precious nitrogen that your crops need. Improve your soil's fertility while working to deal with problem pests and diseases following a simple crop rotation plan to do your part for living sustainably. MY



MORE THAN A PRETTY SMELL

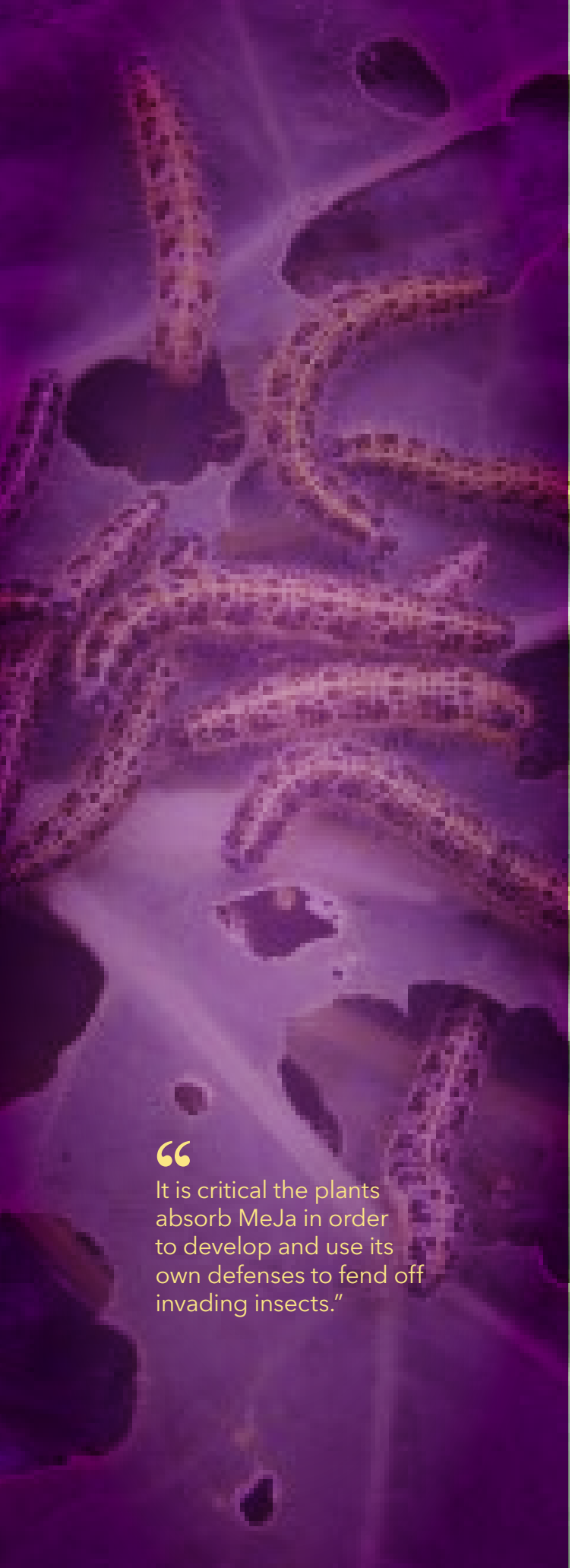
METHYL JASMONATE, PLANT DEFENDER & COMMUNICATOR



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 defense and communication.

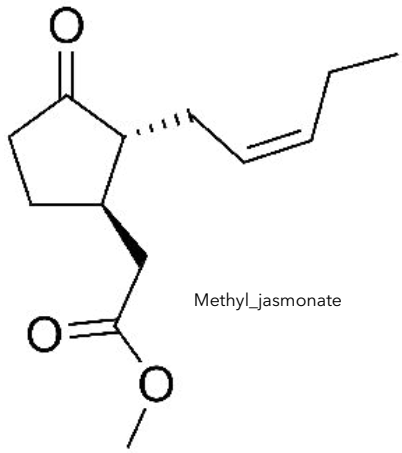
by Chris Bond

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-signaling 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 defense of plants and many of its necessary functions unrelated to plant defense.



> “It is critical the plants absorb MeJa in order to develop and use its own defenses to fend off invading insects.”

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 synthesized 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 DEFENSE 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 neighboring plants, signaling them to increase their own production of MeJa in preparation for whatever onslaught is about to be wrought. Amazingly, this signaling 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-signaling pathways. First, an analysis of mortality in mutant plants that had no natural ability to produce MeJa found that 80 per cent of the

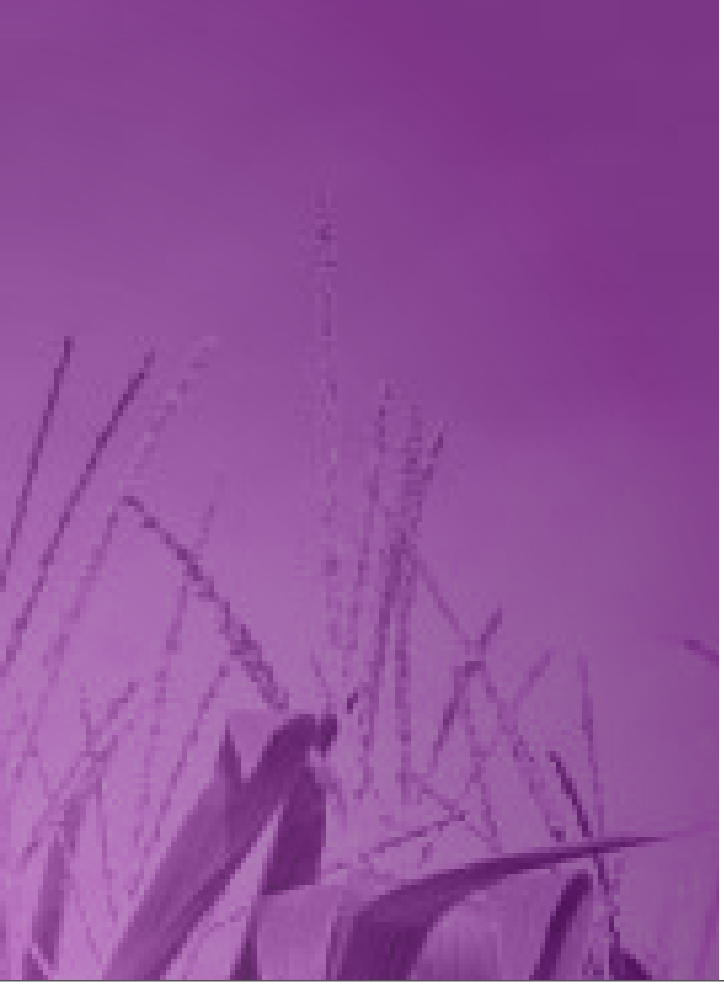
> “In plant predators, the effects of MeJa can range from an unpleasant digestive issue to causing cannibalistic tendencies.”

plants succumbed to predation by fungal gnat larvae. 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 defenses to fend off invading insects. Further, this study found that it was possible to block the wound-signaling 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 defense.”

The ability to protect a plant from predators is not the only defense 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 defense of plant pathogens as opposed to those that aid in the defense 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 defense 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.

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 neighbors, 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

> “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.”

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HydroGarden, the largest manufacturer and distributor of hydroponic equipment in Europe, is set to enter the US market. We sat down with **Danny Bower**, US sales manager, to see how this latest venture is unfolding and learn a little bit about how the company started.

Danny Bower

First, a little background info. When and where did the company begin?

In 1996, from a small business unit situated just outside Coventry in the UK.

What did the owners of HydroGarden do before starting this company?

HydroGarden was one of the first hydroponic shops in the UK when it was founded in 1996 by Iain Reynolds. He has a background in aerospace engineering and hydroponic retailing. Eight years later, in 2002, Stuart Green and Barry Geaney joined the company as directors and shareholders. Stuart has previously been the principal of a marketing and design studio; Barry was the finance director of an analytical laboratory. Our managing director, Jonathan Aldridge, joined later in 2012. He comes from a wide commercial background in industry and previously worked for PricewaterhouseCooper.

How did the partners of HydroGarden get into this industry?

Iain used to run a hydroponic farm in Australia, producing lettuces. He already had an interest in hydroponic growing. Stuart was consulting for HydroGarden on marketing and design before being invited to join the company, and Barry was approached by Iain for his financial background and experience. Jonathan was basically out of work when a job in sales at HydroGarden popped up and he applied for it—can't imagine he would have expected it to lead to becoming MD four years later.

What did you first produce?

So, apparently the first product we manufactured was a range of magnetic ballasts under the brand PowerPlant. I wasn't around for these ballasts. This year, we launched a new range of LUMii BLACK ballasts, which are taking the UK lighting market by storm. Sometimes, it's the old reliable concepts that need a slight tweak to keep business booming.

What are your company's strengths?

Our dedication to providing excellent customer service. We have some of the best reps in the industry. (No, I'm not just biased; this is genuinely the feedback we get in the UK). Our marketing team is creative and original, and we are the leaders in the market for product design and marketing campaigns.

How many people now work for the company?

Ninety-five.

What makes the HydroGarden employees so awesome?

The best thing about the staff at HydroGarden is the level of care and attention to detail they all give. We place massive emphasis on customer service and developing relationships with the retailers. It's something that gives us an edge in the industry, especially within the UK. Our team bond is fantastic; there's a real sense of cohesion, especially within sales, that I've yet to find in other businesses. It certainly makes working life easier on the more troublesome days.

What are some of your proudest moments?

We've achieved a lot as a company over 21 years. After speaking to various people, this is the shortlist we've got:

- **2006:** Secured freehold premises that still operate as head office to this day (with the support of two additional units)
- **2014:** This is one of my favorite moments at HydroGarden: we achieved a significant monthly turnover target, which resulted in all staff being rewarded with a holiday! Myself and the other account managers chose to go to Ibiza.
- **2016:** For its twentieth anniversary, HydroGarden celebrated with special offers, champagne at the most popular exhibition in Europe, marketing campaigns, and the opportunity for customers to win a trip to New York.
- **2017:** Our commercial team designed and developed an indoor vertical farming solution: V-Farm. This year, the company won a national award for manufacturing innovation.

How has HydroGarden expanded since the beginning?

We have been in our head office for 11 years now and since being here, we've added two warehouses, making a total of 120,000 square feet of warehousing space. We hold nearly 2,000 product lines in stock and are distributing in over 33 countries. Part of my job over in the States is to look at creating a presence for HydroGarden in the US market with four key product lines that we believe are a unique offering to US retailers.

What are these product lines?

The four products we're focusing on for the States are GoGro auto-irrigation system, Hyperion White Plessey LED, Spectron LED Boosters, and VitaLink plant nutrients and additives.

Where will you distribute in the States?

When we are fully set up, we will be able to distribute all over the US.

What significant things have you learned so far about the US market?

There are more similarities between the US and UK hydro industry than I first thought. Having the right product mix and offering unique USPs is essential over here, and it's the same back home. There are a lot of competitors battling it out on the same product lines/types. Most importantly, what I've learnt is that the retailers' passion for the industry and helping their customers over in the US is incredibly strong.

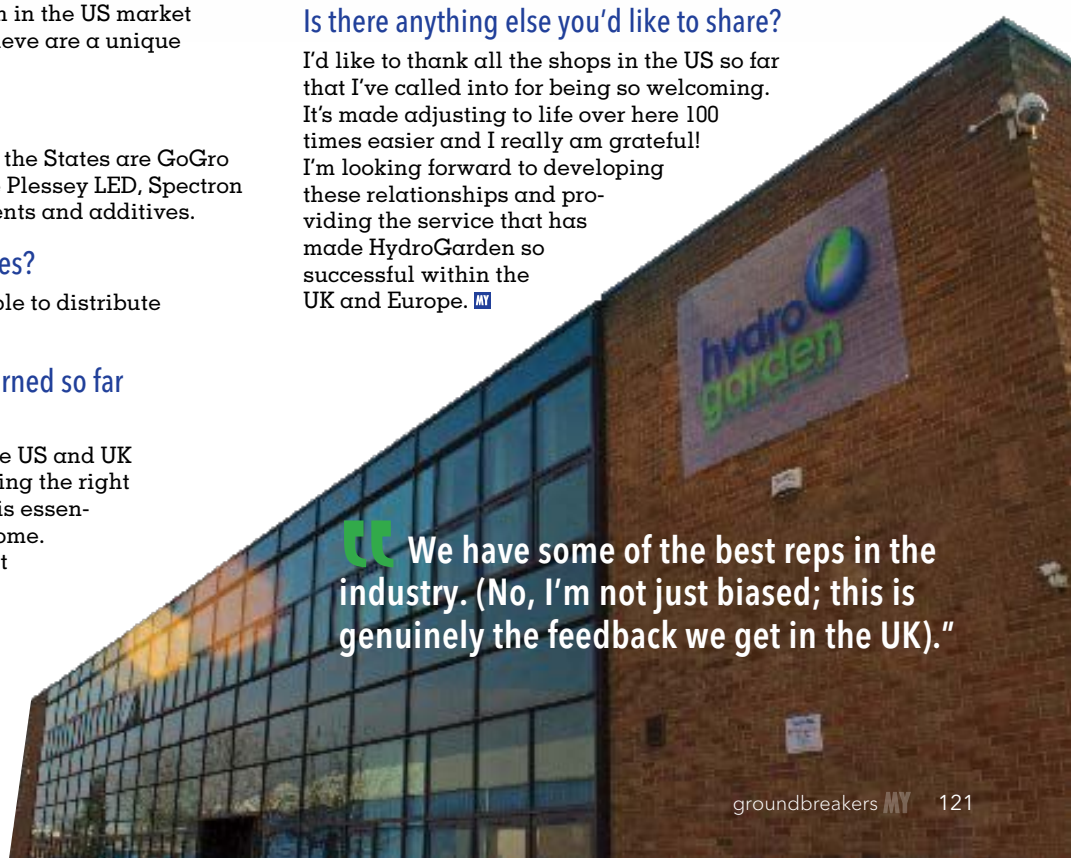
Top: The HydroGarden office and manufacturing team.
Bottom: The HydroGarden distribution team.

What have you learned about starting and growing a company?

From seeing numerous retailers start up over the years, I've learnt first and foremost that it takes real commitment and persistence, especially in the early days, to make the business a success. Reinvesting as much as you can back into the store—stock—is vital, as well as building a solid customer base that trusts you and can rely on you.

Is there anything else you'd like to share?

I'd like to thank all the shops in the US so far that I've called into for being so welcoming. It's made adjusting to life over here 100 times easier and I really am grateful! I'm looking forward to developing these relationships and providing the service that has made HydroGarden so successful within the UK and Europe. MY



"We have some of the best reps in the industry. (No, I'm not just biased; this is genuinely the feedback we get in the UK)."

Machiavellian Media Ltd.

1 Link Road, Edgbaston, Birmingham B160EP

www *thegrowersguide.co.uk*

2 Years in business

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, specializing 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 labor. 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 realized 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.

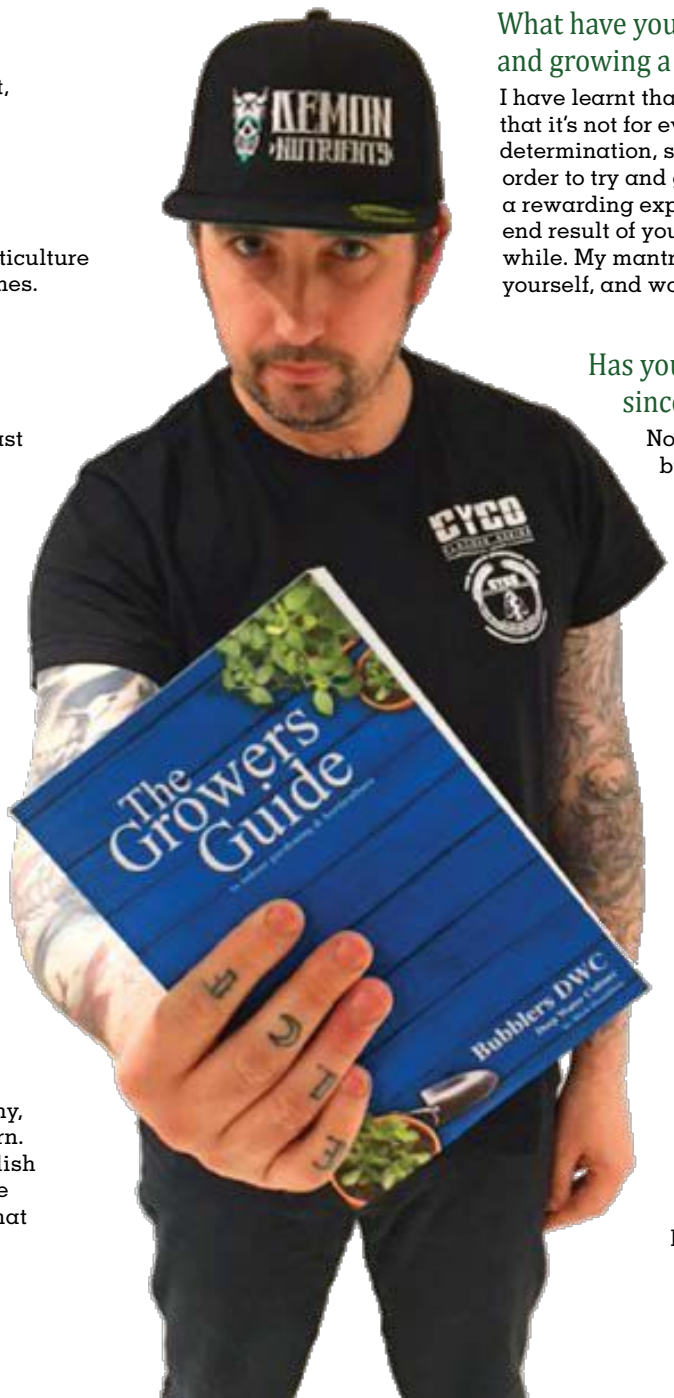
What were some of your struggles as you started the business?

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

ALABAMA

Alabama Organics
3348 Bethel Rd.
HAMMONDVILLE, AL 35989
256-635-0802

Hydro-Ponics Inc. (of Birmingham)
2969 Pelham Pkwy. Ste. 3
PELHAM, AL 35124
205-358-3009

ALASKA

Alaska Jack's Hydroponics and Garden Supply
331 E. 87th St.
ANCHORAGE, AK 99515
907-349-2200

Alaska Mill, Feed and Garden Center
114 N. Orca
ANCHORAGE, AK 99501
907-279-4519

Far North Garden Supply
2834 Boniface Pkwy.
ANCHORAGE, AK 99504
907-333-3141

Southside Garden Supply AK
171 Muldoon Rd.
ANCHORAGE, AK 99504
907-334-9997

Southside Garden Supply AK
12870 Old Seward Hwy., Unit 114
ANCHORAGE, AK 99515
907-339-9997

Southside Garden Supply AK
3005 Spenard Rd.
ANCHORAGE, AK 99503
907-562-9997

Southside Garden Supply AK
449 W. Parks Hwy.
WASILLA, AK 99654
907-357-9997

Holmtown Nursery Inc.
1301 - 30th Ave.
FAIRBANKS, AK 99701
907-451-8733

Panama Reds Indoor Gardening Supply
3585 E. End Rd.
HOMER, AK 99603
907-235-7337

Panama Reds Indoor Gardening Supply
38792 Kalifornsky Beach Rd.
KENAI, AK 99611
907-283-6010

Alaska Jack's Hydroponics and Garden Supply
1150 S. Colony Way, Ste. 9
PALMER, AK 99645
907-746-4774

Alaska Jack's Hydroponics and Garden Supply
244 S. Sylvan Way, Unit 25
WASILLA, AK 99654
907-373-4757

Far North Garden Supply
300 Centaur St.
WASILLA, AK 99654
907-376-7586

ARIZONA

Arizona Hydroponics
3900 E. Western Dr. #D
COTTONWOOD, AZ 86326
928-649-1138

Sea of Green - Flagstaff
204 E. Route 66
FLAGSTAFF, AZ 86001
928-774-7643

Green Life Hydroponics
10798 N. 75th Ave. Ste. A4
PEORIA, AZ 85345
623-487-0148

The Grow Shop LLC
1733 E. McDowell Rd.
PHOENIX, AZ 85006
602-340-7591

Sea of Green Hydroponics - Tempe
1828 E. University Dr. 11
TEMPE, AZ 85281
480-967-2045

Growers House
1501 E. 21st St.
TUCSON, AZ 85719
855-289-1441

MJGreen Hydroponics
TUSCON, AZ 85750
mjgreenhydroponics.com
844-465-4733

ARKANSAS

Growfresh Organics & More
5724 S. 29th St.
FORT SMITH, AR 72908
479-648-8885

Fermentables
3915 Crutcher St.
LITTLE ROCK N., AR 72118
501-758-6261

Anuway Hydroponics
2711 W. Walnut St.
ROGERS, AR 72756
479-631-0099

CALIFORNIA

Colt's Mountain High Garden Supply
42300 Hwy. 49
AHWAHNEE, CA 93601
559-683-7645

Vertical Hydro Garden #2
1676 W. Lincoln Ave.
ANAHEIM, CA 92801
714-254-0005

Grass Roots Hydroponics & Organics
56040 Hwy. 371
ANZA, CA 92539
951-744-0415

High Desert Hydroponics
13631 Pawnee Rd., #7
APPLE VALLEY, CA 92308
760-247-2090

American Hydroponics
286 S. G St.
ARCATA, CA 95521
800-458-6543

Northcoast Horticulture Supply
639 6th St..
ARCATA, CA 95521
707-826-9998

Sweet Harvest Hydroponics & Organics
1041 E. Grand Ave.
ARROYO GRANDE, CA 93420
805-473-0004

Auburn Garden Supply
1668 Auburn Ravine Rd.
AUBURN, CA 95603
530-889-8171

Quail Mountain Ranch
1775 Grass Valley Hwy., Ste. B
AUBURN, CA 95602
530-889-2390

Hands On Hydroponics
1340 Roberts Ln.
BAKERSFIELD CA, 93308
661-399-7770

Kern Hydroponics
2729 Brundage Ln.
BAKERSFIELD, CA 93304
661-323-7333

Berkeley Indoor Garden
844 University Ave.
BERKELEY, CA 94710
510-549-2918

The Hydroponic Connection - Berkeley
2816 San Pablo Ave.
BERKELEY, CA 94702
510-704-9376

Brentwood Hydroponics & Organics
560 Valdry Ct Ste. B-1
BRENTWOOD, CA 94513
925-634-6704

Good To Grow & Global Garden Supply
1350 Rollins Rd.
BURLINGAME, CA 94010
650-733-4420

Orchard City Garden Supply
132 Kennedy Ave.
CAMPBELL, CA 95008
408-866-8176

Global Garden Supply - Santa Cruz
1655 38th St.
CAPITOLA, CA 95010
831-854-7890

The Greenhouse Garden Supply
7619 Fair Oak Blvd.
CARMICHAEL, CA 95608
916-515-9130

The Hydro Shop of Cerritos
15961 S. Piuma Ave.
CERRITOS, CA 90703
562-653-0700

Chico Garden Center
3028 Esplanade Ave. Unit E
CHICO, CA 95973

Garden Connection, The
629 Entler Ave. #32
CHICO, CA 95928
530-342-7762

Green Fire Chico
2725 CA-32
CHICO, CA 95973
530-895-8301

San Diego Hydroponics N.
651 Anita St., #B-1
CHULA VISTA, CA 91911
619-737-9272

Green Thumb Hydroponics
6412 Tupelo Dr.
CITRUS HEIGHTS, CA 95621
916-721-6969

Sierra Horticulture
158 Whitcomb Ave. Unit 7
COLFAX CA 95713
530-346-6000

Emerald City Garden - Concord
1776 Arnold Ind. Way, Ste. I
CONCORD, CA 94520
925-822-3713

Green Forest Hydroponics, Inc.
2410 Wardlow Rd. #108
CORONA, CA 92880
951-270-5300

The Hydro Spot
21785 Temescal Cyn Rd.
CORONA, CA 92883

A+ Hydroponics & Organics
1606 Babcock St.
COSTA MESA, CA 92627
949-642-7776

The Hydro Source
671 E. Edna Pl.
COVINA, CA 91723
877 HYDRO 82; 626-915-3128

Pacific Coast Hydroponics
4147 Sepulveda Blvd.
CULVER CITY, CA 90230
310-313-1354

Valley Gardening Supplies
9888 Stephens St.
DELHI, CA 95315
209-668-2178

Watch It Grow Hydro
9453 Firestone Blvd.
DOWNEY, CA
562-861-1928

Dublin Seed Bank and Aquaponics
7079 Village Pkwy.
DUBLIN, CA 94568
925-828-4769

The Lucky Garden
7071 Village Pkwy.
DUBLIN, CA 94568
925-828-GROW

Encinitas Hydroponics
463 Encinitas Blvd.
ENCINITAS, CA 92024

Go Green Hydroponics
15721 Ventura Blvd.
ENCINO, CA 91436
818-990-1198

GREENCOAST Escondido LLC
2402 Auto Pkwy.
ESCONDIDO, CA 92029
760-747-1292

Bayside Garden Supply
4061 Hwy. 101 Ste. 6
EUREKA, CA 95503
707-826-7435

Humboldt Hydroponics
1302 Union St.
EUREKA, CA, 95501
707-443-4304

Northcoast Horticulture Supply
852 W. Wabash Ave.
EUREKA CA, 95501
707-444-9999

Constantly Growing
4301 Hazel Ave.
FAIR OAKS, CA 95628
916-962-0043

Everything Green Hydroponics
4229 Lozano Ln.
FAIRFIELD, CA 94534
707-432-0774

The GrowBiz - Felton
5980 Hwy. 9
FELTON, CA 95018
831-335-9990

Eel River Hydroponics & Soil Supply
164 Dinsmore Dr.
FORTUNA, CA 95540
707-726-0395

Dirt Cheap Hydroponics
17975 H Hwy. 1
FORT BRAGG, CA 95437
707-964-4211

Hydrogarden Mendocino County
1240 North Main St.
FORT BRAGG, CA 95437
707-962-9252

Northcoast Horticulture Supply
357 Main St.
FORTUNA, CA 95540
707-725-5550

Fremont Hydroponics
45461 Fremonth Blvd #1
FREMONT, CA 94538
510-573-0873

California Green Hydroponics
1330 N. Hulbert Ave. #101
FRESNO, CA 93728
559-228-9929

Full Scale Soil & Hydro
3865 N. Ann Ave.
FRESNO, CA 93727
559-292-4769

Gro More Garden Supply & Hydroponics
2686 Clovis Ave., Ste. 109
FRESNO, CA 93727
559-348-1055

Hand's On Hydroponics
3320 N. Cedar Ave.
FRESNO, CA 93726
559-222-7770

Roots Grow Supply
1922 W. Belmont Ave.
FRESNO, CA 93705
559-840-0122

Valley Hydroponics
207 E. Sierra Ave.
FRESNO, CA 93710
559-449-0426

Grow Wurks Hydroponics
765 S. State College Blvd., Ste. J
FULLERTON, CA 92831
714-253-Grow (4769)

Hydroponic Discounts
10372 Trask Ave. Unit F
GARDEN GROVE, CA 92843
800-88-YIELD & 714-643-9574

Golden Gecko Garden Center
4665 Marshall Rd.
GARDEN VALLEY, CA 95633
530-333-2394

SB Hydro
1109 W. 190th St., Unit #F
GARDENA, CA 90248
310-538-5788

GrowBigOgh
320 Kishimura Dr., Unit #3
GILROY, CA 95020
408-848-0884800-784-4769

Xtreme Gardening
5355 Monterey Frontage Rd.
GILROY, CA 95020
800-784-4769

530 Hydro & Soil
10021 Wolf Rd. C-16
GRASS VALLEY, CA 95949
530-268-0859

AG Natural
403 Idaho Maryland Rd.
GRASS VALLEY, CA 95945
530-274 0990

Grass Valley Hydrogarden
12506 Loma Rica Dr.
GRASS VALLEY, CA 95945
530-477-2996

All Seasons Hydroponics
17614 Chatsworth St.
GRANADA HILLS, CA 91344
818-368-4388

Sierra Hydroponics
124 Clydesdale Ct., Ste. G
GRASS VALLEY, CA 95945
530-802-5443

Growing Wild Garden Supply
10 North Oak Ave
HAYFORK, CA 96041
530-628-5331

American Ave Hydroponics
1208 W. Winton Ave.
HAYWARD, CA 94545
510-785-4376

Eden Garden Supply
23000 Connecticut St., Unit 2
HAYWARD, CA 94545
510-940-8469

Growers Choice #2
24089 Watkins St.
HAYWARD, CA 94544
510-278-6200

Thrive Hydroponics
30-A Mill St.
HEALDSBURG, CA 95448
707-433-4068

Hydro Zen
3518 Tanya Ave.
HEMET, CA 92545
951-392-5016

Mark's Hydroponics & Organic Gardening
114 N. Harvard St.
HEMET, CA 92543
951-652-5784

Bear Valley Hydroponics & Homebrewing
17455 Bear Valley Rd.
HESPERIA, CA 92345
760-949-3400

No Stress Hydroponics
7543 Santa Monica Blvd.
HOLLYWOOD W., CA 90046
323-845-9874

One Stop Hydroponics
12822 Victory Blvd.
HOLLYWOOD N., CA 91606
818-980-5855

Orange County Hydroponics & Organics
15801 Rockfield Blvd, Unit C
IRVINE, CA 92618
949-837-8252

La Habra Hydroponics
1301 S. Beach Blvd., Ste. O
LA HABRA, CA 90631
562-947-8383

Grass Roots Hydroponics
31875 Corydon Rd., Ste. 170
LAKE ELSINORE, CA 92530
951-245-2390

Advanced Garden Supply
2110 Eloise Ave.
LAKE TAHOE S., CA 96150
530-541-4769

San Diego Hydroponics East County
11649 Riverside Dr., Ste. 141
LAKESIDE, CA 92040
619-562-3276

Room to Grow
43511 13th St. W
LANCASTER, CA 43511
661-940-5599

Weathertop Nursery
44901 Harmon Dr.
LAYTONVILLE, CA 95454
707-984-6385

Redwood Farm and Garden
66150 Drive Thru Tree Rd.
LEGGETT, CA 95585
707-925-6420

National Garden Wholesale/ Sunlight Supply
6150 Las Positas Rd.
LIVERMORE, CA 94551
888 570 4678

Root Solutions Hydroponics
851 N. Sacramento St., Ste A
LODI, CA 95240
209-368-7668

Sweet Leaf Hydroponics
200 Beckman Rd.
Lodi, CA 95240
209-365-6100

Valley Rock Landscape Supply
2222 North H St.
LOMPOC, CA 93436
805-736-0841; 805-735-5921

GREENCOAST Hydroponics
2405 Mira Mar Ave.
LONG BEACH, CA 90815
562-627-5636

The Hydro Shop of Long Beach
1732 Clark Ave.
LONG BEACH, CA 90815
562-498-9525

Atwater Hydroponics
3039 Roswell St.
LOS ANGELES, CA 90065
323-254-3400

Downtown Hydroponics
443 E. 16th St.
LOS ANGELES, CA 90015
213-742-8817

Green Door Hydroponics
2317 S. Santa Fe Ave.
LOS ANGELES, CA 90058
213-625-1323

GREENCOAST DTLA LLC
2211 E. Olympic Blvd.
LOS ANGELES, CA 90021
213-439-9051

GREENCOAST LAX LLC
5200 W. 104th St
LOS ANGELES, CA 90045
310-337-6995

GREENCOAST Hydroponics
3865 Grand View Blvd.
LOS ANGELES, CA 90066
310-398-0700

Hollywood Hydroponics & Organics
5109 1/2 Hollywood Blvd.
LOS ANGELES, CA 90027-6105
323-662-1908

Sunland Hydroponics
4136 Eagle Rock Blvd.
LOS ANGELES, CA 90065
323-254-2800

Superior Hydroponic Supply
5651 Hollywood Blvd.
LOS ANGELES, CA 90028
323-465-GROW (4769)

Green Giant Hydroponics
7312 Hwy. 49, Unit B
LOTUS, CA 95651
530-622-4465

Agro Lake Garden Supply
11455 Clayton Creek Rd.
LOWER LAKE, CA 95457
707-994-1788

California Green Hydroponics
16850 Rd. 26
MADERA, CA 93638
559-674-1400

Monterey Bay Horticulture Supply
218 Reindollar Ave., Ste. 7A
MARINA, CA 93933
831-38-HYDRO

Four Seasons Landscape Materials
4413 Hwy 20
MARYSVILLE, CA 95901
530-742-0443

Two Chix Garden Supply
1230 Yuba St.
MARYSVILLE, CA 95901
530-923-2536

Northcoast Horticulture Supply
1580 Nursery Way, Ste. D
MCKINLEYVILLE, CA 95519
707-839-9998

Mendocino Garden Shop
44720 Main St. (at Hwy. 1)
MENDOCINO, CA 95460
707-937-3459

Hydro Bros
1665 West Hwy. 140
MERCED, CA 95341
209-233-9606

Valley Gardening Supplies
1501 W. Main St.
MERCED, CA 95340
209-580-4425

The Urban Farmer Store
653 E. Blithedale Ave.
MILL VALLEY, CA 94941
415-380-3840

Hydroponics Inc.
3811 Wacker Dr.
MIRA LOMA, CA 91752
951-685-4769

Coca's Central Valley Hydroponics
116 West Orangeburg Ave.
MODESTO, CA 95350
209-567-0590

Growers Choice #4
1100 Carver Rd. #20
MODESTO, CA 95350
209-522-2727

Hydro Bros.
521 Winmoore Way, Ste. A
MODESTO, CA 95358
209-537-8220

Hydroponics Max
664 Bitritto CT
MODESTO, CA 95356
209-491-2816

Valley Gardening Supplies
1903 Yosemite Blvd.
MODESTO, CA 95354
209-577-4769

Valley Gardening Supplies
509 Winmoore Way Ste. T
MODESTO, CA 95358
209-537-4769

Hydroponics Inc.
5458 Moreno St.
MONTCLAIR, CA 91763
909-946-7100

Murphys Hydroponics & Organics
969 E. Hwy. 4
MURPHYS, CA 95247
209-728-8058

Grass Roots Hydroponics
27250 Madison Ave. Ste. C
MURRIETA, CA 92590
951-296-1090

Redwood Garden Supply
55 Myers Ave.
MYERS FLAT, CA 95554
707-943-1515

Endless Green Hydroponics
55 Enterprise Ct., Ste. 3
NAPA, CA 94558
707-254-0200

Wyatt Supply
4407 Solano Ave.
NAPA, CA 94558
707-251-3747

SCV Hydro Garden
3481 Old Conejo Rd., #106
NEWBURY PARK, CA 91320
661-255-3700 ext. 2

Vital Garden Supply
204 Gold Flat Ct. #7
NEVADA CITY, CA 95959
530-273-3187

Agro Lake Garden Supply
2581 Stokes Ave.
NICE, CA 95464
707-274-8386

Marin Hydroponics
55 Frosty Ln.
NOVATO, CA 94949
415-233-4104

Oak Hills Hydroponics & Aquaponics
13312 Ranchero Rd., Ste. 23
OAK HILLS, CA 92344
760-998-2890

Absolute Hydroponics
1230 East F St.
OAKDALE, CA 95361
209-845-1000

Occidental Hardware
3799 Bohemian Hwy.
OCCIDENTAL, CA 95465
707-874-3441

Hands On Hydroponics
311 Airport Rd.
OCEANSIDE, CA 92058
760-547-5426

San Diego Hydroponics North County Coastal
1024 S. Coast Hwy.
OCEANSIDE, CA 92054
760-420-8934

GREENCOAST Ontario
Unit 102-103 1920 S. Rochester Ave.
ONTARIO, CA
909-605-5777

National Garden Wholesale/ Sunlight Supply
1950 C South Grove Ave.
ONTARIO, CA 91761
888-888-3319

Palm Tree Hydroponics
2235 E. 4th St., Ste. G
ONTARIO, CA 91764
909-941-9017

GREENCOAST Hydroponics
496 Meats Ave.
ORANGE, CA 92865
714-974-4769

Advanced Soil & Garden Supply
350 Oro Dam Blvd.
OROVILLE, CA 95965
530-533-2747

Oroville Garden Center
5967 Lincoln Blvd.
OROVILLE, CA 95966
530-534-1288

In House Hydro
1730 Teal Club Rd.
OXNARD, CA 93035
805-312-3983

US Orchid & Hydroponic Supplies
1621 South Rose Ave.
OXNARD, CA 93033
805-247-0086

Discount Hydroponics of Palm Springs
1251 Montalvo Way. Ste H
PALM SPRINGS, CA 92262
760 424 8292

Palm Springs Hydroponics
1301 Montalvo Way, Ste. #8
PALM SPRINGS, CA 92262
760-327-7668

America's Best Hydroponics & Gardening Center
641 W. Palmdale Blvd., Unit D
PALMDALE, CA 93551
661-266-3906

Hydroponics Unlimited
641 W. Palmdale Blvd., D
PALMDALE, CA 93550
661-266-3906

Palmdale Hydroponics
3020 E. Palmdale Blvd., Ste. B
PALMDALE, CA 93550
661-274-7940

Alternative Hydro
3870 East, Colorado Blvd.
PASADENA, CA 91107
888-50-HYDRO

Boldly Grow Hydro
1271 E. Colorado Blvd.
PASADENA, CA 91106
626-200-1021

Dubs Green Garden
14th Park
PASO ROBLES, CA 93446
805-286-5987

Garden All Year Inc.
3850 Ramada Dr., Unit D2
PASO ROBLES, CA 93446
805-434-2333

Growing Wild Garden Supply
3260 Hwy 3
HAYFORK, CA 96041
530-628-5331

Anything Green Hydroponics
17551 Penn Valley Dr.
PENN VALLEY, CA 95946
530-432-GREEN (4733)

Four Seasons Landscape Materials
17115 Penn Valley Dr.
PENN VALLEY, CA 95946
530-432-9906

Humboldt Direct
1622 Illinois Ave., Ste. #10
PERRIS, CA 92571
951-928-1100

Funny Farms Hydroponics
963 Transport Way, #12
PETALUMA, CA 94954
707-775-3111

Hydrofarm, Inc.
2249 South McDowell Ext.
PETALUMA, CA 94954
800-634-9990

Wyatt Supply
1016 Lakeville St
PETALUMA, CA 94952
707-762-3747

JNJ Hydroponics
4774 Phelan Rd., Ste. 2
PHELAN, CA 92371
760-868-0002

Kirk's Hydro
23605 State Highway 88
PIONEER, CA 95666
209-295-3500

Emerald City Garden - Pittsburg
543 Bliss Ave.
PITTSBURG, CA 94565
925 500 8010

Appleseed Horticulture, Inc.
560 Placerville Drive
PLACERVILLE, CA 95667
530-622-5190

Mission Hydroponics
1236 E. Mission
POMONA, CA 91766
909-620-7099

Hands on Hydroponics
1309 S. Main St.
PORTERVILLE, CA 93257
559-784-7770

The Growbiz
3127 Fite Circle
RANCHO CORDOVA, CA 95827
916-315-3580

Galactic Garden Center
22755 Antelope Blvd.
RED BLUFF, CA 96080
530-527-9166

Bare Roots Hydroponics
1615 East Cypress, #5
REDDING, CA 96002
530-244-2215

Big Daddy's Garden Supply - Redding
18673 Old Oasis Rd.
REDDING, CA 96003
530-241-1734

The Harvest Company
2420 Athens Ave.
REDDING, CA 96001
530-605-4511

Dazey's Supply
3082 Redwood Dr.
REDWAY, CA 95560
707-923-3002

Humboldt Hydroponics
2010 Tunnel Rd.
REDWAY, CA 95560
707-923-1402

Redway Feed Garden & Pet Supply
290 Briceland Rd.
REDWAY, CA 95560
707-923-2765

Sylvandale Gardens
1151 Evergreen Rd.
REDWAY, CA 95560
707-923-3606

Orsa Organix
111 Willow St.
REDWOOD CITY, CA 94063
650-369-1269

Mendocino Greenhouse & Garden Supply
960 East School Way
REDWOOD VALLEY, CA 95470
707-485-0668

The Urban Farmer Store
2121 San Joaquin St.
RICHMOND, CA 94804
510-524-1604

WC Garden Supplies
5327 Jacuzzi St., Ste 2D
RICHMOND, CA 94806
510-280-5652

Root 101 Nursery
770 Wildwood Ave.
RIO DELL, CA 95562
707 506 3071

All Ways Hydro
2220 Eastridge Ave., Ste. C
RIVERSIDE, CA 92507
888-HYDRO98

Cheapest Hydro
263 West La Cadena Dr.
RIVERSIDE, CA 92501
951-341-9223

Discount Hydroponics
4745 Hiers Ave.
RIVERSIDE, CA 92505
877-476-9487, 951-689-4575

Green Forest Hydroponics, Inc.
570 E. La Cadena Dr., Ste. #1D
RIVERSIDE, CA 92507
951-784-5733, Fax 951-704-4633

The Hydro Spot
9901 Indiana Ave.
RIVERSIDE, CA 92503
951 688-4769

Green Garden Store
4447 Granite Drive Ste. #701
ROCKLIN, CA 95677
916-968-1375

The Growbiz
4391 Granite Dr.
ROCKLIN, CA 95677
916-GROW-BIZ

Hydro Depot
5665 Redwood Dr., #B
ROHNERT PARK, CA 94928
707-584-2384

Monstergardens
235 Classic Ct.
ROHNERT PARK, CA 94928
855-476-9272

Genesis Hydroponics
6047 Power Inn Rd.
SACRAMENTO, CA 95824
916-330-1658

Green Acres Nursery & Supply
8501 Jackson Rd.
SACRAMENTO, CA 95826
916-381-1620

Green Fire Sacramento
3230 Auburn Blvd.
SACRAMENTO, CA 95821
916-485-8023

Green Thumb Hydroponics
15 Quinta Ct.,
SACRAMENTO, CA 95823
916-689-6464

The Growbiz
3127 Fite Circle
SACRAMENTO, CA 95827
916-GROW-BIZ

Hydro Seasons
5885 Stockton Blvd.
SACRAMENTO, CA 95824
916-451-5751

Hydro City
8510 Morrison Creek Dr. Ste 200
SACRAMENTO, CA 95828
916-388-8333

J Street HydroGarden
2321 J St.
SACRAMENTO, CA 95816
916-444-4473

KY Wholesale
8671 Elder Creek Rd. #600
SACRAMENTO, CA 95828
916-383-3366

Tradewinds Wholesale Garden Supplies
3735 Cincinnati Ave. #200
SACRAMENTO, CA 95765
916-258-8880

World of Hydro
8550 Younger Creek Dr.
SACRAMENTO, CA 95828
916-456-1888

Perfect Gardens
61 Tarp Circle
SALINAS, CA 93901
831-998-8628

National Garden Wholesale/ Sunlight Supply
1900 Bendixsen St., Bldg. 1
SAMOA, CA 95564
800-683-1114 (Northern CA)

Greenmile Hydroponic Garden Supply
1520 South E. St., Unit C
SAN BERNARDINO, CA 92408
909-885-5919

GrowGeneration - San Bernardino
453 S. I St.
SAN BERNARDINO, CA 92410
909-454-7003

City Farmers Nursery
3110 Euclid Ave.
SAN DIEGO, CA 92105
619-284-6358

Mighty Garden Supply
4780 Mission
Gorge Pl. #A-1
SAN DIEGO, CA 92120
619-287-3238

Miramar Hydroponics & Organics
7570 Trade St.
SAN DIEGO, CA 92126
858-549-8649

Oracle Garden Supply
5755 Oberlin Dr., Ste. 100
SAN DIEGO, CA 92121
858-558-6006

San Diego Hydroponics Beach Cities
4122 Napier St.
SAN DIEGO, CA 92110
619-276-0657

House of Hydroponics
732 W. Arrow Hwy.
SAN DIMAS, CA 91773
877-592-5111; 909-592-5111

The Hydroponic Connection San Francisco
1549 Custer Ave.
SAN FRANCISCO, CA 94124
415-864-9376

The Urban Farmer Store
2833 Vicente St.
SAN FRANCISCO, CA 94116
415-661-2204

US Garden
417 Agostinio Rd.
SAN GABRIEL, CA 91776
626-285-5009

Rasa Hydroponics
5725 Winfield Blvd., Ste. 8
SAN JOSE, CA 95123
408-227-7272

Sunny Tool
580 Parrott St.
SAN JOSE, CA 95112
408-278-1800

The GrowBiz - Pomona
1697 Pomona Ave.
SAN JOSE, CA 95110
650-968-4070

The GrowBiz - S. Bascom
1185 S. Bascom Ave.
SAN JOSE, CA 95128
408-292-4040

San Jose Hydroponics
1999 Monterey Rd., #100A
SAN JOSE, CA 95112
408-298-8081

Beach Cities Hydroponics
33155 Camino Capistrano Unit F.
SAN JUAN CAPISTRANO, CA 92675
949-493-4200

D&S Garden Supplies
130 Doolittle Dr., #17
SAN LEANDRO, CA 94577
510-430-8589

Hydrogarden Delight
13708 Doolittle Dr.
SAN LEANDRO, CA 94577
510-903-1808

Mack's Gardening Supplies
2089 E. 14th St. Ste. E
SAN LEANDRO, CA 94577
510-351-3900

Healthy Harvest Hydroponics and Organics
198 South St.
SAN LUIS OBISPO, CA 93401
805-596-0430

Gro Pro Garden Supply
841 Racheros Dr.
SAN MARCOS, CA 1906
760-735-8604

San Diego Hydroponics North County Inland
802 N. Twin Oaks Valley Rd. #108
SAN MARCOS, CA 92069
760-510-1444

WC Garden Supplies
2846 El Portal Dr.
SAN PABLO. CA 94806
510-283-5667

Marin Hydroponics
721 Francisco Blvd. East
SAN RAFAEL, CA 94901
415-482-8802

Green Gopher Garden Supply
679 Redwood Ave., Ste. A
SAND CITY, CA 93955
831-899-0203

Murphy's Hydroponics & Organics
799 W. Stocktan St.
SANORA, CA 95370
209-532-2022

55 Hydroponics
1727 Boyd St.
SANTA ANA, CA 92705
714-259-7755

Champion Hydroponics
231 E. Dyer Rd.
SANTA ANA, CA 92707
714-850-0188

GREENCOAST Hydroponics
135 Nogal Dr.
SANTA BARBARA, CA 93110
805-898-9922

Nutes Int'l
204 N. Quarantina St.
SANTA BARBARA, CA 93103
805-687-6699

Urban Grow Systems
204 N. Quarantina St.
SANTA BARBARA, CA 93103
805-637-6699

SCV Hydro
21444 Golden Triangle Rd.
SANTA CLARITA, CA 91350
661-255-3700

Hydro-Logic Purification Systems
370 Encinal St., Ste. 150
SANTA CRUZ, CA 95060
888-H2O-LOGIC

The GrowBiz
2450 17th Ave., Ste 100
SANTA CRUZ, CA 95062
866-509-4339

The GrowBiz - Santa Cruz
815 Almar Ave., Unit K
SANTA CRUZ, CA 95060
831-466-9000

Hydrofarm Southwest
12991 Leffingwell Rd.
SANTA FE SPRINGS, CA 90670
800-634-9990

Spectrum Hydroponics
15421 Carmenita Rd. E.
SANTA FE SPRINGS, CA 90670
562-229-3900

Big Daddy's Garden Supply - Santa Rosa
3236 Dutton Ave.
SANTA ROSA, CA 95407
707-535-0996

Deep Roots Hydroponics
3715 Santa Rosa Ave. Ste. A2
SANTA ROSA, CA 95407
707-540-0773

Garden Spout, The
1236 Briggs Ave.
SANTA ROSA, CA 95401
707-528-3500

GrowGeneration - Santa Rosa
3535 Industrial Dr.
Santa Rosa, CA 95403
707-544-3383

House of Hydro
3260 Santa Rosa Ave.
SANTA ROSA, CA 95407
707-542-7297

Hydro Depot
13 West 3rd St.
SANTA ROSA, CA 95401
707-542-3866

Santa Rosa Hydroponics
4880 Sonoma Hwy.
SANTA ROSA, CA
707-595-1340

Santa Rosa Hydroponics
4130 S. Moorland Ave.
SANTA ROSA, CA
707-584-9370

Sonoma Hydro LLC
3535 Industrial Dr., Ste. B2-3
SANTA ROSA, CA 95403
707-544-3383

Wyatt Supply
747 Yolanda Ave.
SANTA ROSA, CA 95404
707-578-3747

Gardening Unlimited
815 Almar Ave. Unit K.
SANTA CRUZ CA 95060
831-457-1236

Deep Roots Hydroponics
2661 Gravenstein Hwy. S. #E
SEBASTOPOL, CA 95472-8200
707-829-7668

Hydro Depot
6731 Sebastopol Ave.
SEBASTOPOL, CA 95472
707-829-1510

We Grow Hydroponics
3350 East Los Angeles Ave.
SIMI VALLEY, CA 93063
805-624-4566

Motherlode Hydroponics and Organics
759 W. Stockton St.
SONOMA, CA 95370
209-532-2022

Santa Cruz Hydroponics & Organics - East Side
4000 Cordelia Lane
SOQUEL, CA 95073
831-475-9900

Orange County Hydroponics & Organics
12797 Beach Blvd.
STANTON, CA 90680
714-893-9493

Golden Harvest Hydroponics & Garden Supply
1810 Field Ave. Ste. #4
STOCKTON, CA 95203
209-951-3550

HomeGrown Indoor Garden Supply
681 A Grider Way
STOCKTON, CA 95210
209-477-4447

Hydro Bros
4099 Callaway Ct.
STOCKTON, CA 95215
209 337 3614

Hydroponics Depot
8712 Sunland Blvd.
SUN VALLEY, CA 91352
818-771-0600

Sunland Hydroponics
8300 Foothill Blvd.
SUNLAND, CA 91040
818-352-5300

Beyond Hydro Inc.
12639 San Fernando Rd.
SYLMAR, CA 91342
818-362-5373

GREENCOAST Temecula LLC
26201 Ynez Rd., Ste 102
TEMECULA, CA 92591
951-296-2281

Inland Empire Hydrogarden
28061 Jefferson Ave #1
TEMECULA, CA 92590
886-74-HYDRO

Los Angeles Hydroponics & Organics
3007-3009 W. Artesia Blvd.
TORRANCE, CA 90504
310-323-4937

Growers Choice Hydroponics
470 W. Larch Rd. #1
TRACY, CA 95304
209-833-1212

Tracy Hydroponics
543 W. Grant Line
TRACY, CA 95376
209-207-9065

Tulare Roots Hydroponics
1350 E. Sierra Ave.
TULARE, CA 93724
559-688-4769

Aloha Hydroponics
225 Lander Ave.
TURLOCK, CA 95380
209-667-6653

Garden Depot Hydroponics
1460 Freitas Park
TURLOCK, CA 95380
209-250-0101

Big Daddy's Garden Supply - Ukiah
310 Mason St.
UKIAH, CA 95482
707-467-9234

Hydro Pacific Garden Supply
351 C Hastings Ave.
UKIAH, CA 95482
707-467-0400

Wyatt Supply
2200 N. State St.
UKIAH, CA 95482
707-462-7473

Sweet Leaf Hydroponics
3463 Double Springs Rd., Building 3
VALLEY SPRINGS, CA 95252
209-754-9660

GREENCOAST Hydroponics
16705 Roscoe Blvd.
VAN NUYS, CA 91406
818-672-8880

Blazzin Hydroponics
6650 Cresent St.
VENTURA, CA 93003
805-644-9376

Discount Hydroponics of Victorville
15208 Bear Valley Rd. Ste. B200
VICTORVILLE, CA 92392
442-242-7994

Kinney's Nursery & Top Soil
4115 Rowles Rd.
VINA, CA 96092
530-839-2196

All Valley Garden Supply
1441 Mineral King Ave.
VISALIA, CA 93292
559-372-8931

BWGS - CA
7530 W. Sunnyview Ave.
VISALIA, CA 93291
888-316-1306

Hands On Hydroponics
1345 N. Plaza Dr.
VISALIA, CA 93291
559-802-3782

Hi Tech Hydro
1919 E. Mineral King Ave.
VISALIA, CA 93292
559-733-9300

Kaweah Grower Supply
1106 1/2 N. Ben Maddox Way
VISALIA, CA 93293
559-625-4937

The Original Green Shop
26420 S. Mooney Blvd., Ste. 1
VISALIA, CA 93277
559-688-4200

Discount Indoor Garden Supply
761 E. Vista Way
VISTA, CA 92084
760-612-4486

Greentrees Hydroponics Inc.
2581 Pioneer Ave., Unit D
VISTA, CA 92081
760-598-7551

Specialty Garden Supply
7 Hangar Way, Ste. B
WATSONVILLE, CA 95075
831-768-0420

Evergreen Farm Feed & Garden
1131 Main St.
WEAVERVILLE, CA 96093
530-623-2884

Art of Hydro
5740 Corsa Ave. #102
WESTLAKE VILLAGE, CA 91362
818-865-2227

Big Daddy's Garden Supply - Willits
330 E. Commercial St.
WILLITS, CA 95454
707-456-0600

Garden Rebels Optimal Wholesale
317 Robert Drive #C
WILLITS, CA 95490
707-391-2007

Garden Spout, The
260 Margie Dr.
WILLITS, CA 95490
707-456-0196

Sparetime Supply
208 E. San Francisco Ave.
WILLITS, CA 95490-4006

Farmer Browns Garden Supply
41212 Hwy. 299
WILLOW CREEK, CA 95573
530-629-3100

Jolly Rancher Hydroponics
399 Business Park Ctr., Ste. 205
WINDSOR, CA 95492
707-838-0842

Lil' Shop of Growers
40 N. East St., Ste F
WOODLAND, CA 95776
530-668-4420

Green Acres Hydroponics
20946 Victory Blvd.
WOODLAND HILLS, CA 91367
818-887-4769

Garden Highway Garden Supply
598 Garden Highway #22
YUBA CITY, CA 95991
530-755-2877

Golden Valley Hydroponics
870 W. Onsott Rd. Ste. F
YUBA CITY, CA 95993
530-763-2151

COLORADO

Alamosa Garden Supply
0711 W. US Highway 160
ALAMOSA, CO 81101
719-206-3336

Green Spot Garden Center & Antiques
711 State Ave.
ALAMOSA, CO 81101
719-589-6362

South Park Hydroponics
13 S. Main St.
ALMA, CO 80420
719-836-1533

Aurora Hydroponic LLC
4250 S. Chambers Rd.
AURORA, CO 80014
303-400-6941

The Big Tomato Indoor Garden Supply
14440 E. 6th Ave.
AURORA, CO 80011
303-364-4769

National Garden Wholesale/ Sunlight Supply
3550 B Odessa Way
AURORA, CO 80011
866-877-4188 (Northeast)

Nick's Garden Center
2001 S. Chambers Rd.
AURORA, CO 80014
303-696-6657

Black Dog LED
2805 Wilderness Pl. #100
BOULDER, CO 80301
720-506-4279

One Love Garden Supply
3620 Walnut St.
BOULDER, CO 80301
303-586-1715

Way To Grow - Boulder
6395 Gunpark Dr.
BOULDER, CO 80301
303-473-4769

Deep Roots Garden Supply
156 Co Rd. 450
BRECKENRIDGE, CO 80424
970-453-1440

Mile High Hydroponics
37 Strong St.
BRIGHTON, CO 80601
303-637-0069

ACME Hydroponics
300 Nickel St., Ste. 3
BROOMFIELD, CO 80020
720-524-7306

GrowGeneration - Cañon City
1181 Fremont Dr.
CAÑON CITY, CO 81212
719-275-3784

Advanced Hydro Gardens
2476 Waynoka Rd.
COLORADO SPRINGS, CO 80915
719 591 6932

GrowGeneration - Colorado Springs
310 S. 8th Ave., Unit H
COLORADO SPRINGS, CO 80904
719-635-5441

Grotools
2408 E. Platte Ave.
COLORADO SPRINGS, CO 80909
719-475-7699

Purple Mountain Hydroponics LLC
1109 S. Tejon St.
COLORADO SPRINGS, CO 80903
719-635-5859

Roots and Rocks Hydroponic and Organic Garden Supply
1014 S. 21st St.
COLORADO SPRINGS, CO 80904
719-634-1024

Way To Grow - Colorado Springs
4215 Sinton Rd.
COLORADO SPRINGS, CO 80907
719-602-3000

High Tech Garden Supply - Commerce City
6025 Parkway Dr #125
COMMERCE CITY, CO 80022
720-222-0772

Grofax, The
25797 Conifer Rd. #A-8
CONIFER, CO 80433
303-838-5520

Grow Your Own
27051 Barkley Rd.
CONIFER, CO 80433
303-816-GROW (4769)

GrowGeneration - Conifer
26591 Main St.
CONIFER, CO 80433
303-838-8700

Desert Sun Hydro
321 Ranney St.
CRAIG, CO 81625
970-824-1715

Valley Wide Hydro
110 Andreas Cir.
CRESTED BUTTE, CO 81224
970 349-0144

Whetstone Garden Supply
300 Belleview Ave.
CRESTED BUTTE, CO 81224
970-349-9666

Joy of Growing
223 Main St.
DELTA, CO 81416
970-874-2550

BWGS-CO
11685 E. 55th Ave.
DENVER, CO 80239
888-316-1306

Chlorophyll
3801 Mariposa St.
DENVER, CO 80211
303-433-1155

Cost Plus Hydro
2530 W. Barberry Pl.
DENVER, CO 80204
303-790-2211

Cultivate Colorado
6400 Stapleton Dr. S. Unit E
DENVER, CO 80216
720-627-6648

Cultivate Hydroponics & Organics
666 S. Buchtel Blvd.
DENVER, CO 80210
303-625-6498

Greenlight Garden Supply
7741 E. Colfax Ave.
DENVER, CO 80220
720-389-8320

The Grofax
7540 E. Colfax Ave.
DENVER, CO 80220
720-328-2127

The Grofax
755 S. Federal Blvd.
DENVER, CO 80219
720-328-5164

GrowGeneration - Denver
4731 Lipan St.
DENVER, CO 80211
720-949-1174

GrowGeneration - Denver S.
1000 W. Mississippi Ave.
DENVER, CO 80223
303-386-4796

Grow Your Own
2118 S. Bellaire St.
DENVER, CO 80222
303-990-1929

Hydrofarm Mountain
4200 E. 50th Ave.
DENVER, CO 80216
800-634-9990

One Love Garden Supplies
6271 Beach St., Unit F
DENVER, CO 80221
303-396-1420

Indoor Paradise Denver
6401 N. Broadway, Unit A
DENVER, CO 80221
303-428-5020

Ultimate Hydroponics & Organics
2380 S. Broadway
DENVER, CO 80210
303-282-0034

Way To Grow - Central Denver
1051 S. Platte River Dr.
DENVER, CO 80223
720-310-1984

Way To Grow - Denver
301 East 57th Ave.
DENVER, CO 80216
303-296-7900

DHL Garden Supply
178 Bodo Dr. Unit B
DURANGO, CO 81303
970-247-1090

The Grow Store South
5050 S. Federal Blvd., #37,
ENGLEWOOD, CO 80110
303-738-0202

Florida Garden Supplies
3771 Monarch St.
FREDERICK, CO 80516

Colorado Growers Supply
2016 E. Lincoln Ave.
FORT COLLINS CO, 80524
970-484-3042

The Grow Shop LLC
1711 S. College Ave.
FORT COLLINS, CO 80525
970-484-1042

Way To Grow - Fort Collins
3201 E. Mulberry St. Ste. K
FORT COLLINS, CO 80524
970-484-4769

Florida Hydroponics
3771 Monarch St.
FREDERICK, CO 80516
720-287-3099

Hydro Shack, The
753 10 Mile Dr.
FRISCO, CO 80443
970-668-0359

Forbidden Fruit Garden Supply
507 Taos St., #C
GEORGETOWN, CO 80444
720-498-0260

Indoor Garden Supply
50633 Hwy 6 & 23 #3
GLENWOOD SPRINGS, CO 81601
970-945-2469

2 Mile High Garden Supply
52 4th St.
GRANBY, CO 80446
970-557-3031

Green Head Hydroponics
809 E. Jasper Ct.
GRANBY, CO 80446
970-557-3031

Desert Bloom Hydroponics
445 Pitkin Ave.
GRAND JUNCTION, CO 81501
970-245-6427

Natural Order Supply
2493 Hwy. 6 & 50, Unit 5
GRAND JUNCTION, CO 81505
970-242-3648

Green Thumb Garden Supply Co.
2380 W. 27th St.
GREELEY, CO 80634
970-506-1711

Grow Shop LLC, The
1701 Greeley Mall Rd.
GREELEY, CO 80631
970-352-5447

Valley Wide Hydro
650 S. 11th St.
Gunnison, CO 81230
970 641-0144

Grow in Peace
1241 Mine Rd.
IDAHO SPRINGS, CO 80452
303-567-GROW

The Grow Store
8644 W. Colfax Ave.
LAKEWOOD, CO 80215
888-510-0350

GroWize
3225 S. Wadsworth Blvd.
LAKEWOOD, CO 80227
303-986-2706

MileHydro
355 S. Harlan St.
LAKEWOOD, CO 80226
303-935-4769

Way to Grow - Lakewood
11989 W. Colfax Ave.
LAKEWOOD, CO 80215
303-546-3600

Grow It Big - Organics & Hydroponics
133 W. County Line Rd.
LITTLETON, CO 80129
303-284-3447

The Flower Bin
1805 Nelson Rd.
LONGMONT, CO 80501
303-772-3454

Victory Hydro Gardening
1387 E. South Boulder Rd.
LOUISVILLE, CO, 80027
303-664-9376

Grow Shop LLC, The
240 S. Cleveland Ave.
LOVELAND, CO 80537
970-619-8678

WarHammer Supply
1112 Munroe Ave.
LOVELAND, CO 80537
970-635-2602

The Green Mountain Company
1414 Hawk Parkway Unit D
MONTROSE, CO 81401
970-240-6165

Greener Mountain Indoor Gardening
20 Lakeview Dr., Unit 210
NEDERLAND, CO 80466
303-258-7573

Grow In Peace
176 Hwy. 119 S.
NEDERLAND, CO 80466
303-258-3520

Grow Depot
970 W. 104th Ave.
NORTHGLENN, CO 80234
303-459-7878

Four Corners Organics & Hydroponics LLC
68 Bastille Unit #3, PO Box 627
PAGOSA SPRINGS, CO 81147
970-731-1685

GrowGeneration - Pueblo Downtown
113 W. 4th St.
PUEBLO, CO 81003
719-542-6798

The Greenhouse Hydroponics and Organics
448 S. McCulloch Blvd.
PUEBLO W., CO 81007
719-547-1870

GrowGeneration - Pueblo W.
609 E. Enterprise Dr. Ste. 150
PUEBLO W., CO 81007
719-647-0907

Grow Your Own - Pueblo
500 West Third Ave.
PUEBLO, CO 81003
719-696-9220

One Love Garden Supply
618 East 4th St.
PUEBLO, CO 81001
719-542-6189

The Greenhouse Hydroponics & Organics Garden Supply Store
448 S. McCulloch Blvd
PUEBLO W., CO

Salida Hydroponic Supply
1242 C St.,
SALIDA, CO 81201
719-539-4000

Way To Grow- Silverthorne
265 Brian Ave.
SILVERTHORNE, CO 80497
970-368-7220

Little Shop of Growers
2560 Copper Ridge Dr.
STEAMBOAT SPRINGS, CO 80487
970-879-8577

GrowGeneration - Trinidad
2012 Freedom Rd., Ste. #65
TRINIDAD, CO 81082
719-846-8592

Hydro Planet
5022 Kippling St.
WHEAT RIDGE, CO 80033
303-279-6090

CONNECTICUT

CT Home Grown
23 N. Canterbury Rd.
CANTERBURY, CT 06331
860-546-6161

Grow Crazy
11 Berlin Rd., Unit 2
CROMWELL, CT 06416
860-788-2519

High Tech Garden Supply - Orange
367 Boston Post Rd.
ORANGE, CT 06477
203-672-1324

CT Roots
82 Myrtle Ave.
STAMFORD, CT 06902
203-595-5007

LiquidSun® CT
10C South Main St.
WINDSOR E., CT 06088
860-254-5757

DELAWARE

1st State Seed And Garden Supply
People's Plaza Ste. 950
NEWARK, DE 19702
302-834-0440

DISTRICT OF COLUMBIA

Let's Grow DC! Good Hope Hydroponics
1113 Good Hope Rd. SE
WASHINGTON, DC 20020
202-525-4115

FLORIDA

Keys Organic & Hydroponic Supply
85 Industrial Rd., Unit 1&2
BIG PINE KEY, FL 33043
305 872 7277

Boca Hydro LLC
10018 Spanish Isles Blvd.
BOCA RATON, FL 33498
561-672-1708

Best Hydro
4914 Lena Rd., Ste. 101
BRADENTON, FL 34211
941-756-1928

Palm Coast Hydroponics
4490 N. Hwy US1, Ste. 108
BUNNELL, FL 32110
386-246-4119

East Coast Hydroponics & Organics
461 Forrest Ave., Ste. 105
COCA, FL 32922
321-243-6800

The Future Farms
3332 Griffin Rd.
DANIA BEACH, FL 33312
754-208-2262

Greener Touch Hydroponics
5011 S. State Rd. 7, Ste. 104
DAVIE, FL 33314
954-316-8815

Biofloral
6250 NW 27th Way
FORT LAUDERDALE, FL 33309
877-735-6725

Electric Blooms Hydroponics
1021 NE 45th St.
FORT LAUDERDALE, FL 33334
954-541-2210

Green Thumb Hydroponics Supplies
17031 N. Cleveland Ave.
FORT MEYERS, FL 33903
239-997-4769

Gator Hydroponics
4460 SW 35th Terrace, Ste. 310
GAINESVILLE, FL 32608
352-301-5383

Florida Garden Supplies
2692 W. 79 St.
HIALEAH, FL 33016
800-931-5215

Fresh Health Hydroponics & Organics
1738 Kings Ave.
JACKSONVILLE, FL 32207
904-398-8012

Grower's Choice & Hydroponics
11855 North Main St.
JACKSONVILLE, FL 32218
904-683-4517

Growers Choice South
8535 Baymeadows Rd., Ste. 13
JACKSONVILLE, FL 32256
904-647-7156

Urban Gardens of Jax
1185 Talbot Ave.
JACKSONVILLE, FL 32205
904-466-4746

Grow Giant
811 E. Donegan Ave.,
KISSIMMEE, FL 34744
407-964-3233

Simply Hydroponics & Organics
7949 Ulmerton Rd.
LARGO, FL 33771
727-531-5355

Hydrofarm Southeast
12600 NW 115th Ave.
Medley, FL 33178
877-780-4567

High Tech Garden Supply - Melbourne
2975 West New Haven Ave.
MELBOURNE, FL 32904
321-821-0853

Advanced Hydro Gardens
4960 NW 165 St., Ste. B-4
MIAMI, FL 33014
305-474-4376

All Star Hydroponics Inc
8901 SW 129th St.
MIAMI, FL 33176
800-842-8582

Florida Garden Supplies
14025 SW 142 Ct. #27
MIAMI, FL 33175
305-598-4311

Florida Garden Supplies
12811 SW 42 St.
MIAMI, FL 33175
800-931-5215

Future Farms Inc., The
22700 SW Krome Ave.
MIAMI, FL 33170
305-382-2757

Healthy Harvest
13444 SW 131st St.
MIAMI, FL 33186
305-964-7403

New Smyrna Beach Hydroponics & Organic Garden Supply
630 N. Dixie Freeway
NEW SMYRNA BEACH, FL 32168
386-410-4956

TD Supply Corp.
7207 NW 54th St.
MIAMI, FL 33166
305-805-4382

Florida Garden Supplies
8442 Tradeport Dr., Unit 200
ORLANDO, FL 32827

Grow Giant
1360 N. Goldenrod Rd. #11
ORLANDO, FL 32807
407-613-5998

Root Grow Bloom
6100 Hanging Moss Rd., Ste 500
ORLANDO, FL 32807
407-647-4769

Urban Sunshine
6100 Hanging Moss Rd., Ste. 500
ORLANDO, FL 32807
407-647-4769

Florida Garden Supplies
8020 Belvedere Rd.,Unit 4
PALM BEACH, FL 33411
800-931-5215

Palm Beach Discount Hydroponics – East
968 North Congress Ave.
PALM BEACH W., FL 33409
561-296-6161

Healthy Harvest
911 NW 209th Ave., #129
PEMBROKE PINES, FL 33029
954-538-1511

Eden Garden Supply
3111 N. Davis Hwy.
PENSACOLA, FL 32503
850-439-1299

Healthy Gardens and Supply of Florida, Inc.
196 East Nine Mile Rd., Ste. F
PENSACOLA, FL 32534
850-912-4545

Healthy Harvest
590 SW 9th Terrace #3
POMPANO BEACH, FL 33069
954-786-7997

Bliss Feed II and Hydroponic Supply
3669 Paul Buchman Hwy.
PLANT CITY, FL 33565
813-752-0011

National Garden Wholesale/ Sunlight Supply
455 S. Andrews Ave.
POMPANO BEACH, FL 33069
877-649-3567 (Southeast)

Hydroponic Depot II
2395 S. Tamiami Trail #209
PORT CHARLOTTE, FL 33952
941-255-3999

Avid Brew Company
1745 1st Ave. S.
ST. PETERSBERG, FL 33712
727-388-6756

Mr. Nice Guy Hydroponics
1800 NW. Federal Hwy.
STUART, FL 34994
772-934-6785

Esposito Garden Center
2748 Capital Cir. NE
TALLAHASSEE, FL 32308
850-386-2114

Grace's Hydro-Organic Garden Center
8707 Temple Terrace Hwy.
TAMPA, FL 33637
813-514-9376

MJ Richards Grow Supply
11612 N. Nebraska Ave.,
Tample Flea Market, Aisle B5
TAMPA, FL 33629
813-508-7891

Schiro's Barn-N-Garden Supplies Inc.
7812 Causeway Blvd.
TAMPA, FL 33619
813-626-0902

Stoney Hydro @ Schiro's Barn-N-Garden Supplies
7812 Causeway Blvd.
TAMPA, FL 33619
813-626-0902

Urban Roots Garden Supply
11780 North Dale Mabry Hwy.
TAMPA, FL 33618
813-962-7668

Tampa Hydroponics
4412 North 56th St.
TAMPA, FL 33610
800-283-9676

Happy Planet Hydroponics
1179 E. Alfred St.
TAVARES, FL 32778
352-253-1001

365 Hydroponics
13054 W. Colonial Dr.
WINTER GARDEN, FL 34787
407-656-GROW (4769)

GEORGIA

Flora Hydroponics, Inc.
195 Paradise Blvd.
ATHENS, GA 30607
706-353-2223

Atlantis Hydroponics
1422 Woodmont Lane, #4
ATLANTA, GA 30318
404-367-0052

Taproot Hydroponics
2111 Faulkner Rd.
ATLANTA, GA 30324
404-464-8313

Growtopia Hydroponics
4155 S. Lee St., Ste. #200
BUFORD, GA 30518
678-288-9890

Atlantis Hydroponics
2561 West Point Ave.
COLLEGE PARK, GA 30337
678-510-0032

Savannah Hydroponics & Organics
4107 Eighth St., Ste. C
GARDEN CITY, GA 31408
912-349-4030

Garden City Hydroponics and Organics
101 Maple Drive
MARTINEZ, GA 30907
706-814-5656

Atlantis Hydroponics
5182-B Brook Hollow Parkway
Norcross, GA 30071
770-558-1346

Hab Hydro
3388 W. Currahee St.
TOCCOA, GA 30577
706-282-4845

HAWAII

Haiku Hardware & Garden
375 W. Kuiaha Rd.
HAIKU, HI 96708
808-575-9360

Ohana Greenhouse and Garden Supply
797 Kanoelehua Ste. A
HILO, HI 96720
808-961-3111

Green Hands of Aloha
500 Alakawa St. #120-1001
HONOLULU, HI 96817
808-847-4263

Hawaiian Hydroponics and Garden
4224 Wailae, Ste. 1A
HONOLULU, HI 96816
808-735-8665

Ohana Greenhouse and Garden Supply
2014 Republican St.
HONOLULU, HI 96819
808-841-GROW

Ohana Greenhouse and Garden Supply
73-5581 Lawehana St. #4
KAILUA, HI 96740
808-331-8710

Ohana Greenhouse and Garden Supply
320 Hoohana St. #13-16
KAHULUI, HI 96732
808-871-6361

Pahoa Feed & Fertilizer
15-2754 Old Government Rd.
PAHOA, HI 96778
808-965-9955

IDAHO

Boise Hydroponics
1528 S. Vista Ave.
BOISE, ID 83705
208-344-3053

ILLINOIS

Aerogro
502 N. Prospect, Ste. 18
BLOOMINGTON, IL, 61704

Brew and Grow
181 Crossroads Parkway
BOLINGBROOK, IL 60440
630-771-1410

Brew and Grow
3625 N. Kedzi Ave.
CHICAGO, IL 60618
773-463-7430

Chicago Roots Hydroponics & Organics
4020 W. Irving Park Rd.
CHICAGO, IL 60641
773-545-4020

Alternative Garden Supply
3625 N. Kedzie Ave.
CHICAGO, IL 60618
815-301-4940

Goldman's Grow Shop
910 Greenwood Rd.
GLENVIEW, IL 60025
847-657-7250

Grow Masters
4641 Old Grand Ave.
GURNEE, IL 60031
224-399-9877

Big Grow Hydroponics
9225 Trinity Dr.
LAKE IN THE HILLS, IL 60156
847-854-4450

Grow Big Hydroponics
5024 Willow Creek Rd.
MACHESNEY PARK, IL 61115
815-637-4769

GroUp Gardening
229 Court St.
PEKIN, IL 61554
309-349-4407

Aerogro
127 N. Main St.
PEORIA E., IL 61611
309-694-0368

Heartland Hydrogardens
7403 Broadway St.
QUINCY, IL 62305
217-214-GROW (4769)

Brew and Grow
3224 S. Alpine Rd.
ROCKFORD, IL 61109
815-874-5700

Grow Big Hydroponics
5055 28th Ave.
ROCKFORD, IL 61108
815-708-7369

Rock Valley Garden Center
785 N. Bell School Rd.
ROCKFORD, IL 61107
815-398-9419

Brew and Grow
359 W. Irving Park Rd.
ROSELLE, IL 60172
630-894-4885

Organic Garden Center
9223 Skokie Blvd.
SKOKIE, IL 60077
847-675-2722

Deep Roots Midwest
1219 W. Ash St.
SPRINGFIELD, IL 62704
217-679-1454

Kreation's Indoor Gardening Center
3427 Old Chatman Rd.
SPRINGFIELD, IL 62704
217-341-0821

Simple Soil Hydroponics
336 E. St. Charles Rd.
VILLA PARK, IL 60181
630-903-6775

INDIANA

Five Point Gardens
56555 Oak Rd.
BEND S., IN 46619
574-287-9232

Goldleaf Hydroponics LLC
5081 S. Production Dr., Ste. B
BLOOMINGTON, IN 47403
812-500-0423

Worm's Way Indiana
7850 North State Rd. 37
BLOOMINGTON, IN 47404
800-598-8158

Worm's Way Mail Order
7850 North State Rd. 37
BLOOMINGTON, IN 47404
800-274-9676

Hops & Harvest
10812 Coldwater Rd. Ste 100-200
FORT WAYNE, IN 46845
260-918-3035

Brew and Blooms
7205 Calumet Ave.
HAMMOND, IN 46324
219-595-BREW (2739)

Harvest Moon Hydroponics
1234 N. Capital Ave.
INDIANAPOLIS, IN 46202
317-780-8070

Magic Bulb Garden Center
3156 Shadeland Ave.
INDIANAPOLIS, IN 46226
317-202-2852

Maximum Grow Gardening
6117 E. Washington St.
INDIANAPOLIS, IN 46219
317-359-GROW (4769)

Maximum Grow Gardening
140 Frontage Rd. Ste. D
LAFAYETTE, IN 47905
765-464-6689

The Wine-N-Vine Inc.
1524 East McGalliard Rd.
MUNCIE, IN 47303
765-282-3300

BWGS-IN
1400 Hancel Pkwy.,
MOORESVILLE, IN 46158
800-316-1306

IOWA

Infinite Season
1501 NE Broadway Ave., Ste. 5
DES MOINES, IA 50313
515-975-9358

KANSAS

Year-Round Garden
117 S. Mur-Len Rd.
OLATHE, KS 66062
913-397-0594

Johnson's Garden Center Inc.
2707 W. 13th
WICHITA, KS 67203
316-942-1443

Johnson's Garden Center Inc.
6225 E. Shadybrook
WICHITA, KS 67208
316-687-5451

KENTUCKY

Modern Farm Concepts
163 Castleheights Rd.
BOWLING GREEN, KY 42103
270-202-5525

Garden Grove Organics
701 Scott Blvd.
COVINGTON, KY 41011
859-360-1843

Worm's Way Kentucky
1360 Donaldson Hwy. Ste. A
ERLANGER, KY 41018
800-669-2088

Success Hydroponics
139 E. New Circle, Ste. 130
LEXINGTON, KY 40505
859-294-4769

Louisville Hydroponics
3471 Taylor Blvd.
LOUISVILLE, KY 40215
502-366-4000

New Earth Garden Center
9806 Taylorsville Rd.
LOUISVILLE, KY 40299
800-462-5953

Paducah Hydroponics
3845 Benton Rd.
PADUCAH, KY 42003
270-558-5186

Bluegrass Organic Grow Shop
109 Quinn Dr.
NICHOLASVILLE, KY 40356
859-887-0677

LOUISIANA

Grow Wiser Garden Supply
2109 Decatur St.
NEW ORLEANS,LA 70116
504-644-4713

Laughing Buddha Nursery
4516 Clearview Parkway
METAIRIE, LA 70006
504-887-4336

Ourcrazydeals Hydroponics
201 Angus Dr.
YOUNGSVILLE, LA 70592
337-303-6146

MAINE

Liquid Blue Organics
505 Benton Rd.
ALBION, ME 04910
207-437-1087

Grow Depot
245 Center St.
AUBURN, ME 04210
207-312-5535

Grow Depot
171 Capitol St.
AUGUSTA, ME 04330
207-213-6852

New England Garden Connection Inc.
141 Riverside Dr.
AUGUSTA, ME 04330
207-621-1700

Salsbury Organics
1501 State Hwy. 102
BAR HARBOR, ME 04609
207-288-5182

All Ways Green Hydroponics - Belfast
100 Seasport Ave.
BELFAST, ME 04915
207-338-4294

Greenlife Garden Supply
380 Elm Street, #4
BIDDEFORD, ME 04005
207-571-9455

The Urban Garden Center
600 Wilson St.
BREWER, ME 04412
207-989-2020

A2Z Grow Supplies
172 Pleasant St.
BRUNSWICK, ME 04011
207-725-6400

All Ways Green Hydroponics - Ellsworth
138 High St.
ELLSWORTH, ME 04605
207-412-0190

Full Bloom Hydroponics
502 Wilton Rd.
FARMINGTON, ME 04938
207-860-2808

Four Seasons Horticulture Supply
235 Bridgton Rd.
FRYEBURG, ME 04037
207-935-5444

Northern Roots Grow Supply
3 Bird Hill Rd.
GREENWOOD, ME 04255
207-875-2089

Hy-Grow Organics
355 North St.
HOULTON, ME 04730
207-521-5009

Maine Hydroponic Supply
50 Rockland Rd.
JEFFERSON, ME 04348
207-390-0857

The Urban Garden Center
806 Sabattus
LEWISTON, ME 04240
207-333-3696

Inside/Out Indoor Garden Supply, LLC
1766 Federal Rd.
LIVERMORE, ME 04253
207-897-2221

Grow Life Hydroponics
301 Forest Ave.
PORTLAND, ME 04101
207-761-2800

High Tech Garden Supply - Portland
178 Rand Rd.
PORTLAND, ME 04102
207-899-4387

The Urban Garden Center
659 Warren Ave.
PORTLAND, ME 04103
207-347-2350

Here We Grow
686 Main St.
PRESQUE ISLE, ME 04769
207-554-8797

Rootz Down
265 Water St.
RANDOLPH, ME 04346
207-582-0661

HighWire Hydroponics
1 Murray Dr.
RAYMOND, ME 04071
207-655-2072

Maine Indoor Garden Supply
829 Portland Rd., Route 1
SACO, ME 04072
207-494-8379

Highland Horticultural
14 Gary L. Maietta Pkwy.
SOUTH PORTLAND, ME 04106
207-650-1625

The Urban Garden Center
235 Lewiston Rd.
TOPSHAM, ME 04086
207-373-0990

Greenlife Garden Supply
611 US Route 1
YORK, ME 03909
207-363-0844

MARYLAND

High Tech Garden Supply - Beltsville
11602 Baltimore Ave.
BELTSVILLE, MD 20705
240-965-1733

All Good Garden Supply
3150 A Baltimore Blvd.
FINKSBURG, MD 21048
443-273-3273

GF Agriculture
14627 Cearfoss Pike
Hagerstown, MD 21740
240-457-0288

Maryland Hydroponics Inc.
10051 N. 2nd St.
LAUREL, MD 20723
301-490-9236

Hydroworks
1035 Benfield Blvd., Ste. G
MILLERSVILLE, MD 21108
443-795-4525

Meadowview Feed & Garden Center
1202 Meadowview Rd.
PASADENA, MD 21122
443-817-0018

Montgomery Hydroponics
8950 Brookville Rd.
SILVER SPRING, MD 20910
301-588-1935

Purple Mountain Organics
100-7010 Westmoreland Ave.
TAKOMA PARK, MD 20912
877-538-9901

MASSACHUSETTS

Mass Hydro
679 Washington St.
ATTLEBORO S., MA 02703
508-915-6115

New England Hydroponics
6 Johnson St.
AUBURN, MA 1501
888 529 9025

Grow It Green LLC
122 Pulaski Blvd.
BELLINGHAM, MA 02019
508-883-GROW (4769)

Greenlife Garden Supply
481 Boston Rd., Unit 4
BILLERICA, MA 01821
978-262-9966

GYOstuff – Grow Your Own
2400 Massachusetts Ave.
CAMBRIDGE, MA 02140
617-945-1654

East Coast Hydro
390 Rhode Island Ave.
FALL RIVER, MA 02721
704-GO-HYDRO

Harvest Moon Hydroponics
29 Washington St., Route 1
FOXBORO, MA 02035
800-660-6977

New England Hydroponics
855 Worcester Rd. Route 9
FRAMINGHAM, MA 01701
888-529-9025

Western Mass Organic Garden Supply
12 Kenwood St.
GREENFIELD, MA 01301
413-676-9664

Here We Grow
123 Russell St. (Route 9)
HADLEY, MA 01035
413-584-FARM (3276)

Perpetual Harvest
273 Hanover St. Route 139 Ste.14
HANOVER MA, 02339
781-829-6900

LiquidSun MA
8 Lynwood Ave.
HOLYOKE, MA 01040
413-539-6875

Cape Cod Hydroponics
195 Ridgewood Ave.
HYANNIS, MA 02601
508-737-2555

Rootdown Hydroponics Indoor Garden Center
236 Mystic Ave.
MEDFORD, MA 02155
781-874-1693

Growing Point Garden Supply
466 Lowell St.
METHUEN, MA 01844
978-655-3173

Green Matters - Middleboro
592 Wareham St.
MIDDLEBORO, MA 02346
508-923-2800

Matt's Hydroponics
206 E. Main St., Unit 5
MILFORD, MA 01757
508-478-0710

Project Grow
898 Mount Pleasant St.
NEW BEDFORD, MA 02745
774-202-6383

Whaling City Hydroponics
201 Popes Island
NEW BEDFORD, MA 02740
508-990-1803

Green Path Garden Supply
276 West Main St.
NORTHBOROUGH, MA 01532
508-393-4181

NewFarm
225 Cranberry Hwy.
ORLEANS, MA 02653
508-255-0205

LiquidSun RI
1179 Central Ave.
PAWTUCKET, MA 02861
401-722-2724

Green Harvest Hydroponics
82 Newbury St.
PEABODY, MA 01960
978-278-5898

H2Grow Hydroponics
194 Washington St.
PEABODY, MA 01960
978-977-GROW (4769)

Berkshire Hydroponics
1450 East St.
PITTSFIELD, MA 01201
413-464-7875

Green Matters, Pocasset
4 Barlows Landing Rd.
POCASSET, MA 02559
508-392-9249

East Coast Hydro
1470 Route 44
RAYNHAM, MA 02767
508-499-7220

Hydroponics N More Garden Center
331 Centre Ave.
ROCKLAND, MA 02370
781-421-3356

RI Hydroponics
495 Central Ave
SEEKONK, MA 02771
508-915-6172

High Tech Garden Supply - Shrewsbury
502 Boston Turnpike (Route 9)
SHREWSBURY, MA 01545
508-845-4477

New England Hydroponics
15 D College Hwy. (Route 10)
SOUTHAMPTON, MA 01073
888-529-9025

Nor'easter Organic Life
515 College Hwy. Unit J
SOUTHWICK, MA 01077
413-998-3951

RI Hydroponics
140 Worcester Providence Turnpike
SUTTON, MA 01590
508-865-4276

Worm's Way Massachusetts
121 Worc-Providence Turnpike
SUTTON, MA 01590
800-284-9676

Hydro-Earth
65 Swansea Mall Dr.
SWANSEA, MA 02777
508-646-0300

Taunton Hydro
451 Winthrop St.
TAUNTON, MA 02780
508-824-1599

Aquarius Hydroponics
138 Memorial Ave.
WEST SPRINGFIELD, MA 01089
413-732-3300

High Tech Garden Supply - West Springfield
1458 Riverdale St., Unit D
WEST SPRINGFIELD, MA 01089
413-726-9023

Emerald City Indoor Gardening
51 Main St.
WESTMINSTER, MA 01473
978-668-5393

Gardin
500 Columbian St.
S. WEYMOUTH, MA 02190
781-277-4887

MICHIGAN

Barrett's Flowers and Gardens
1033 W. Beecher St.
ADRIAN, MI 49221
517-265-5595 | 800-748-0279

Get Growing Urban Garden Centre
142 S. Main St.
ADRIAN, MI 49221
517-920-4833

Albion Hydroponics
110 W. Watson St.
ALBION, MI 49224
517-343-2130

Cultivation Station of Michigan Inc., The
6540 Allen Rd.
ALLEN PARK, MI 48101
313-383-1766

Hydroponics and More Inc
3519 Vandyke Rd.
ALMONT, MI
810-798-2524

MI-Hydro and Gardening Center
4260 Van Dyke Rd., Ste. 107
ALMONT, MI 48003
810-673-3500

Cultivation Station
1948 W. Stadium Blvd.
ANN ARBOR, MI 48103
734-213-7740

The Grow Show
4095 Stone School Rd.
ANN ARBOR, MI 48108
734-677-0009

Battle Creek Indoor Gardening
1125 E. Michigan Ave.
BATTLE CREEK, MI 49014
269-282-0554

BIG Green Tomato
478 Main St.
BATTLE CREEK, MI 49014
269-282-1593

The Indoor Grow Store
912 North Ave.
BATTLE CREEK, MI 49017
269-753-1998

Homelight Gardens
3471 S. Huron Rd.
BAY CITY, MI 48706
989-922-0088

Hydro Magic
120 N. Ross St. Unit 4
BEAVERTON, MI 48612
989-394-8004

Premier Hydro
11820 Belleville
BELLEVILLE, MI 48111
734-325-6210

Grow Supply Center
3131 Benzie Hwy.
BENZONIA, MI 49616
231-882-9270

Indoor Grower's Edge
805 Maple St.
BIG RAPIDS, MI 49307
231-629-8177

Downriver Hydro
19280 Allen Rd.
BROWNS TOWN, MI 48183
734-301-3745

Growers Outlet
7720 Clyde Park SW
BYRON CENTER, MI 49513
616-878-4444

Happy Harvesters Hydroponics
4410 S. Saginaw St.
BURTON, MI 48529
810-496-3005

Two Guys and a Grow Shop
3374 Atherton Rd.
BURTON, MI 48509
810-820-4275

Greenway Gardens
916 W. 13th St.
CADILLAC, MI 49601
231-775-7075

Indoor Grower's Edge
8998 E. 34 Rd., Ste. B
CADILLAC, MI 49601
231-468-3343

Caledonia Gardens
9750 Cherry Valley Ave. SE
CALEDONIA GARDENS, MI 49316
616-891-0706

The Great Lakes Hydroponics Co.
5998 US.31 South
CHARLEVOIX, MI 49720
231-237-9153

Cultivation Station 3 Inc.
46912 Gratiot
CHESTERFIELD, MI 48051
586-949-7453

Hydro Pro's Indoor Garden
30504 23 Mile Rd.
CHESTERFIELD, MI 48047
586-741-8805

HydroMaster
36345 Grosebeck Hwy.
CLINTON TWP, MI 48035
586-792-0277

Clio Cultivation
11394 N. Saginaw Rd.
CLIO, MI 48420
810-686-4769

Sun & Soil Hydro
882 E. Chicago St.
COLDWATER, MI 49036
517-227-5245

H2O Grow Supply
3364 Arent Ct.
COLOMA, MI 49038
269-468-3890

The Local Indoor Garden Store
4979 N. Lapeer Rd.
COLUMBIAVILLE, MI 48421
810-793-5064

Lets Grow Hydroponics
1141 W. Randall St., Ste. L
COOPERSVILLE, MI 49404
616-997-0420

All Seasons Organic Garden Supply
721 S. State Rd.
DAVISON, MI 48423
810-412-4025

Hydro Giant - Dearborn
14455 Ford Rd.
DEARBORN, MI 48126
313-216-8888

Cultivation Station – Eastern Market, The
2518 Market St.
DETROIT, MI 48207
313-394-0441

Growers R Us
19317 W. Warren
DETROIT, MI 48228
313-633-1617

Hydro Giant - Detroit
21651 W. 8 Mile Rd.
(8 Mile & Lahser)
DETROIT, MI 48219
313-387-7700

Urban Gardening Center, The
2520 22nd St.
DETROIT, MI 48216
313-898-0200

Total Hydroponics Center LLC
24930 Gratiot Ave.
EASTPOINT, MI 48021
586-777-2528

GroMart Indoor Gardening Solutions
68991 M-62 Ste. Q
EDWARDSBURG, MI 49112
269-414-4385

All Season Garden Supply
833 N. Lincoln Rd.
ESCANABA, MI 49829
906-553-7191

Fenton Hydroponics & Garden Center
1380 N. Leroy St.
FENTON, MI 48430
810-714-1719

Green Thumb Garden Center
22963 Woodward Ave.
FERNDALE, MI 48220
248-439-1851

Garden Depot
4506 W. Pierson Rd.
FLINT, MI 48504
810-820-8110

The Indoor Grow Store
3009 S. Dort Hwy.
FLINT, MI 48929
810-228-3962

Urban Garden Supply
4516 Pasadena Ave.
FLINT, MI 48504
810-733-0420

Urban Garden Supply
3410 S. Dort Hwy.
FLINT, MI 48507
810-875-9580

Granny Greenthumbs Soil & Hydroponics
103 W. Grand River Ave.
FOWLERVILLE, MI 48836
517-223-1302

Indoor/Outdoor Garden Shop
105 N. Seymour Rd.
FLUSHING, MI 48433
810-867-4351

The Grow Shop of Garden City
28505 Ford Rd.
GARDEN CITY, MI 48135
734-956-5400

Happy Hydro
1261 Main St.
GAYLORD, MI 49735
989-448-8877

Holland Hydroponic Outlet
604 N. Beacon Blvd.
GRAND HAVEN, MI 49423
616-847-1277

Grand Rapids Hydroponics Inc.
520 Leonard St.
GRAND RAPIDS, MI 49504
616-454-2500

Growco Garden Supply
877-939-6900
1042 Michigan St. NE
GRAND RAPIDS, MI 49503
4640 W. River Dr.
COMSTOCK PARK, MI 49321

Horizen Hydroponics
2200 Alpine Ave., NW
GRAND RAPIDS, MI 49504
866 791 1664

Greenville Gardens
11500 Morgan Mills Rd., NE
GREENVILLE, MI 48838
616-745-0500

Holland Hydroponic Outlet
1220 Phoenix Rd.
HAVEN S., MI 49090
269-637-5941

HydroHarry's- HP
24047 Dequindre Rd.
HAZEL PARK, MI 48030
248-541-0099

Flower Factory Hydroponics
2223 E. Highland Rd.
HIGHLAND, MI 48356
248-714-9292

Roots 2 NV
2223 E. Highland Rd.
Highland, MI 48356
248-714-9292

Grow It Again Hydroponics
840 N. Black River Dr., Ste. 70
HOLLAND, MI 49424
616-772-9421

Holland Hydroponic Outlet
587-40 E. 8th St.
HOLLAND, MI 49423
616-298-7395

HGR Garden Supply
15231 N. Holly Rd.
HOLLY, MI 48442
248-369-8333

Indoor Grower's Edge
705 S. Loxley Rd.
HOUGHTON LAKE, MI 48629
989-366-1474

Grow Fast Gardens
5015 S. Straits Hwy.
INDIAN RIVER, MI 49749
231-238-4113

Aric's Indoor Garden Supply
W. 7788 US Hwy 2
IRON MOUNTAIN, MI 49801
906-828-2000

Grow Maxx
1220 S. Stephenson Ave.
IRON MOUNTAIN, MI 49801
906-221-2111

Hydrocapitol
258 Cooper St.
JACKSON, MI 49201
517-795-2633

Mighty Grow
2418 W. Michigan Ave.
JACKSON, MI 49202
517-962-4822

High Tech Garden Supply - Kalamazoo
1745 W. Main St.
KALAMAZOO, MI 49006
269-978-8697

Horizen Hydroponics
4606 W. Main St.
KALAMAZOO, MI 49006
866-791-1664

Kalamazoo Indoor Garden
450 W. Maple St.
KALAMAZOO, MI 49001
269-344-2550

Plainwell Indoor/Outdoor Garden Center
8201 Douglas Ave.
KALAMAZOO, MI 49009
269-532-1167

Zoo City Grower Supply
3514 S. Westnedge
KALAMAZOO, MI 49008
269-903-2450

Garden Wise
5719 S. Sheldon Rd.
KANTON, MI 48193
734-225-6414

Halms Hydro
2368 S. Huron Rd.
KAWKAWKLIN, MI 48631
989-402-1296

Howz It Growing
1290 S. Lapeer Rd.
LAKE ORION, MI 48360
248-693-5747

Capital City Growers
2208 E. Michigan Ave.
LANSING, MI 48912
517-853-9988

H2O Hydroponics
5210 W. Saginaw Hwy.
LANSING, MI 48917
517-703-8120

High Tech Garden Supply - Lansing
2815 E. Grand River Ave.
LANSING, MI 48917
517-580-0555

Horizen Hydroponics
5425 W. Saginaw Hwy.
LANSING, MI 48917
517-323-ROOT

The Indoor Grow Store
4929 S. Cedar St.
LANSING, MI 49254
517-513-3902

The Indoor Grow Store
644 Migaldi Ln., Ste. 500
LANSING, MI 48917
517-731-6967

The Indoor Grow Store
16999 US Old 27 Hwy.
LANSING, MI 48906
517-203-5100

Superior Growers Supply Inc.
3928 W. Saginaw Hwy.
LANSING, MI 48917
517-327-1900

Superior Growers Supply, Inc.
5716 S. Pennsylvania Ave.
LANSING S., MI 48911
517-393-1600

Wholesale Gardening Center
229 W. Grand River
LANSING, MI 48906
517-202-4225

Edenz Hydro
560 Oak St.
LAPEER, MI 48446
248-291-6691

Superior Growers Supply Inc.
292200 Seven Mile W.
LIVONIA, MI 48152
248-473-0450

The Barefoot Gardener
11635 Fulton St. Ste. 300B
LOWELL, MI 49331
616-987-3457

Plant Paradise
4593 W. US 10
LUDINGTON, MI 49431
231-843-3000

Edenz Hydro
1411 W. 14 Mile
MADISON HEIGHTS, MI 48071
248-291-6691

Northern Lights Hydroponic & Garden Supply
29090 Campbell Rd.
MADISON HEIGHTS, MI 48071
248-439-6269

The House of Gardening
29245 Dequindre Rd.
MADISON HEIGHTS, MI 48071
248-206-7427

Hypnotic Hydroponics
321 Deer St.
MANISTIQUE, MI 49854
906- 341-GROW

Big Creek Hydroponics
555 Old Little Lake Rd.
MARQUETTE, MI 49855
906-249-5297

Northern Hydroponics
401 W. Washington St.
MARQUETTE, MI 49855
906-228-4769

Grow Masters
2900 10th St
MENOMINEE, MI 49858
906-863-2083

The Indoor Grow Store
4538 Page Ave.
MICHIGAN CENTER, MI 48929
810-228-3962

Sweet Greens Hydroponics
119 Fifth St.
MICHIGAN CENTER, MI 49254

Cultivation Innovations
15223 S. Dixie Hwy.
MONROE, MI 48161
734-682-5819

Cedar Garden Wholesale
138 N. Bound Gratiot
MT. CLEMENS, MI 48043
586-738-0030

Green Grow LLC
9046 N. Dort
MT. MORRIS, MI 48458
810-687-9500

Greens Indoor Garden Supply
9384 N. Saginaw Rd.
MT. MORRIS, MI 48458
810-564-8700

Indoor Grower's Edge
2410 S. Leaton Ste. 5
MT. PLEASANT, MI 48858
989-317-0944

Sunshine Supply Co.
5800 E. Pickard St.
MT. PLEASANT, MI 48858
989-775-3700

Big Blue Hydroponics
590 Ottawa St.
MUSKEGON, MI 49441
231-571-9400

Green Lantern H2O
1383 E. Laketon Ave.
MUSKEGON, MI 49442
231-722-0420

Growing Consultant Hydroponics & Things
2260 Apple Ave.
MUSKEGON, MI 49442
231-773-5600

Harbor Country Hydro
17648 US Highway 12
NEW BUFFALO, MI 49117
269-469-2242

Flo-N-Grow Hydroponics Co.
214 N. 2nd St.
NILES, MI 49120
269-683-1877

Gro-Pro Depot
8235 Mason Dr, Ste. C
NEWAYGO, MI 49337
231-519-9987

Owlyn Solutions for Growers
2398 Jolly Rd., Ste. 300
OKEMOS, MI 48864
517-203-5070

Watch it Grow Hydroponics
407 W. Center St.
OMER, MI 48749
989-653-2141

Happy Harvesters Hydroponics
1772 S. Ortonville Dr.
ORTONVILLE, MI 48462
248-793-3357

Healthy Harvest Garden Supply
233 S. State St.
OSCODA, MI 48750
989-569-3006

Happy Hydro
1691 US Hwy 131
PETOSKEY, MI 49770
231-348-3000

Green Earth Hydroponics
8127 Portage Rd.
PORTAGE, MI 49002
269-342-4190

Two Guys and a Grow Shop
1665 Jager St.
PORT HURON, MI 48060
810-621-3790

Ultra Green Hydroponics
9300 Telegraph Rd.
REDFORD, MI 48239
313-534-9377

Green Thumb Hydroponics & Organic Indoor Supply
8460 Algoma, Ste. G
ROCKFORD, MI 49341
616-884-5500

Growers Edge
4444 14 Mile Rd.
ROCKFORD, MI 49341
616-863-9095

Happy Gardening
20840 Telegraph Rd.
ROMULUS, MI 48174
734-486-4115

High Tech Garden Supply - Roseville
28000 Groesbeck Hwy.
ROSEVILLE, MI 48066
586-435-2335

Plant Paradise
7657 Michigan Ave.
ROTHBURY, MI 49452
231-843-3000

GrowMart
2135 Warwick St.
SAGINAW, MI 48603
989-799-6330

Third Coast Garden Supply LLC
2327 Auburn Rd.
SHELBY TOWNSHIP, MI 48195
586-997-2700

Hydro Giant - Southgate
19363 Eureka Rd.
SOUTHGATE, MI 48195
734-281-8888

Cultivation Station of Michigan Inc., The
23529 Little Mack Ave.
ST. CLAIR, MI 48080
586-775-9485

Horti-Toad Hydroponic Supply
21323 Harper
ST. CLAIR SHORES, MI 48080
586-944-0650

Ideal Growing Solutions
1331 W. Cedar St.
STANDISH, MI 8658
800-322-0527

Hydro City LLC
34863 Schoenherr
STERLING HEIGHTS, MI 48312
586-883-9075

CBP Farmers Market
2451 S. Derby Rd.
SIDNEY, MI 48885
989-328-6065

High Tech Garden Supply - Taylor
7889 Telegraph Rd.
TAYLOR, MI 48180
313-908-7554

Hydro Grow, The
8210 Telegraph Rd.
TAYLOR, MI 48180
313-633-0641

Cultivation Innovations
6652 Lewis Ave. Ste. 7
TEMPERANCE, MI 48182
419-725-4769

Unigrow Hydro
140 W. Michigan
Three Rivers, MI 49093
269-718-7309

Cultivation Station
1990 US-31 N. Ste. C
TRAVERSE CITY, MI 49686
231-421-8118

Grow Store, The
90 N. U.S. Highway 31 South
TRAVERSE CITY, MI 49685-7923
231-421-5191

High Tech Garden Supply - Traverse City
1029 Hannah Ave.
TRAVERSE CITY, MI 49686
231-668-6913

High Tech Garden Supply - Troy
3914 Rochester Rd.
TROY, MI 48083
248-275-1739

Hydro Pro's Indoor Garden
45410 Van Dyke Ave.
UTICA, MI 48317
586-803-0966

Forever Green
340 S. Main St.
VASSAR, MI 48768
989-882-9177

H2 Hydro
702 N. Pontiac Trail
WALLED LAKE, MI 48390
248-669-6063

Beste's Hydroponic Supply
21410 Schoenherr Rd.
WARREN, MI 48089
586-776-1794

Greco's Nursery & Garden Supplies
12219 E. 11 Mile Rd.
WARREN, MI 48093
586-759-1335

Hydro King Indoor Garden Supply
32000 Van Dyke Ave.
WARREN, MI 48093
586-939-0518

Happy Harvesters Hydroponics
5720 Highland Rd.
WATERFORD, MI 48327
248-599-9761

Indoor Garden Superstore
2570 Dixie Hwy.
WATERFORD, MI 48328
248-673-2200; 877-22-HYDRO

Light Green Water
3661 Highland Rd.
WATERFORD, MI 48329
248-681-0001

OG Hydro, Inc.
1027 S. Cass Lake Rd.
WATERFORD, MI 48328
248-481-7019

Hydrospot
34236 Michigan Ave.
WAYNE, MI 48184
734-722-1285

Hydro Giant - West Bloomfield
7480 Haggerty Rd.
WEST BLOOMFIELD, MI 48322
248-661-0034

B&B Hydro Supply
28974 Warren Rd.
WESTLAND, MI 48185
734-469-2805

Ultra Green Hydroponics
8067 N. Wayne Rd.
WESTLAND, MI 48185
734-425-1000

Grow Green MI
9197 M36
WHITMORE, MI 48189
810-299-2900

Indoor Eden
9281 E.-M 36
WHITMORE, MI 48189
810-355-1465

Cultivation Station – Grand Rapids, The
5812 S. Division Ave.
WYOMING, MI 49548
616-855-4440

MINNESOTA

Extended Seasons Indoor Gardening
614 Central St. W.
BAGLEY, MN 56621
218-694-2002

Duluth Hydroponics
26 W. 1st St.
DULUTH, MN 55802
218-341-7253

The Interior Tomato, LLC
321 N. Central Ave.
DULUTH, MN 55087
218-260-5167

Indoor Gardening
10 NE 3rd St.
FARIBAULT, MN 55021
507-209-1546

Interior Gardens
115 -1620 Central Ave. NE
MINNEAPOLIS, MN 55413
800-498-4178; 612-870-9077

Brew and Grow
8302 Highway 65 NE.
SPRING LAKE PARK, MN 55432
763-780-8191

Midwest Hydroponics
5825 Excelsior Blvd.
ST. LOUIS PARK, MN 55416
888-449-2739

Eco Garden Supply
800 Transfer Rd. Ste. 3
ST. PAUL, MN 55114
651-647-1896

MISSOURI

Versaponics LTD
879 S. Kings Hwy.
CAPE GIRARDEAU, MO 63703
573-450-5401

Advanced Garden Supply
1414 Rangeline St., Ste. E
COLUMBIA, MO 65201
573-214-2794

Grow Your Own Hydroponics
1117 S. Fuller Ave.
INDEPENDENCE, MO 64050
816-241-2122

River Market Hydroponics
12 E. Missouri Ave.
KANSAS CITY, MO
816-421-1840

The Sharper Edge
610 E. 135th St.
KANSAS CITY, MO 64145
816-941-3343

Sho-Me Hydroponics
1873 N. State Hwy. CC
NIXA, MO 65714
417-714-4875

Fendler Nursery and Garden Center Inc.
1803 Lemay Ferry Rd.
ST. LOUIS, MO 63125
314-892-1150

Happy Hydro
5521 S. Lindbergh Blvd.
ST. LOUIS, MO 63106
314-842-2090

U-Grow
1724 N. 13th St.
ST. LOUIS, MO 63106
314-452-6368

St. Louis Hydroponics Company
1225 N. Warson Rd.
ST. LOUIS, MO 63132
800-285-9676

MONTANA

Dr. GreenThumbs
111 S. Broadway
BELGRADE, MT 59714
406-388-2424

Harvest Tech
1415 S. 32nd St. W.
BILLINGS, MT 59102
406-656-1156

Planet Natural
1251 N. Rouse Ave.
BOZEMAN, MT 59715
406-551-2240

Harvest Tech
3103 Harrison Ave.
BUTTE, MT 59701
406-494-4222

Alpengrow Indoor Gardening
855 2nd Ave. E.
EUREKA, MT 59917
406-297-7722

Box of Rain INC
860 N. Meridian Rd., Ste. B #19
KALISPELL, MT 59901
406-755-RAIN (7246)

Outside In Garden & Greenhouse Supply
2302 McDonald Ave, #B
MISSOULA, MT 59801
406-274-3017

Bizzy Beez LLP
5785 Hwy. 93 S.
WHITEFISH, MT 59937
406-863-9937

NEBRASKA

Bodhi Organic Garden Supply
1438 S1 St., Ste. 6
LINCOLN, NE 68502
402-438-6785

Paradigm Gardens
8949 J St., Ste. 5
OMAHA, NE 68127
402-339-4949

NEVADA

2 Green Thumbs Hydroponics
135 W. Clearview Dr #143
Carson City, NV 89701
775-461-3858

Phoenix Pharms
803 Spring Valley Dr.
GARDNERVILLE, NV 89410
530-386-5630

Advanced Gardens Hydroponics
7850 Dean Martin Dr., Ste. 506
LAS VEGAS, NV 89139
702-247-4769

Advanced Gardens Hydroponics
3111 S. Valley View, Ste. V-103
LAS VEGAS, NV 89102
702-247-GROW

Best Hydroponic Supply
6818 W. Cheyenne
LAS VEGAS, NV 89108
702-750-9300

GrowGeneration - Las Vegas
5885 S. Valley View Blvd.
LAS VEGAS, NV 89118
702-478-7059

Anything Grows
190 W. Moana Lane
RENO, NV 89509
775-828-1460

Grow Shop LLC, The
1030 E. 4th St.
Reno, NV 89512
775-501-5633

Battle Born Hydroponics
1630 Merchant St.
SPARKS, NV 89431
775-432-1945

NEW HAMPSHIRE

Greenlife Garden Supply
885 Second St.
MANCHESTER, NH 03102
603-782-8233

Hydro101
545 Hooksett Rd. #24
MANCHESTER, NH 03104
603-782-8894

Natural Roots Hydroponics
295 DW Hwy., Ste. 8-B
NASHUA, NH 03060
603-204-5528

Green Harvest Hydroponics
23 Plaistow Rd., Unit 2
PLAISTOW, NH 03865

Blue Seal Feeds
275 Portland St.
ROCHESTER, NH 03867
603-332-4122

Tomato Joe's Garden Supply
14 New Zealand Rd.
SEABROOK, NH 03874
603-814-1657

In Grown Gardens
40 Interchange Dr.
WEST LEBANON, NH 03784
603-790-8063

NEW JERSEY

Dambly's Garden Center
51 W. Factory Rd.
BERLIN, NJ 08009
856-767-6883

77HYDRO
37 Fairfield Pl.
CALDWELL W., NJ 07006
973-227-8048

Green Dragon Hydroponics
57 Crescent Blvd.
GLOUCESTER CITY, NJ 08030
856-456-5000

Bergen County Hydroponics
70 Essex St.
HACKENSACK, NJ 07601
201-342-2001

Creative Hydroponics
379 Amwell Rd.
HILLSBOROUGH, NJ 08844
908-359-7171

Shore Grow LLC
3329A Doris Ave.
OCEAN, NJ 07712
732-531-7600

Cleatus Farms
236 Livingston St.
NORTHVALE, NJ 07647
201-768-3099

NEW MEXICO

AHL Year Round Garden Supply
1051 San Mateo Blvd. S.
ALBUQUERQUE, NM 87108
505-255-3677

All Seasons Gardening
7900 Lorraine Ct., Ste. B
ALBUQUERQUE, NM 87113
505-508-4292

Heavy's Grow Supply
1325 San Mateo Blvd. NE.
ALBUQUERQUE, NM 87110
505-315-4573

Dr. Green Hydroponics
129 E. Idaho Ave.
LAS CRUCES, NM 88005
575-524-6751

Southwest Hydroponics & Lighting
1300 El Paseo Rd.
LAS CRUCES, NM 88001
575-524-5963

All Seasons Gardening
3201 Rufina St., Ste. C
SANTA FE, NM 87507
505-438-GROW

New Mexico Hydroponics
923 W. Almeada
SANTA FE, NM 87501
505-316-5855

Earthgoods
120 Bertha
TAOS, NM 87571
575-758-9131

NEW YORK

Organica: Garden Supply & Hydroponics
484 Central Ave.
ALBANY, NY 12206
518-729-5950

Green Zone Hydroponics
2850 Niagara Falls Blvd.
AMHERST, NY 14228
716-693-9663

The Grow Room
32-32 49th St.
ASTORIA, NY 11103
718-545-GROW (4769)

Saratoga Organics & Hydroponic Supply
998 Route 50
BALLSTON LAKE, NY 12019
518-930-0057

Empire Hydroponics
8512 Rt. 57, Ste. 150
BALSWINSVILLE, NY 13027
315-303-4540

The Grape Vine
4020 Hempstead Turnpike
BETHPAGE, NY 11714
516-731-1100

Green Gnome Hydro Gardens
51 N. Main St.
BROCKPORT, NY 14420
585-431-3006

Indoor Outdoor Gardener
8223 5th Ave.
BROOKLYN, NY 11209
718-836-2402

Buffalo Roots Hydroponics and Organics
3231 Main St.
BUFFALO, NY 14214
716-240-9075

Hydroponics of Buffalo
1471 Hertel Ave.
BUFFALO, NY 14216
716-838-3545

Mother Earth Hydroponics
9135 Sheridan Dr.
BUFFALO, NY 14031
716-634-9376

Harvest Moon Hydroponics
Airport Plaza, 4204 Union Rd.
CHEEKTOWAGA, NY 14225
716-634-8290

Harvest Moon Hydroponics
320 W. Route 59
CENTRAL NYACK, NY 10960
845-353-7310

Upstate Hydroponics
3931 West Rd. (plaza)
CORTLAND, NY 13045
607-423-4704

Sunset Hydroponics & Home Brewing
40 Cobblestone Ct. Dr.
VICTOR, NY 14564
585-223-3410

Sunset Hydroponics & Home Brewing
830 Country Rd., Rt.64
ELMIRA, NY 14903
607-796-2603

Planted Earth Hydroponics
120 Vestal Ave.
ENDICOTT, NY 13760
607-239-6207

Hippo Hydroponics & Organics
37 Elm St. #5
FISHKILL, NY 12524
845-202-7444

Hydroponic Garden Centers Inc.
127-11 20th St.
COLLEGE POINT, NY 11356
718-762-8880

Healthy Harvest Organics & Hydro
163 Broadway
FORT EDWARD, NY 12828
518-480-4698

Saratoga Organics & Hydroponic Supply
10 Saratoga Ave.
GLEN FALLS S., NY 12803
518-798-8200

Dans Pro Grow Indoor Growing & Hydroponics
2653 Route 17M
GOSHEN, NY 10924
845-294-GROW

Sunset Hydroponics & Home Brewing
133 Balta Dr.
HENRIETTA, NY 14623
585-475-0011

Gotham Hydroponics
143 Route 59, #2M, PO Box 525
HILLBURN, NY 10931
845-504-5723

Upstate Hydroponics
3092 Lake Rd.
HORSE HEADS, NY 14845
607-483-9199

LI Hydro
3104 Expressway Dr. S.
ISLANDIA, NY 11749
631-651-8281

Greentree Garden Supply
606 Elmira Rd.
ITHACA, NY 14850
607-272-3666

Planted Earth Hydroponics
2255 N. Triphammer Rd.
ITHACA, NY 14850
607-319-0918

Jamestown Hydroponics
211 N. Main St.
JAMESTOWN, NY 14701
716-640-9460

Organica Garden Supply & Hydroponics
1094 Morton Blvd.
KINGSTON, NY 12401
845-481-4009

Mike's Nursery & Grower Supplies
199 E. Fairmount Ave.
LAKEWOOD, NY 14750
716-763-1612

O.G. Green Thumbz Hydroponics
678 Old Liverpool Rd., Space #7
LIVERPOOL, NY 13088
315-453-2371

TJ's Hydroponics
4205 Long Branch Rd. Ste. 5
LIVERPOOL, NY 13090
315-314-6776

Roots to Bloom Hydroponics
5714 South Transit Rd.
LOCKPORT, NY 14094
716-491-8999

Hydro Hut
3698 Horseblock Rd.
MEDFORD, NY 11763
631-775-9565

Crossroads Hydroponics and Organics
47 S. Plank Rd. (Route 52)
NEWBURGH, NY 12550
845-561-4769

The Grow Room
8 Bridge St.
NYACK, NY 10960
800-449-9630

Green Zone Hydroponics
2928 Southwestern Blvd.
ORCHARD PARK, NY 14127
716-677-9663

Mor Gro Hydroponics
5680 State Route 104 E
OSWEGO, NY 13126
315-877-8725

All Season Hydro
2159 Buffalo Rd.
ROCHESTER, NY 14624
585-247-8001

Hydro Garden Center
1069B Lyell Ave.
ROCHESTER, NY 14606
800-277-1322

Sunset Hydroponics & Home Brewing
777 Culver Rd.
ROCHESTER, NY 14609
585-654-8766

Sunset Hydroponics & Home Brewing
1590 West Ridge Rd.
ROCHESTER, NY 14615
866-395-9204

LiquidSun of New York
1702 Fiero Ave.
ROTTERDAM, NY 12303
518-952-4654

Little Heck's Hydroponics & Organics Supply
615 Maple Ave.
SARATOGA SPRINGS, NY 12866
518-306-4992

Hydroponic Shops of America
2606 Erie Blvd. E
SYRACUSE, NY 13224
315-251-2516

Hydrotek East
27 Corporate Circle
SYRACUSE E., NY 13057
315-432-9387; 866-411-0865

Big Bloom Hydroponics
1864 Colvin Blvd.
TONAWANDA, NY 14150
716-83-BLOOM

M&M Hydroponics & Garden Supply
2222 Oriskany St. W.
UTICA, NY 13502
315-790-9825

Sunset Hydroponics & Home Brewing
8053 Route 96
VICTOR, NY 14564
585-223-3410

Eastern Ground Organics
7 W. Main St.
WEBSTER, NY 14580
585-228-6092

Follow The Sun
1185 B Yonkers Ave.
YONKERS, NY 10704
914-237-2760

NORTH CAROLINA

Asheville Hydroponics & Organics
44 Buck Shoals Rd. F6-7
ARDEN, NC 28704
828-676-2111

Fifth Season Gardening Company
4 S. Tunnel Rd.
ASHEVILLE, NC 28805
828-412-3200

L.O.T.U.S. Urban Farm and Garden Supply
455 N. Louisiana Ave, Ste. 8
ASHEVILLE, NC 28806
828-505-3533

Fifth Season Gardening Company
106 S. Greensboro St.
CARRBORO, NC 27510
919-932-7600

American Beauty Garden Center
4400 E. Independence Blvd.
CHARLOTTE, NC 28205
704-334-8651

BWGS-NC
4045 Perimeter W. Dr., Ste. 400
CHARLOTTE, NC 28214
800-316-1306

High Tech Garden Supply - Charlotte
2712 Freedom Dr.
CHARLOTTE, NC 28208
704-697-0911

Flow & Grow Hydroponics & Organic Garden Center
4521 Cumberland Rd.
FAYETTEVILLE, NC 28306
910-423-FLOW (3569)

Indoorganics Plus
914 E. Franklin Blvd.
GASTONIA, NC 28054
803-792-2882

Fifth Season Gardening Company
1616 D-3 Battleground Ave.
GREENSBORO, NC 27408
336-271-3373

Fifth Season Gardening Company
5619-A Hillsborough St.
RALEIGH, NC 27606
919-852-4747

New Age Gardens
2236A US Highway 70
SWANNANOA, NC 28778
828-299-9989

GreenSpirit Hydrogardens
3114 Market St.
WILMINGTON, NC 28403
910-769-0082

LiquidSun East
12 Bay St., Unit 105
WILMINGTON, NC 01887
978-447-5442

OHIO

Akron Garden Center
434 W. Wilbeth Rd.
AKRON, OH 44314
330-724-2700

Indoor Gardens
2076 Romig Rd.
AKRON, OH 44320
234-678-5820

Ohio Hydroponics and Indoor Gardening
1474 Brittain Rd.
AKRON, OH 44310
330-615-7857

Summit Hydroponics
1030 Kenmore Blvd.
AKRON, OH 44314-2114
330-753-5222

Cool Digs
6 Euclid Dr.
ATHENS, OH 45701
740-249-4270

Almost Heaven Hydroponics
56104 National Rd.
BRIDGEPORT, OH 43912
740-738-0578

Campbells Indoor Gardening Supplies
1721 Greenville Rd.
BRISTOLVILLE, OH 44402
330-889-0049

Magic Home Gardens
209 Cemetery Rd.
CANAL WINCHESTER, OH 43110
614-837-2440

Dumont Seed Co.
619 30th St. NW.
CANTON, OH 44709
330-492-0204

Green Garden Indoor Garden Center
1664 N. Main St., Ste 25
CANTON N., OH 44720
330-494-1234

The Bubbling Bucket
11156 Kenwood Rd.
CINCINNATI, OH 45242
513-469-2825

Dayton Hydroponics
4920 Provident Dr.
CINCINNATI, OH 45246
513-942-7111

Eastside Hydroponics
834 Ohio Pike #318
CINCINNATI, OH 45245
513-528-4769

Kissed by the Sun Hydroponic
10740 Reading Rd.
CINCINNATI, OH 45241
513-769-0159

Hydro Garden and Lights
24497 State Route 23
CIRCLEVILLE, OH 43113
740-420-9376

Cleveland Garden Center Inc.
727 E. 185th St.
CLEVELAND, OH 44119
216-481-7868

The Grow Wizard
5700 Denison Ave.
CLEVELAND, OH 44102
216-961-2500

Herb-N-Garden Center
14901 Puritas Ave.
CLEVELAND, OH 44135
216-252-2001

The Indoor Gardener Store
4900 Pearl Rd.
CLEVELAND, OH 44109
216-795-5056

The Indoor Gardener Store
23005 Sprague Rd. #5
COLUMBIA STATION, OH 44028
440-532-7722

Indoor Gardens
5705 Chantry Dr.
COLUMBUS, OH 43232
614-866-5180

Indoor Gardens
4720 Indianola Ave.
COLUMBUS, OH 43214
614-262-1600

Magic Home Garden
4538 Indianola Ave.
COLUMBUS, OH 43214
614-263-2440

Dayton Hydroponics
3856 Miamisburg-Centerville Rd.
DAYTON, OH 45449
937-859-3999

USA Hydrogarden
542 Griswold Rd.
ELYRIA, OH 44035
440-324-4769

Ohio Hydroponics
2108 Tiffin Ave., Ste. 1
FINDLAY, OH 45840
567-525-3680

Garden Connections
3341 Centerpoint Dr.
GROVE CITY, OH 43123
614-871-0707

Hydro Innovations
5425 Roberts Rd.
HILLIARD, OH 43026
614-319-4934

Hygrowponics
3914 Brown Park Dr.
HILLIARD, OH 43026
614-363-4995

Sweet Greens
5540 Brecksville Rd.
INDEPENDENCE, OH 44131
800-421-7084

Hydro Gardens Wholesale
1144 N. Memorial Dr.
LANCASTER, OH 43130
740-654-9376

CropKing
134 West Dr., LODI, OH 44254
330-302-4203

USA Hydrogarden
7450 Industrial Pkwy., Ste. A
LORAIN, OH 44053
440-282-4880

Urban Gardens
3665 Likens Rd.
MARION, OH 43302
740-375-2800

Campbell's Indoor Gardening Supplies
8226 Warren Sharon Rd.
MASURY OH, 44438
330-978-6200

Top Garden Products
8600 East Ave., Ste. C
MENTOR, OH 44060
440-290-8773

USA Hydrogarden - West
11001 Route 250 Ste. B9
MILIN, OH 44846
419-499-0480

Gardening-Indoor
5851 Youngstown-Warren Rd.
NILES, OH 44446
330-932-1023

Pet Finatics LLC
3150 Navarre Ave., Ste. A
OREGON, OH 43616

The Indoor Gardener Store
6583 Pearl Rd.
PARMA HEIGHTS, OH 44130
440-253-8001

Trinity Hydro Organics
465 Woodman Dr.
RIVERSIDE, OH 45431
937-252-GROW

Cultivation Innovations
1564 S. Byrne Rd.
TOLEDO, OH 43614
419-214-GROW (4769)

Hot Hydro
855 S. Holland-Sylvania Rd. #2
TOLEDO, OH 43615
419-866-1266

Toledo Hydroponics Ltd.
855 S. Holland-Sylvania Rd., Ste. 2
TOLEDO, OH 43615
877-893-0716

Toledo Indoor Garden
5614 Secor Rd.
TOLEDO, OH 43623
419-725-2450

Plant Lighting Hydroponics
2201-A Pinnacle Parkway
TWINSBURG, OH 44087
888-258-0670

Greenleaf Hydroponics
556 High St.
WARREN, OH 44483
330-646-6046

Gardening-Indoor
9215 Market St.
YOUNGSTOWN (NORTH LIMA), OH 44452
330-758-0272

Indoor Garden Worx
304 W. Monroe St.
ZANESVILLE, OH 43701
866-900-9679

OKLAHOMA

Aeroponic Tower Garden
204 W. 5th St. PO Box 712
BEGGS, OK 74421
918-221-4630; 1-877-213-8868

Organics OKC Garden Supply
2800 N. Pennsylvania Ave.
OKLAHOMA CITY, OK 73107
405-528-GROW

Red Lion
301 N. MacArthur Blvd.
OKLAHOMA CITY, OK 73127

OREGON

Indoor Hydroponic Garden & Lights
5990 SW 185th Ave.
ALOHA, OR 97078
503-848-3335

Aqua Serene
465 Applegate Way
ASHLAND, OR 97520
541-482-7600

Fullbloom Hydroponics
415 Williamson Way, Ste. #3
ASHLAND, OR 97520
888-725-4769

Paradise Supply
1409 Hwy. 99 N
ASHLAND, OR 97520
541-552-1037

Astoria Indoor Garden Supply
487 W. Marine Dr.
ASTORIA, OR 97103
503-468-0606

Northern Light & Garden
9290 SW Beaverton-Hillsdale Hwy.
BEAVERTON, OR 97005
503-297-7331

Suburban Garden Wholesale
18968 SW Shaw
BEAVERTON, OR 97078
503-268-1803

Bend's Indoor Garden Station
20794 High Desert Ln.
BEND, OR 97701
541-385-5222

Gorillas Garden Supply
2011 Union Ave.
BEND N., OR 97459
541-756-5005

Green Leaf Garden Center
610 SE 9th St.
BEND, OR 97701
541-306-4505

Westcoast Organic & Hydroponic Supply
12410 SE 282nd Ave, Unit C
BORING, OR 97009
503-512-7710

The Good Earth Organics
30088 Redwood Hwy.
CAVE JUNCTION, OR 97523
541-592-4496

Urban Garden Supply
9069 SE Jannsen Rd.
CLACKAMAS, OR 97015
503-305-6879

Corvallis Hydroponics & Organics
5490 SW Philomath Blvd.
CORVALLIS, OR 97333
541-738-2820

Samurai Greenhouse Supply
705 NE Circle Blvd.
CORBALLIS, OR 97330
541-550-7451

Aqua Serene
2836 W. 11th Ave.
EUGENE, OR 97402
541-302-9073

Aurora Innovations
PO Box 22041
EUGENE, OR 97402
866-376-8578

Emerald Valley Gardens Inc.
88680 McVay Hwy.
EUGENE, OR 97405
541-636-3763

Oregon's Constant Gardener
990 Garfield St.
EUGENE, OR 97402
541-636-4220

Vital Organics Northwest
453 River Ave.
EUGENE, OR 97404
541-688-0028

Advanced Indoor Gardens
17831 SE 82nd Dr.
GLADSTONE, OR 97027
503-305-6341

Paradise Superstore
543 NE East St.
GRANTS PASS, OR 97526
541 955 7224

NLG Pro Shop LLC
1203 Rogue River Hwy.
GRANTS PASS, OR 97527
541-474-1700

Redwood Nursery
1303 Redwood Ave.
GRANTS PASS, OR 97527
541-474-2642

Grow World
161 NE 181st Ave.
GRESHAM, OR 97230
503-477-9351

Urban Garden Supply
12115 SE 82nd Ave, Ste. B
HAPPY VALLEY, OR 97086
503-305-6531

Healthy Harvest Indoor Garden
Ste. 1, 1635 SE Tualatin Valley Hwy.
HILLSBORO, OR 97123
503-640-0995

Gorge Garden Center
1203 12th St., Ste. H
HOOD RIVER, OR 97031
541-386-4769

Healthy Harvest Indoor Garden
3837 River Rd.
KEIZER, OR 97303
503-393-2901

Basin Indoor Gardening
417 N. Spring St.
KLAMATH FALLS, OR 97601
541-273-2023

Green Zone Garden Center & Hydroponic Supplies
1845 SW Hwy. 101 Ste. 3
LINCOLN, OR 97367
541-994-7070

Applegate Soils & Hydroponics
610 Rossanley Dr.
MEDFORD, OR 97501
541-952-2378

Green Thumb Hydrogarden & Organic Supply
2021 W. Main St.
MEDFORD, OR 97501
541-779-8600

The Greenway Hydroponics
1010 Fisher Ave.
MEDFORD, OR 97504
541-622-8097

In & Out Gardens
1574 Skypark Dr.
MEDFORD, OR 97501
541-858-3333

Advanced Organics & Garden Supply
290-B Merlin Ave.
MERLIN, OR 97532
541-659-1466

Indoor Garden Depot
3260 SE Oak Grove Blvd.
MILWAUKIE OR 97267
503-786-2445

Indoor Garden Depot
3260 SE Oak Grove Blvd.
OAK GROVE, OR 97267-1421
503-786-2445

Four Seasons Garden Supply
329 S. Oregon St.
ONTARIO, OR 97914
541-889-6499

Green Thumb Garden Supply
144 S. Oregon St.
ONTARIO, OR 97914
541-881-9935

Ladybug Indoor Gardens
The Shoppes at Exit 24,
205 Fern Valley Rd., Ste. X
PHOENIX, OR 97535
541-618-4459

The Grateful Harvester
35855 Hwy. 58
PLEASANT HILL, OR 97455
541-731-0224

American Agriculture
9220 SE Stark St.
PORTLAND, OR 97216
800-433-6805

Bloom Garden Supply
518 NE 20th Ave.
PORTLAND, OR 97232
971-255-1336

BWGS-OR
18201 NE Portal Way, Ste. 104
PORTLAND, OR 97230
888-316-1306

Evergreen Garden Supply
3393 SE 21st Ave.
PORTLAND, OR 97055
503-206-5670

Evergreen Garden Supply
10415 NE Sandy Blvd., Unit C
PORTLAND, OR 97220
503-408-6635

Garden Spout, The
4532 SE 63rd Ave.
PORTLAND, OR 97206
503-788-GROW

GREENCOAST Portland LLC
3365 SE 17th St.
PORTLAND, OR 97202
503-235-8040

Hydrofarm Northwest
15311 NE Airport Way
PORTLAND, OR 97230
800-634-9990

Jantzen Beach Hydroponics
909 N. Tomahawk Island Dr., Ste. 103
PORTLAND, OR 97217
503-546-3185

Mt. Hood Garden Supply
19959 SE Burnside St.
PORTLAND, OR 97233
503-328-8630

North West Hydroponic Repair & Resale
2510 E. Burnside St.
PORTLAND, OR 97214
503-719-7671

Roots Garden Supply
6850 N. Interstate Ave.
PORTLAND, OR 97217
503-285-4768

VM Indoor Garden Supply
7720 SE 82nd Ave.
PORTLAND, OR 97266
503-774-2300

Oregon Indoor Organics
210 B St. Hwy. 30
RANIER, OR 97048
503-556-5565

BIGS Warehouse
2606 SW 4th St., Unit B
REDMOND, OR 97756
541-504-8886

Green Solutions Garden Supply
628 SW Glacier Ave.
REDMOND, OR 97756
541-504-2604

DC Hydroponics & Organics
1775 Green Siding Rd.
ROSEBURG, OR 97471
541-679-3700

Roseburg Hydroponics
853 SE Stephens St.
ROSEBURG, OR 97470
541-229-1420

Indoor Garden Center
2230 NE Fairgrounds
SALEM, OR 97302
503-566-7888

Northern Light & Garden Salem
1915 Lancester Dr.
SALEM, OR 97305
503-364-4769

Grow Big Inc.
16572 SE 362nd Dr.
SANDY, OR 97055
503-826-8277

Greener Side of Life
623 W. Centennial Blvd.
SPRINGFIELD, OR 97477
541-636-3552

Oregon's Constant Gardener
2053 Laura St.
SPRINGFIELD, OR 97477
541-747-8170

Moonshine Park Farm
135 SE 62nd, Unit F
SOUTH BEACH, OR 97366
541-444-2298

Rogue Farmers
1007 S. Pacific Hwy.
TALENT, OR 97540
541-512-4600

Portland Hydroponics & Organics
11564 SW Pacific Highway
TIGARD, OR 97223
503-746-4303

Pharmer Hydroponics
11135 SW Industrial Way, Bldg 10-4
TUALATIN, OR 97062
503-486-5751

The Green Future Garden & Hydroponics
25999 SW Canyon Creek Rd., Ste. I
WILSONVILLE, OR 97070
503-685-9200

PENNSYLVANIA

Pocono Hydroponic Solutions
3280 Route 611
BARTONSVILLE, PA 18321
570-730-4544

Lehigh Valley Hydroponics
7576 Beth Bath Pike
BATH, PA 18014
610-837-7500

Garden Indoors of Pennsylvania
208 Route 13
BRISTOL, PA 19007
215-781-0305

422 GROW
1631 N. Main St. Ext.
BUTLER, PA 16001
724-561-3777

High Tech Garden Supply - Cranberry Twp
20232 Route 19, Unit 6
CRANBERRY TWP., PA 16066
724-473-1113

Hydrofarm East
270 Canal Rd.
FAIRLESS HILLS, PA 19030
888-780-4567

A&G Botanical Supply
965 New Holland Rd.
KENHORST, PA 19607
610-777-6919

Buds to Blooms Garden and Supply Co., LLC
509 Orchard Ave.
KENNETT SQUARE, PA 19348
610-388-0100

Hydro Ponics of Harrisburg
310 S. 10th St.
LEMOYNE, PA 17043
877-684-3808

Esbenshades Greenhouses
546A E. 28th Div. Hwy.
LITITZ, PA 17543
717-626-7007

Always Green Garden Supply
4400 Old William Penn Hwy., Ste. 106
MONROEVILLE, PA 15145
412-646-1243

Home Hydroponics of Pittsburgh
19th & Mulbury Way
PITTSBURGH, PA 15222
412-232-7030

High Tech Garden Supply - Prospect Park
746-A Chester Pike
PROSPECT PARK, PA 19076
610-619-0441

Northeast Hydroponics & Homebrewing
221 Scranton Carbondale Hwy.
SCRANTON, PA 18508
570-209-7924

Organic Garden Center
201 Elmwood St.
STATE COLLEGE, PA 16801
814-208-8300

The Barn at Lemont
201 Elmwood St.
STATE COLLEGE, PA 16801
814-954-4667

Organic Garden Center
1307 Park Ave.
WILLIAMSPORT, PA 17701
570-322-3120

Home Hydroponics of Pittsburgh
404 N. 3rd St.
YOUNGWOOD, PA 15697
724-836-1118

Hydro-Ponics Inc. (of Lancaster/York)
4464 Lincoln Hwy East, Ste. 1
YORK, PA 17406
717-668-8641

National Garden Wholesale/ Sunlight Supply
450 Grim Lane
YORK, PA 17406
877-779-7111 (Northeast)

PA Hydroponics & Home Gardening Supply
20 Quaker Church Rd.
YORK SPRINGS, PA 17372
717-528-4175

RHODE ISLAND

EZ Grow Supply
477A Tiogue Ave.
COVENTRY, RI 02816
401-822-4769

Chelsea's Trading Post & Garden Supply
151 Danielson Pike
FOSTER, RI 02825
401-647-4637

Good To Grow
34 Nooseneck Hill Rd.
GREENWICH W., RI 02817
401-392-3100

GrowRI
184 Admiral Kalbfus Rd.
NEWPORT, RI 02840
401-619-0776

Liquid Sun RI
1179 Central Ave.
PAWTUCKET, RI 02861
401-722-2724

Hydro-Earth
1243 Mineral Springs Ave.
PROVIDENCE N., RI 02920
401-305-5520

Rhode Island Hydroponics
420 Atwood Ave.
CRANSTON, RI 2920
401-942-5490

Growers Edge Indoor Garden Supply
190 Newport Ave.
RUMFORD, RI 02916
401-383-1860

Good to Grow - North
300B George Washington Hwy.
SMITHFIELD, RI 02917
401-233-0500

The Organic Grow Hut
375 Putnam Pike, Ste. 13
SMITHFIELD, RI 02828
401-349-4141

Good To Grow
51 Old Tower Hill Rd.
WAKEFIELD, RI 02879
401-783-1733

East Coast Hydroponic Warehouse
380 Jefferson Blvd.
WARICK, RI 02886
855-EZ-HYDRO

Grow With Us
709 Warwick Ave.
WARWICK, RI 02888
401-270-6998

Home & Hydro
21 Riverdale Ct.
WARWICK, RI 02887
401-738-1414

Live to Grow
719 Bald Hill Rd.
WARWICK, RI 02886
401-615-5122

Mother Nature Hydroponics
1268 Post Rd.
WARWICK, RI 02888
401-780-0600

The Grow Store
1889 Post Rd.
WARWICK, RI 02886
401-773-7910

GrowRI
105 Franklin St., Unit # 38
WESTERLY, RI 02891
401-596-0904

RI Hydroponics
85 Front St.
WOONSOCKET, RI 02895
401-356-1899

Growin' Crazy
93 Kingston Rd.
WYOMING, RI 02898
401-284-0810

SOUTH CAROLINA

GreenSpirit Hydrogardens
1864 Meeting St.
CHARLESTON, SC 29405
843-225-1GRO

Skyes the Limit
455 B Fleming Rd.
CHARLESTON, SC 29412
843-566-2121

247 Garden Supply
535 D Clemson Rd.
COLUMBIA, SC 29229
803-788-4445

The Urban Garden Hydroponics
9557 Two Notch Rd., Ste. E
COLUMBIA, SC 29223
803-788-9313

Green Thumb Unique Gardening & More
1230 Rutherford Rd.
GREENVILLE, SC 29609
864-271-8830

L.O.T.U.S Urban Farm and Garden Supply
1259 S. Pleasantburg Dr., Ste D
GREENVILLE, SC 29605
869-412-5296

SOUTH DAKOTA

Green Earth Products Inc.
5700 Highway 79 S., Unit 1
RAPID CITY, SD 57702
605-342-1307

Steins and Vines
2307 W. Madison St.
SIOUX FALLS, SD 57104
605-274-7002

TENNESSEE

Grow Your Own Garden Store
100 Boonabrook Drive
HERMITAGE, TN 37076
615-678-7259

Jackson Organics & Home Brew
42 Federal Dr., Ste. D
JACKSON, TN 38305
731-501-6373

Downtown Farming
221 Cherry St., Ste. 120
JOHNSON CITY, TN 37604
423-929-3833

Grow Green Garden Shop
4644 NE Walker Blvd.
KNOXVILLE, TN 37918
865-249-8259

Innovative Hydroponic Supply Inc.
3308 Old Knoxville Hwy.
MARYVILLE, TN 37804
865-984-0280

Sun City Hydroponics
2235 Whitten Rd., Ste. 104
MEMPHIS, TN 38133
901-372-8100

Wet-Werk
584 Tillman St., Ste 8
MEMPHIS, TN 38117
901-529-7722

National Garden Wholesale/ Sunlight Supply
126 Belinda Parkway
MT. JULIET, TN 37122
888-265-9005

MidTN Hydroponics & Gardening
1370 W. Clark Blvd.
MURFREESBORO, TN 37129
615-900-3781

All Seasons Gardening and Brewing Supply Co.
924 8th Ave. S.
NASHVILLE, TN 37203
800-790-2188

TEXAS

Abundant Harvest Hydroponics & Organics
3101 Ave. E.
ARLINGTON, TX 76011
817-649-0100

Hydro-Mart
4353 Green Acres Cir.
ARLINGTON, TX 76017
972-475-6114

Brite Ideas Hydroponics & Organics
4201 S. Congress Ave., Ste. 310
AUSTIN, TX 78745
512-444-2100

Brite Ideas Hydroponics & Organics
7010 Burnet Rd., Ste. A
AUSTIN, TX 78757
512-495-4353

BotaniCo. Indoor Garden Store
5888 Everhart St., Ste. A
CORPUS CHRISTI, TX 78413
361-334-1612

Lone Star Hydroponics & Organics
10550 Markinson Rd.
DALLAS, TX 75207
214-221-GROW (4769)

Lone Star Hydroponics and Organics
8330 Director's Rd. Ste. 200
DALLAS, TX 75247
214-63-HYDRO (4-9376)

Texas Hydroponics & Organics (Dallas)
2606 Manana Dr.
DALLAS, TX 75220
214-744-4769

Urban Garden Hydroponics & Organics
14462 Midway Rd.
DALLAS, TX 75244
972-770-3182

Texas Hydroponics & Organics (Ft. Worth)
2501 Airport Frwy.
FORT WORTH, TX 76111
817-834-4769

Hydrofarm Central
915 Ave. S.
GRAND PRAIRIE, TX 75050
800-634-9999

Aggressive Garden
3582 W. T.C. Jester Blvd.
HOUSTON TX 77018
713-681-7764

Botani Hydroponics and Organics
15106 Bellaire Blvd.
HOUSTON, TX 77083
281-575-1999

Houston Discount Hydroponics
9380 Richmond Ave.
HOUSTON, TX 77063
713-464-9406

Hydroponic Nation
9001 Frey Rd.
HOUSTON, TX 77034
713-943-1115

HydroShack
1138 W. 20th St.
HOUSTON, TX 77008
713-292-1921

Righteous Roots Hydroponics
13940 Bammel N. Houston Rd. Ste 228
HOUSTON, TX 77066
281-271-6604

Texas Growers Supply
5750 N. Sam Houston Pkwy. E. Ste. 703
HOUSTON, TX 77032
281-442-3739

Ultimate Hydroponic Garden Supply
6125 W. Sam Houston Pkwy. N. #206
HOUSTON, TX 77041
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SAN ANTONIO, TX 78219
210-248-9309

Texas Hydroponics & Organics (San Antonio)
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SAN ANTONIO, TX 78219
210-226-4769

Texas Hydroponics & Organics (San Antonio West)
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SAN ANTONIO, TX 78238
210-684-4769

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PowerGrow Systems & Utah Hydroponics
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VINEYARD, UT 84057
801-588-7099

Moonlight Garden Supply
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SALT LAKE CITY, UT 84115
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802-899-4323

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MOUNT HOLLY, VT 05758
802 259 2003

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802 773 5200

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WATERBURY CENTER, VT 05677
802-241-4199

White River GrowPro
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802-281-6186

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804-423-9208

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540-265-2483

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AJ's Indoor Gardening
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360-533-1170

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ANACORTES, WA 98221
360-293-0000

Mike's Indoor Garden Supply
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360-474-1900

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Bellingham, WA 98225
360-820-4112

Northern Lights Gardening
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BELLINGHAM, WA 98226
360-715-8585

Kitsap Garden & Lighting
2130 6th St.
BREMERTON, WA 98312
360-377-1277

Indoor Tropics
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509-470-7782

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Indoor Tropics
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509-933-4441

Indoor Garden & Lighting
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253-373-9060

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LACEY, WA 98516
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KP Indoor Garden Store
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Indoor Gardening
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LONGVIEW, WA 98632
360-353-3851

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425-673-2755

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360-386-8230

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by Philip McIntosh

10 facts on...

SPIDER MITES

Of all garden pests, the **TWOSPOTTED SPIDER MITE** may be the most feared. These little critters are hard to get rid of and can wreak havoc on your crop.

THE TWOSPOTTED spider mite *(Tetranychus urticae)* is quite possibly the most hated—and feared—of all plant pests.

ALTHOUGH THE creatures themselves are small (0.4-0.5 mm, about 1/50 of an inch) and difficult to see, their distinctive webs and sometimes swarming behavior can give them away. A hand lens is recommended when inspecting plants for their presence before they get too abundant.

RELATED TO their fellow arachnids, the spiders (no surprise), there are more than 1,200 species of mites and they all look pretty similar.

SPIDER MITES must be studied closely to be sure of the exact species identification. The twospotted spider mite is generally pale but variable in color with two dark spots on the dorsal side.

SPIDER MITES are a challenge to treat with pesticides because of their tendency to be on the underside of leaves and the rapid onset of resistance. Insecticides are generally ineffective and miticides may require multiple applications before control is achieved.

THE WEBS of spider mites are much finer than most spider webs and in severe infestations, mites can be seen moving about en masse over the webs.

BESIDES THE red predatory mite, there are other predatory mites as well as midges and beetles available as biological control agents.

SPIDER MITES like to hang out on the undersides of leaves where they use their piercing mouth parts to suck the sap out of plants. This damages chlorophyll, causing pale speckling of the leaves.

DO NOT mistake the red predatory mite *(Phytoseiulus persimilis)* for the twospotted spider mite. Red predatory mites are beneficial, able to eat several adults and many spider mite eggs in a day. Red predatory mites are more solitary than the twospotted variety and seem to move about frantically on surfaces.

SPIDER MITE infestations can arise quickly at low relative humidity (20-40 per cent) when temperatures are above 85°F. Overhead watering helps keep humidity up and can wash mites off of leaves.

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