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The complete UL report is available at: hyperarc.NET

Results were achieved using a high frequency 1000 watt Galaxy ® ballast operating on the Turbo setting.

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The complete UL report is available at: hyperarc.NET
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Search for the ship on the gold bottle.

REIZIGER.COM
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by Kent Gruetzmacher
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Might be a good opportunity to grab an ice-cold drink, find a spot in the shade, and start reading.”

Man, it’s been hot. Hard to believe it can get much hotter with temperatures over 100°F in much of the western US and pushing 90°F in the rest of the country as I write this in early July. Long-term forecasts suggest there is not much relief in the near future. If it’s tough on you, it’s tough on your plants whether they’re indoors or out. At least you can go jump in the nearest lake to cool off or crank up the air conditioning. Your plants aren’t so lucky.

Most vegetables begin to suffer adverse effects starting around 85°F. Fortunately, we anticipated this heat and asked Bryan Traficante to provide some tips on how to grow in extreme heat in his article “Gardening in the Summer: Plant Survival Tips” on page 96. Might be a good opportunity to grab an ice-cold drink, find a spot in the shade, and start reading.

You can also head to the grocery store to cool off, but before you do, take a look at Isaac Cedillo’s article on page 114 titled “Going the Distance: Modern Food Supply.” It may make you want to detour to your nearest farmers’ market instead for food that is more nutritious and has a smaller carbon footprint. It also helps support your local growers.

Also in this issue of Maximum Yield is a wide array of information from growing indoor berries to foliarponics to how to start a lemonade farm stand. For those who thrive in the heat, it’s the perfect time to try square foot gardening out in the backyard (page 102). For those less energetic, kick back, enjoy the dog days of summer, and enjoy this issue of Maximum Yield.

Stay cool, my friends.

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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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.

SARA ELLIOTT is a professional writer with extensive horticultural knowledge acquired through theoretical study and practical experience. You can find her gardening and lifestyle pieces in print and online.

RICH HAMILTON has been in the hydroponics industry for more than 20 years, working originally as a general manager in a hydroponics retail outlet before becoming an account manager at Century Growsystems. He enjoys working on a daily basis with shop owners, manufacturers, distributors, and end users to develop premium products.

LACEY MACRI works as head of sales at CleanGrow Ltd., focusing her time on business development within the company. She received a bachelor’s degree in communications and psychology from the University of California, Davis in 2011, where she worked at the California Aggie student newspaper on campus.

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.

ALAN RAY has written five books and is a New York Times best-selling author. Additionally, he is an award-winning songwriter with awards from BMI and ASCAP respectively. He lives in rural Tennessee with his wife, teenage son and two dogs: a South African Boerboel (Bore-Bull) and a Pomeranian/Frankenstein mix.

AMY STOREY is the content coordinator at Bright Agrotech, a company that manufactures vertical high-density farming equipment. Amy and the Bright Agrotech team provide modern growers with ZipGrow technology to build a fresher, more distributed food system.

ISAAC CEDILLO works as the marketing manager at Current Culture H2O in Fresno, California. He holds his bachelor’s degree from CSU Fresno and is currently pursuing his MBA in marketing. As an avid photographer, Isaac loves to travel the country chronicling his adventures through his camera.

KENT GRUETZMACHER is a Denver-based freelance writer and the west coast director of business development at Mac & Fulton Executive Search and Consulting, an employment recruiting firm dedicated to the indoor gardening and hydroponics industries. He is interested in utilizing his Master of Arts in humanities to explore the many cultural and business facets of this emerging industry by way of his entrepreneurial projects.

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.

MONICA MANSFIELD After owning an indoor garden store for 5 1/2 years, Monica sold the business and started a seven-acre homestead with her husband, Owen. Monica is passionate about gardening, sustainable living, and holistic health. She writes about these topics and her homestead adventures on her blog thenaturelifeproject.com.

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

BRYAN TRAFICANTE is one of the co-founders of gardeninminutes.com, where he and his family have one mission: making it easier for people to build and grow great gardens. They’re the inventors of the Garden Grid watering system, crafters of modular garden beds, and share their time-saving gardening advice on Facebook, Pinterest, and their blog, aptly named Easy Growing.

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Mycorrhizal fungi act as extensions of the root and allow the plant to find nutrients.

@MammothMicrobes

To see why aquaponic plants grow so fast, look at a sample of pond water with a microscope.

@Fishnure

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

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UV/UVB grow lights on light movers: It’s one smart combo for eliminating powdery mildew.

@GualalaRobotics

Congratulations @Max_Yield, your blog has been selected as one of the Top 50 Hydroponics Blogs on web.

@feedspotblog

Phosphites are labeled and sold as both fungicides and fertilizers. If we’re to maximize our success with our crops, there needs to be a clear understanding of what the nutrients we provide do for our plants.

Frank Rauscher
Maximum Yield, July 2017

Nice little read.

@AshtonHydro

Understanding how to establish and maintain a container garden will help you create a more consistent and nurturing environment for your plants over the long term.

Sara Elliott
Maximum Yield, May 2017

Great info on container gardening do’s and don’ts. Thanks, Maximum Yield!
Lehigh Valley Hydroponics

Looks like this basil is handling its transplant quite well!

@moonlightgardensupply


@goldleafhydro

Top Feeds to Follow on Social Media

Get the latest updates on modern growing from these top influencers:

Modern Farmer publishes all sorts of timely content geared towards people who care about where their food comes from, both plants and animals. Their Instagram is gorgeous and their tweets are inspiring.

@ModFarm

Plant Green offers practical tips on how to live a greener lifestyle. Their Twitter stream alone offers actionable advice across a variety of topics in a fun, entertaining way.

@PlanetGreen

The Upstart Farmers network is the fastest growing network of modern farmers taking a pragmatic and holistic approach to commercial hydroponic farming.

@UpstartFarmers

Just because the ambient air temperature in your growroom is ideal doesn’t mean your plants are growing in ideal temperatures. Recent technology now allows for the measuring of leaf surface temperature.

Kevin Frender
Maximum Yield, July 2017

Thank you for publishing this research. It will help many growers who are already using LEDs and those making the move to LEDs.

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Hi, *Maximum Yield!*

I have a question: If I have 42 ppm of NO₃ in the soil where I plan to plant corn, is it better or not to use a starter basic fertilizer?

*Ask the experts*

**Q**

**A**

Hello,

Thank you for your question. The pre-sidedress soil nitrogen test (PSNT) was developed by Dr. Fred Magdoff at the University of Vermont to help make an accurate nitrogen (N) fertilizer recommendation for a corn crop. The test assumes the soil has had an application of manure, a cover crop that contributes to the N in the soil, or has had a previous application of nitrogen. The PSNT test displays the needed concentration of N in the nitrate-nitrogen (NO₃-N) form.

Research done in many states has shown that when 25 ppm of NO₃-N is present in the top foot of soil, additional N applications are not necessary. However, if the NO₃-N level in the top foot of soil is less than 10 ppm, the full recommended rate of N would most likely be necessary. In other words, for a corn crop to have all the N it needs to grow properly, the soil needs to have a concentration of 25 ppm of NO₃-N or greater. Soils with a concentration of NO₃-N below 10 ppm would need to be fertilized at the full recommended rate, whereas those with a concentration of NO₃-N between 10-25 ppm may need supplementary fertilization (that is, less than full strength).

From your soil sample, we know the concentration of NO₃ (nitrate) in the soil is 42 ppm. However, to use the PSNT with your soil test results, we need to convert your NO₃ value into a NO₃-N value. To convert NO₃ to NO₃-N, we multiply the NO₃ value by 0.226. So, in your case, the NO₃-N value for your soil is 9.49 ppm (42 ppm x 0.226 = 9.492 ppm). As you can see, your NO₃-N value is less than 10 ppm.

This means it would be a good idea to use a fertilizer at its full recommended rate to help raise the concentration of NO₃-N in your soil. Keep in mind, it is possible for the concentration of NO₃-N to build up over time with the addition of organic matter (be it manure or cover crop) or fertilizers. Therefore, it is a good idea to test the soil for NO₃-N concentrations each year prior to planting as your soil’s NO₃-N concentration could raise above 10 ppm over the course of the year. Hope this helps.

Keep on Growing,
Eric Hopper

---

**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.
Adjusts to your needs

Active Aqua’s Universal Tray Stand is the most versatile stand on the market. It can be adjusted to accommodate flood trays in several sizes from 2’ x 4’ to 8’ x 4’, with options for an adjustable light bar and trellis bar. Low profile leg kits are also available. No tools required — no-hassle assembly!
Boy Creates Garden to Feed His Community

Austin Hurt, an 11-year-old boy from Indianapolis, has created a garden across the street from his school to help feed the community. “It’s the right thing to help feed the community, and it feeds people so nobody goes hungry,” he says. So far, he and different groups in the community have planted blueberries, raspberries, grapes, blackberries, peppers, tomatoes, beans, lettuce, corn, sweet potatoes, potatoes on the donated land. Hurt, who started gardening at the age of seven to help provide extra food for his family, says the garden is open at any time for anyone to stop by and pick fresh fruits and vegetables. Hurt’s mom says that they work at the garden every Saturday from 9 a.m. to 12 p.m. and everyone is welcome to help. Hurt is also sharing his message and gardening knowledge on his YouTube channel, theyoungurbangardener Hurt.

- wishtv.com

Organic Trade Association Steps Up Fight Against Organic Fraud

As organic food continues to grow in popularity, the reports of organic food fraud—situations in which conventionally grown food is labelled and sold as organic—also rises. To combat this trend, the Organic Trade Association (OTA) is forming its own anti-fraud task force, which will share information and documentation with organic certification agencies. “There is a strong desire on the part of industry to stop the incidence of fraud in organic,” OTA director Laura Batcha says. “The consumer expects that organic products are verified back to the farm. The industry takes that contract with the consumer very seriously.” The USDA also announced it is now publishing suspension or revocation of organic certification notices, and it will post more organic program enforcement actions on its website. The agency is also lobbying to give USDA more enforcement powers in next year’s new farm bill.

- fooddive.com

Student Uses Huntington Convention Center Farm for Bee Research

On a quarter acre of land at the north end of its property, the Huntington Convention Center has a sustainable farm that supplies its in-house catering group with fresh food. Alongside raised garden beds, 26 chickens, and three Mangalista heritage breed pigs, the lot is also home to 13 bee hives, whose buzzing occupants annually generate more than 2,000 pounds of honey. This summer, Andy Mondello, a business management undergrad from the Ohio State University at Wooster, worked closely with the facility’s bees for a special research project. He and professor Reed Johnson collected pollen samples in traps located at the entrance of hives. They then looked at the samples to determine the pollen’s origin to study how the insects interacted with and moved in the urban environment of downtown Cleveland.

- tsnn.com
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US and Australia Sign Food Safety Recognition Agreement

The Food and Drug Administration and the Australian Department of Agriculture and Water Resources have signed a bilateral food safety recognition agreement, which allows the countries to recognize one another’s food safety and regulatory systems as comparable. As a result, the process of importing and exporting food between the two countries will be greatly simplified. “Not all foods are included in this agreement, but most canned foods, seafood, dairy products, fresh fruit and vegetables, fruit juices, confectionery, baked goods, and pet food are in scope,” says Department of Agriculture and Water Resources head of exports, Greg Read. “Just as Australia does, the USA continues to regulate foods such as meat, egg products, shellfish, and dietary supplements, and more stringent requirements continue to apply.” The agreement took five years to finalize.

- hydroponics.com.au

Organic Conditions Lead to Healthier Onions

A six-year study published in the Journal of Agricultural and Food Chemistry has suggested that organically grown onions have higher antioxidant activity and flavonol levels than conventional onions. In fact, researchers found that flavonol levels in organic onions were up to 20 per cent higher. These finding contradict a highly publicized analysis of more than 200 studies that concluded organic food was no more nutritious than conventionally grown food. The study’s authors propose that the conflicting results could be due to short study periods and the exclusion of variables such as weather in other research.

- sciencedaily.com
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Unlocking Genetic Potential in Plant Cell Walls

Researchers have unlocked the genetic secrets of plant cell walls, which could help improve the quality of plant-based foods and products. Plant cell walls are made of sugars, and variations in these sugars alter the properties of the plant and any materials made from the plants, says researcher Dr. Ian Bancroft. “With a better understanding of the genetic controls of plant cell wall synthesis, we can make more effective improvements to support agricultural industries and the bioindustry,” he says. The team used a microarray, sometimes called a lab-on-a-chip, to analyze thousands of plant cell samples simultaneously. “This work tells us what genes are really important to a particular trait. As we were able to gather a large amount of data, we can identify the best traits for breeders with a good degree of accuracy,” says Professor Keith Waldron. “Using the genetic markers identified using this new technique, breeders will be better able to breed for varieties that may be more nutritious, or enhance how waste parts of the plant could be converted to biofuels or other biopolymers.”

- scencedaily.com

A New Type of Weather App for Farmers

Weathermelon is a new weather app designed to help growers, buyers, and sellers potentially stay ahead on pricing swings. The app tracks weather data for growing regions spanning from Canada to Chile. Then, each morning by 8 a.m. EST, it sends out alerts for the growing regions of the top 30 consumed fresh produce items in the US. To create the app, designers Thomas Barton and David Robidoux spent more than a year analyzing and consolidating FDA shipping reports, industry web sites, newsletters, and more. “Dave always talked about the fluctuation in the weather, how it was affecting prices he was getting for his products, which were tomatoes, and how he wished he could stay ahead of the weather to stay ahead of the pricing,” Barton says. The app is currently available for iOS, though there will be an Android version released this fall. To learn more, visit weathermelon.com.

- freshplaza.com

Strawberry and Lettuce Positively Influenced by Biochar and Chitin Additives

Researcher Caroline De Tender has found that adding biochar and chitin to soil or substrates can control the bacterial community around plant roots to the point where a higher number of plant growth promoters and biocontrol organisms install themselves in the rhizosphere. While studying biochar in the cultivation of strawberries, she found that the number of growth promoters and biocontrol organisms doubled (even quadrupled) while the evaporation of water decreased and the levels of potassium and phosphorus in the growth medium increased. Biochar also doubled the dry weight of the plant, doubled the fruiting yield, and increased resistance to Botrytis cinerea. After the addition of chitin to the soil cultivation of lettuce, up to 13 times more microorganisms were observed and the lettuce grew 25 per cent more. It also decreased the survival rate of Salmonella enterica on the lettuce leaves while the stimulation of chitin degradation helped fight harmful fungi, insect larvae, and nematodes.

- hortidaily.com
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High School Gets Grant for Hydroponics Center

Our Lady of Lourdes High School will soon have its own hydroponics center, thanks to a grant award. A Verizon STEM (Science, technology, engineering and math) grant worth US$1,445 was awarded to faculty in Poughkeepsie-based private school's science department through the Community Foundations of the Hudson Valley. The money will be used to buy a hydroponics center this summer; it will be shared among biology classes come September, says Christine Kolosky, Lourdes director of marketing and enrollment. “Unfortunately, hydroponics and concepts like sustainability, healthy living and food production remain poorly understood by many Americans,” the school says in a statement. That makes it “more important than ever for students to have the opportunity to engage in hydroponic farming.” The hydroponic center “will also give students, especially visual learning students, a better understanding of these processes and genetics as a whole,” says John Herles, a Lourdes biology teacher.

- poughkeepsiejournal.com

High Labor Costs Driving Fruit & Veg Production Out of Some US States

While demand for local produce in the US is growing, so too are labor costs. With higher costs, high-value fruit and vegetable production is being pushed out of states like California, Arizona, and Colorado and onto farms south of the border. Philip Martin, professor emeritus of ag economics at the University of California-Davis, and Guadalupe (Lupe) Sandoval, executive director of the California Farm Labor Contractors Association, say the shift is already happening and likely to intensify. Most of the recent agricultural expansion in Mexico has been financed by US growers and shippers, who can produce four times the vine-ripened tomatoes there at a fraction of the cost. Heavily urbanized states like California and Colorado are among the largest producers of fruit and vegetables, industry segments that are especially labor intensive. They also tend to have skyrocketing housing and transportation costs.

- freshplaza.com
**Micronutrients Market Likely to Surpass US$8.5 billion by 2023**

The micronutrients market size was estimated at more than US$4.5 billion in 2014 and with a compound annual growth rate of more than eight per cent is likely to surpass US$8.5 billion by 2023, according to a report from Global Market Insights. The Asia Pacific agriculture micronutrients market accounted for over 50 per cent of the total revenue share and will likely see a growth rate of more than eight per cent from 2016 to 2023. In North America, the market size was estimated to exceed US$950 million and is likely to witness gains of more than 8.5 per cent in the same time period. Europe will see more moderate gains of approximately 5.5 per cent up to 2023. Soil applications accounted for more than 55 per cent of the total demand in 2014; foliar applications accounted for more than 22 per cent. Hydroponics applications are likely to witness significant gains over the same forecast period.

-gminsights.com

**Piedmont Farm Grows Hydroponic Business**

Okra and blackberries are thriving at Ingram Farms. But the latest crop at the Guilford County farm isn’t growing out of the ground. It’s growing out of cups within a maze of white pipes and are part of the newest venture at Ingram Farms. It’s unique because it’s the only permanent outdoor hydroponic system in Guilford County. The Ingrams take seeds, put them in cups filled with material that can absorb the nutrient rich water that’s flowing through the pipes, and watch the vegetables grow. It’s not as easy as it sounds, however, and involves “a lot of trial and error,” Rhonda Ingram says. This year, Ingram Farms will raise up to 1,000 cool season plants like lettuce and Swiss chard because a constant flow of water is keeping them cool during the heat of summer, “You can design your own hydroponics for as cheap as $50 using pallets, gutters, a water pump and a Rubbermaid container,” says John Ivey, with Guilford County Cooperative Extension. “This is accessible to anyone that wants to do it.”

-myfox8.com

**Aircraft Evacuated Because of Controversial Fruit**

An airplane was recently evacuated due to a suspected gas leak from the cargo compartment. However, there was no gas leak. The mistake was simply due to the presence of a fruit that was taken on the plane by a passenger. “Security always has the highest priority. The fire brigade was called and it appeared that the smell came from an Asian durian fruit, which is obviously completely harmless,” stated Tonje Naess, of the airline’s press service. The plane was able to reach its destination a little over half an hour late. The durian is controversial because of its powerful smell. The fruit, also called stink fruit, has such a strong smell that it is forbidden for consumption in hotels and other public places in some Asian countries.

-freshplaza.com
WINTER FROST

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All measurements = ml/gal

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www.newmilleniumnutrients.com
Titan Controls Hyperion 2

Titan Controls’ Hyperion has become synonymous with advanced indoor gardening environmental control technology. Thanks to premium components, sturdy, dust-free housings, and exceptional finish, Titan Controls has earned a reputation for producing sophisticated, professional-grade equipment that lasts. Adding to this renowned line is the newest addition to the family, the Hyperion 2. This wireless environmental controller will monitor and control your growroom’s temperature, dehumidifier, CO2 system, and up to four lights. Extensively tested to meet Titan Controls’ high standards, the Hyperion 2 allows growers to control their space from up to 200 feet away with a remote control, which is included with purchase.

NovaGreen Mite-Y-Phite 0-7-17

Mite-Y-Phite is a unique formulation containing three important nutrients essential to enabling a plant to develop and maintain a strong immune system. By doing so, the plant can overcome environmental stress such as physical damage, heat, and drought, and develop better resilience to pests and diseases. Mite-Y-Phite 0-7-17 contains potassium silicate, a beneficial substance that has been found to alleviate many abiotic and biotic stresses. Not all silicon in soil is soluble and available to crops. The American Plant Food Control Officials designated silicon as a “plant beneficial substance.” Si plays an important role in plant health, and reinforces cell walls by deposition of solid silica. Plants can take up large amounts of Si where it contributes to their mechanical strength, and helps to protect plants from environmental stress. For some crops, Si fertilization of soils increases crop yield. A second mechanism for the beneficial effects of Si is its role in triggering a range of natural defenses.

Grower’s Choice 1,000W Double-Ended Ceramic Metal Halide Lamp

Introducing the world’s first 1,000W CMH lamp. As a direct replacement for your existing 1,000W HID fixtures, this 1,000W CMH lamp provides the absolute highest photosynthetically active radiation (PAR) to your specialty flowering plants. Emitting an astonishing 2,050 micromoles and with an extremely high CRI of 90, this lamp will not only increase your overall dry weight but will also raise the quality of your harvest. Grower’s Choice has continuously produced the world’s most accurate spectrum, closely replicating the sheer power of the sun. By using existing double-ended fixtures with our new 1,000W CMH lamp, you can completely overhaul the lighting in your facility, and enjoy watching your yields increase as your temperatures decrease.
**Gorilla Grow Tents**

Denier (D) is a unit of measurement used to determine the thickness of the individual threads in a fabric; the higher the number, the thicker the fabric. The use of thicker fabric means that Gorilla Grow Tents are more lightproof, more durable, quieter, stronger, safer, and the best possible growing environment for plants. Tents with a lower denier count will rip easily, leak light more readily, and offer problematic indoor growing environments. Their inadequate thread density presents an unnecessary risk of dangerous hazards such as flooding, and their old-fashioned swirl reflection design creates hot spots and does not effectively utilize rogue light. Grow tents use fabrics that can range anywhere from 200-1,680D. Gorilla Grow Tents offer the thickest fabric, measuring at 1,680D, which is three to nine times thicker than other tents in the market.

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**Reiziger Root Booster**

A sea treasure to activate, revive, and heal. Borne from the sea for the discerning craftsman, Reiziger Root Booster has the reassurance of being used by many professional gardeners and growers for over 20 years to activate, revive, and stimulate indoor hydroponic plants, outdoor plants, seedlings, trees, flowers, bulbs, natives, and more. This nutrient-rich, organic root stimulator has the power to save, revive, or help newly potted plants and transplants grow early white healthy roots, give more uniformity, and improve survivability, resulting in greener, vigorous plant growth and abundant new flowers. Search for the ship on the gold bottle.

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**Garden Gear Supply Radicle Bags**

Radicle Bags are made from a mesh geotextile designed to maximize your yields by promoting better gas exchange, with a cleaner air-pruning grow bag that does not absorb water. The word “Radicle” means root, and that is where the focus is—Radicle Bags support true air pruning by preventing a root-bound root zone. Air pruning allows for more branching, causing smaller roots to grow evenly while allowing much more oxygen to the root zone, effectively maximizing your yields. Ideal for use in hydroponics or dirt farming, Radicle Bags are extremely tough and easy to clean. Radicle Bags are available in tan and white, and have available handles to move even their largest bags. For a superior, truly reusable, premium product, choose Radicle Bags.
SuperCloset Bubble Flow Bucket Systems

As the leading manufacturer of Automated Superponic Grow Systems and Grow Boxes in the world for the last 15 years, consumer demand continues to thrive and grow. Due to increasing demand, SuperCloset Bubble Flow Bucket Systems, as well as other SuperCloset products, are expanding into garden centers and shops nationwide. SuperCloset Bubble Flow Bucket Systems utilize the Superponic method, which is the fusion of proven hydroponic methods including deep water culture, aeroponics, and top feed combined in a single system, recirculating hyper-oxygenated water through the ebb and flow upwelling feature, thus eliminating perilous micro-environments. With products designed for all skill levels from beginner to professional, a three-year warranty, lifetime customer, technical, and grow support, and countless awards, it’s a no-brainer that the full product line has expanded into stores nationwide.

Kind LED Commercially Certified Indoor Grow Lights

Kind LED Commercial Grow Lights challenge the standard of high-performance horticulture lighting technology, having passed the stringent safety requirements needed to earn a certification from respected UL Laboratories. Finding a grow light with UL certification doesn’t mean that cost, wattage, or PAR output must be compromised. Kind LED grow lights use 40% less power, saving nearly half the costs of the electricity used for a traditional HID grow light. With eight-stage internal timers and a complete 12-band proprietary spectrum, growers can program the Kind LED grow light to mimic sunrise and sunset, resulting in faster, healthier, larger, and better-quality yields. A secondary optical lens magnifies PAR and increases canopy penetration by up to 200% per cent, significantly increasing “under canopy” production and yield.

Current Culture H2O EZ Clean Manifolds

In their continuous effort to push design and innovation within the hydroponic industry, Current Culture H2O have announced the newest upgrades to its Under Current systems: the CCH2O EZ Clean Delivery and Return Manifolds. Designed with growers’ needs in mind, the CCH2O EZ Clean Manifolds feature wash-out tees with caps that allow for efficient manifold maintenance and cleaning. Flexible couplings offer quick and easy assembly and expansion without glue. Made from durable, non-translucent ABS, the CCH2O EZ Clean Manifolds offer long-lasting performance and are proudly manufactured in the USA.

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SCROGGER Smart P SCROG

SCROGGER, the world leader in plant training and support kits, is proud to introduce the Smart P SCROG. When purchased in a six-pack configuration, the Smart P SCROG is the company’s most cost-efficient kit ever. Smart P SCROG is a low cost ScrOG kit, complete with a five or 10 gallon Smart Pot. Each single pack contains one and each money-saving, bulk six-pack contains six of the following items: a 21-inch patented polycarbonate screen with 3.25-inch openings, a set of four adjustable stakes (which adjust to approximately 18-36 inches), eight eight-inch zip ties, and an original Smart Pot (five or 10 gallon). The system sets up in minutes without tools.
Did you come to play or grow?

Children play in water

Serious growers use GRODAN to get more crop per drop

Clean. Easy to Use. Controllable.

Professional growers use GRODAN stone wool products for maximum production. Shouldn’t you?

Ask your hydroponics store for GRODAN and get your best results, just like the pros.

Check us out at grodan101.com
BlueDiamond ET Air Pumps

With almost three quarters of a century of experience in the industry, BlueDiamond provides a range of ET air pumps that are perfect for wastewater applications. Ensuring plenty of water movement, the ET range can boost oxygen levels in the water, allowing aerobic bacteria to decompose. All while providing a clean, oil-free air source that is exceptionally quiet in operation, even when running continuously for long periods. Within the ET range, the Envir-o ET60 boasts 2.12 cubic feet flow per minute and is also an incredibly easy service procedure with a competitively priced service kit.

With a weatherproof, robust construction that is supported by the standard BlueDiamond range two year warranty, the ET60 is the obvious choice for a wastewater treatment pump. BlueDiamond also provides tubing, air stones, hose clips, and more.

Growtainers Commercial Container Farm

Growtainers is pleased to announce the availability of its custom-designed, food-safety compliant 53-foot commercial container farm. Unlike any other container farm in the market today, the state-of-the-art Growtainer includes a separate 96-square-foot prep area, which prevents contamination or climate fluctuations entering the production area. Equipped with its proprietary Growrack system, with 480 square feet of ebb and flood growing space, energy efficient LED lighting, high-tech climate and environmental controls, water quality monitoring and dosing system, and a proprietary irrigation system, these professional units are built for high volume production.

Green-Qube Quick-Qube

Green-Qube is once again shaking up the growroom industry with a revolutionary new tent concept. The Quick-Qube represents a new way to create an easy growing space. Adapted from an industrial gazebo frame, the patented pop-up framework combines Green-Qube’s class-leading outer shell with a super sturdy, yet lightweight aluminum frame. The Quick-Qube is fast, easy, and requires almost no effort to erect. Its aluminum frame is 1.4 millimeters thick and has incredible strength, holding over 100 kilograms. Best of all, it’s anti-corrosive, so it will never rust. It also allows you to truly maximize your growing floor space as there are no intruding floor poles, just five adjustable legs. Get growing in record speed, as the tent also offers instant collapsing and neat and easy storage, with no chance of poles or corners being mislaid. Available for all large tent sizes from September 2017. Pre-orders now being taken.

BlueDiamond ET Air Pumps

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Dramm TracFog Nozzle Extensions

Dramm now offers an optional nozzle extension for its line of TracFog PTO-driven fog systems. These nozzle extensions extend the nozzle outlet so that the fogger can easily treat individual Quonset greenhouses from the doorway just by driving alongside. The nozzle extensions thread onto the standard outlets on the TracFog and can be easily swapped in a matter of minutes. Many greenhouse businesses have a combination of gutter-connected and individual houses. The nozzle extensions allow the unit to be utilized to treat both types of greenhouse easily and quickly. The TracFog is available in two different sizes for different sized greenhouses. The 25-gallon unit can treat 500,000 square feet with one tank and the 100-gallon unit can treat 2,000,000 square feet. The TracFog allows growers to rapidly treat large areas, reducing the amount of labor and improving efficiency and efficacy of sprays.
THE INDUSTRY’S ROCK OF FIXTURES

AC/DE FUSION™

The AC/DE Fusion™ features an integrated high frequency 105 kHz Sun® brand ballast made specifically for running double-ended horticultural lamps. The Fusion can operate a 1000 watt DE lamp at 600, 750, 1000, and 1100 watts. Features German made, UL listed double-ended sockets. 95% reflective textured German aluminum interior with 98% reflective corner inserts offer excellent uniformity, output and diffusion. Operates on 120-240 volts. Fabricated and assembled in the USA.

PART # 906602 - MSRP: $599.95

ULTRA SUN HPS 1000 Watt, DE 2,000ºK.
PART # 901469 - MSRP: $119.95

This is the original and only properly designed air-cooled DE reflector. Fabricated and assembled in the USA specifically for double-ended horticultural lamps. Features German made, UL listed double-ended sockets. 95% reflective textured German aluminum interior with 98% reflective corner inserts offer excellent uniformity, output and diffusion. Purchase a Sun System 1 ballast separately.

PART # 904904 - MSRP: $379.95

AC/DE FUSION™ and AC/DE® have the patented and patent pending sealed optic technology which allows removal of heat generated by the lamp without cooling the lamp. Made specifically for double-ended horticultural lamps (not included). Features German made, UL listed double-ended sockets. Unique double-ended construction allows for maximum optical efficiency and uniformity. Improved spectrum DE lamps used in these fixtures focus on the red component for increased photosynthetic response. To learn more about our double ended technology check out our channel on You Tube.

INNOVATING SINCE 1995

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Reiziger Grow Food A & B

Everything Reiziger does is grounded in a history of more than 30 years of formulating fertilizers to a traditional recipe. Sworn by Dutch craftsmen for decades, this legendary two-part nutrient system gives the most vigorous growth rates possible. For Dutch hydroponic master gardeners, growing is an art form. It is about long-standing craftsmanship and the unique blend of art and science. To help them master their craft, Dutch breeders and growers swear by Reiziger Grow Food A & B for greener, lusher plants. When you use Reiziger, you join the ranks of generations of Dutch craftsmen who know how easy it is to achieve rewarding growth rates. Search for the ship on the gold bottle.

Current Culture H₂O Under Current Demo Display and Nutrient Rack

Increase the visibility and sales of Current Culture H₂O products with our new line of retail displays. Bring their proven production system to your store with a Cultured Solutions nutrient display rack or Under Current demo display. The striking retail displays feature fast assembly time and are made in the USA with the highest grade heavy-duty, powder-coated steel. Designed with the retailer in mind, the racks take precise inventory, make stocking a breeze, and allow for efficient use of retail space and marketing of the complete CCH₂O product line. Choose from multiple retail display packages that include an Under Current demo display and a four-foot or eight-foot Cultured Solutions nutrient rack. All packages include marketing material and swag. Free retail displays and deep discounts are available with select stocking purchases.
DIGILAMP

945 WATT
Ceramic Metal Halide Lamps

Proudly designed and developed in California.

US and International Patents Pending.

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Tidal Vision High Tide

High Tide contains all-natural shellfish extract, which enhances your plants’ growth and hardiness when used as an adjuvant by stimulating your plant’s immune system. The shells of Alaska snow crab contain the exact same structural compound that’s found in the exoskeletons of insects. When these compounds come into contact with your plants via roots or foliage, they elicit an immune response in your plants, helping them to be harder and to thrive even when bouncing back from stressors such as transplant, temperature, or drought shock. High Tide works by triggering your plant’s natural immune response, which increases your plant’s yield, sap, resin, or juice production, and increases the hardiness of your plants. Basically, it tricks your plants into believing they are being infested with pests and elicits your plant’s natural immune response. High Tide is good for indoor and outdoor applications on ornamentals, fruits, vegetables, trees, and turf, and can be applied to foliage, soil, or hydroponic reservoirs. It is 100 per cent safe, non-toxic, and all-natural.

Grower’s Choice 315W 10K Grow Lamp

Growers are constantly looking for ways to improve the quality of their crops and 315W agro lamps are becoming increasingly popular in the growroom. The addition of 10K UV light towards the end of the bloom cycle increases resin production in flowering plants as a defense mechanism in response to the ultraviolet light. Traditionally, growers who used 315W agro lamps and wanted to reap the benefits of the 10K spectrum needed to bring in additional fixtures to get the job done. Now, you can simply switch the bulb; Grower’s Choice makes it easy by offering the industry’s first and only 315W 10K finishing lamp, designed specifically for flowering plants.

Active Air Inline Filter from Hydrofarm

For effectively removing odors, dust, and particulates from indoor environments, the new inline carbon filter from Hydrofarm’s Active Air brand features dual direction airflow ability. It also features a two-stage filtration design: the air passes through two interior carbon filters before exiting, for superior filtration. A Hydrofarm exclusive, it allows remote filter placement for saving valuable growroom space and is easy to install and use. Available in six-inch and eight-inch sizes.

Summit Research Tech SPD-2.1 Thermal+ Packable Head

Summit uses genuine Schott Glassware and all of its labware is made in the USA. This is a unique Summit product because the company has pinpointed the issues with packable heads and increased the user experience by manufacturing a truly astounding top-of-the-line custom packable head. The main joint below the flask inlet area has been extended. Summit has created a tight and compact plate using indents to hold back packing material. Using the Summit Research Raschig ring set, you can pack with different results. The amazing performance of this packable SPD-2 head is due to the location of the packing. It encounters a smooth temperature gradient with a factor of half the distance repeated by half its remaining distance stacked. Normally packed gradient is between one-quarter of the distance and reduces consistently through the path when packing the head from the traditional location mid section with an average loss of one to three degrees. Summit supplies a head to ensure the highest heat retention in the packable section allowed on a short path distillation setup like this. This is a game changer when it comes to packable heads.
With its high perlite content, PRO-MIX HP BIOFUNGICIDE + MYCORRHIZAE provides a great growing environment to growers looking for a significant drainage capacity, increased air porosity and lower water retention. The added benefit of fibrous peat moss and coarse perlite makes this formulation ideal for growers who require a superior-quality product adapted to their needs for watering flexibility and crop seasonality.

PRO-MIX® PUR™
Advanced inoculants aiming for professional growers who seek growth enhancement and protection for high-value crops.

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**Reiziger Expanded Clay**

The perfect starting point for magnificent gardens, Reiziger Expanded Clay provides excellent root support and drainage, as well as vigorous root growth. It helps hydroponic craftsmen grow big healthy plants, fruits, and vegetables. Reiziger Expanded Clay is inert, pH neutral, and does not contain any nutrient value. Ideal for recirculating hydroponic systems, Reiziger Expanded Clay’s smart Aqualock formula helps absorb more water and protects against under and overwatering. Reiziger guarantees the expanded clay substrate meets the highest chemical and physical standards and is free from weeds and pathogenic organisms for that next echelon in size, yield, and taste. Growers can be confident that many skilled Dutch craftsmen have used Reiziger growing media for years.

**Remo Supercharged 500ml Nutrient Kit**

The new Remo Nutrients 500ml Supercharged kit contains all you need to get growing with Remo, with two 500ml bottles of Micro, Grow, Bloom, AstroFlower, MagNifiCal, Nature’s Candy, and VeloKelp. The kit also includes a free Remo measuring cup, free growroom glasses, feed chart sticker, and Remo product information booklet. Remo Nutrients offer a complete system of vitamins, minerals, and extracts that your plants need to achieve their maximum growth potential. Using pharmaceutical-grade ingredients, Remo Nutrients opens up your garden’s growth potential to the maximum degree. Available now from Easy Grow.
For nearly 40 years Growers Supply has been supplying commercial growers with GrowSpan Greenhouse Structures, the most versatile line of commercial greenhouses.

Built to Last - GrowSpan greenhouses are built with triple-galvanized, American-made steel frames and numerous covering options. You can be sure your growing structure will be complimenting your business for years to come.

Expert Consultation - We staff Greenhouse Specialists with extensive industry experience. They can provide valuable advice to ensure you get the structure that perfectly fits your operation and growing needs.

Financing Available - Speak to your GrowSpan Greenhouse Specialist today.

Visit www.growspan.com or call 1.800.476.9715 to find out how we can help with all your growing needs.
Autopilot CO₂ Generators from Hydrofarm

A Hydrofarm exclusive, Autopilot CO₂ Generators provide and maintain the carbon dioxide levels needed to meet maximum growing potential and cost very little to run. Safe and easy to operate, these highly reliable CO₂ generators are equipped with a safety feature that shuts off the gas source if the unit tips over. Autopilot CO₂ Generators are available in both propane and natural gas models, along with high-altitude versions in three sizes: four-burner, eight-burner, and 10-burner. They feature a solid-state electronic ignition module, which eliminates the need for a pilot light.

NovaGreen “TKO” Phosphite 0-29-26

NovaGreen’s “TKO” PHOSPHITE 0-29-26 is the nutrient-packed knockout punch growers need in their arsenal. This solution stimulates growth, boosts plant immunity, and increases yield. TKO is a super water-soluble and highly concentrated phosphorus and potassium (P/K) solution that’s more effective than traditional granular fertilizers. Unlike other products that use phosphates, TKO uses smaller phosphites, which result in improved plant uptake capabilities and minimize product waste. TKO also quickly improves P/K imbalances and helps growers produce bigger, stronger, and heavier flowers. In a recent Growth Products study testing TKO’s effectiveness, the product reduced the incidence of downy mildew on cucumbers and squash by 68 per cent over the control group. When paired with Bravo Weather Stik, it reduced the incidence by 76 per cent over the control group. Versatile TKO can be used in soil and soilless mixes, inside or outside, as a foliar spray, in hydroponics and constant feed systems. TKO safe for the environment and workers.

Upgraded Flo-N-Gro Systems

Flo-N-Gro hydroponic growing systems continue to evolve as new features are developed, like the innovative bottom drain that is now included in all Flo-N-Gro buckets. A distinctive notch in the bottom of the bucket captures every bit of water, which results in total drainage, eliminates standing water, and makes cleaning easier and more effective. The built-in bulkhead fitting in the bottom drain is ideally suited to Hydro Flow’s ½- or ¾-inch tub outlet fitting. It easily screws in and requires only a single washer for a leak-proof seal. This built-in tub outlet bulkhead is threaded in such a way that it allows the fittings to screw in and tighten, leaving the fitting in the optimum operating orientation. The bottom of the bucket has been elevated off the floor, which keeps the bucket clear of the floor and prevents the root zone water temperature from being affected by the floor temperature.

Grower’s Choice 630W Double-ended CMH Grow Lamp

Introducing the industry’s first 4K double-ended CMH bulb. The Grower’s Choice 4K CMH bulb runs in any double-ended, high-frequency ballast; just dim it down to 600 watts. Now, growers can enjoy all the benefits of costly CMH systems by simply switching out the bulb in their existing fixture. Thanks to our proprietary spectrum, the Grower’s Choice CMH 4K bulb offers an unbeatable CRI of 98, making it the closest solution to sunlight available on the market. The 4K bulb is a perfect veg bulb, offering thicker branches, tighter node spacing, and bushier growth, which leads to higher yields. With this incredible new product, you get the efficiency of a DE system and the spectral quality of a CMH combined into one.
Budbox™ Defines the Premium Grow Tent

With 14 years of hydroponic engineering experience the leading premium brand of grow tents within the industry has been continuously innovating new products from the very start. With super strong 25mm tempered steel frames, the whole product range is available in four height options, 18 floor plan sizes, three weights of Mylar (210, 600, and 1680), and two colors: pro white and silver, with seven per cent more PAR reflectivity than the nearest competitor. With unprecedented customer support, BudBox delivers the highest-quality, rigorously-tested, most-trusted and fully certified grow tents. Exclusively available via a select group of authorized professional partner stores within Europe, USA, and Canada. Now featuring the ALL NEW BUDBOX™ Pro grow tent series, which combines & amalgamates all the very best ideas, concepts & raw materials we’ve developed over the last 10 years into one fantastic, strong, light-proof, growing environment.

Available in 18 different sizes
25mm diameter tempered high-tensile steel poles
Oversized air ports, electrical and irrigation ports
The only anti-corrosion, powder-coated poles and connectors in the industry.
Micro-mesh passive vents,
steel, push & click fit connectors
Reinforced cover corners
flower friendly green viewing window
Military Grade Zippers
fully-waterproof one piece catchment tray
fully clear floor growing area

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The most trusted name in the indoor grow tent market.
The use of grow tents for indoor gardening has been on the rise over the years with small-scale, hobbyist gardeners. Generally speaking, indoor horticulturalists use grow tents because they are easy to set up, require few materials, and are low-impact on living space. Yet, when using grow tents, cultivators sacrifice some of the flexibility that is enjoyed when operating within a traditionally built-out growroom. This is largely because the size of grow tents usually mirrors the size of a garden canopy per 1,000W—as seen in a 4x4-foot grow tent. Point being, this canopy-to-tent sizing schematic makes it difficult to position equipment, such as lights and exhaust, and leaves little room for working within the allocated grow space. Also, as grow tents are erected by an interior metal frame and have walls, ceilings, and floors made of canvas, their infrastructure presents further challenges for situating equipment efficiently.
BUD, BUD, EVERYWHERE, BUT NOT A PLACE TO GROW...

We understand there are many important factors to consider when shopping for the right home for your plants.

Let us help you design a building that suits your specific needs, so your only job is to grow green, dense, and sparkly blooms.
Regardless of spatial and material constraints within grow tents, clever indoor gardeners can figure out ways to situate their equipment in a fashion which is both expedient and functional. This process is made easier by the convenient holes and ports which are built into tent walls for electrical access as well as airflow and exhaust. These things being noted, for hobbyist gardeners out there, here are a few tips for situating equipment in a grow tent.

**Exhaust and Carbon Filters**

Perhaps the most essential equipment element, as well as the most difficult to situate in a grow tent, is that of an exhaust and carbon filter. For hobbyist gardeners using a 4x4-foot or 4x8-foot tent for flowering, it’s a practical idea to run a carbon filter, air-cooled hoods, and inline fan in one exhaust system. Combining all of these elements will help counteract the spatial constraints present in grow tent cultivation.

For grow tents of the aforementioned sizes, there are relatively small, 

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**BASELINE**

**ORGANIC GRANULAR AND LIQUID HUMUS**

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For grow tents of the aforementioned sizes, there are relatively small,
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Introducing the World’s First Planter Made With Antimicrobial Plastic!

THE Medical Planter & Planter
The Revolutionary Complete Re-Design of The Planter.

NO TOOLS REQUIRED!
Irrigation/Feeding System Snaps On & Off in Seconds!

Maximize Your Efficiency & Minimize Lost/Misplaced Tools.
Workerstation Organizes Your Scissors, Pruners & Features a Cup Holder.

3 Degree “V” Bottom Design Keeps Plants Properly Drained.

Customizable Easy to Use Snap On Spreaders Keeps Stakes Out of Your Roots.

SHOCK-FREE TRANSPLANTING!
Removable Non-Water Absorbing, Breathable Insert.

Insert-able 1-1/4” PVC Legs Keeps Planter Off Of Cold Slabs And Away from Insects. Can Be Placed On Tables Or Directly On The Ground.

Our Patent Pending Plastics have Anti-Mold & Antimicrobial Properties built in!
Air-Channels Create A Steady Flow Of Oxygen To Your Roots.

Universal Application Works With All Types of Medium!

Clay & Lava Rocks
Vermiculite
Perlite
Rockwool
Coco & Coco Coir
Soil

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Marijuana Business Conference & Expo
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lightweight carbon filters that can be easily hung to the interior of a tent frame with the same materials used with lighting. It should be noted, as heat rises one should always strive to hang the carbon filter as near the tent ceiling as possible—the exhaust will simultaneously pull hot air out of the tent and "scrub" the air for smell by way of the carbon filter.

When situating the inline fan for the exhaust system, it should be hung off the ceiling support of the interior tent frame while being simultaneously positioned next to one of the exhaust ports on the wall. These exhaust ports are generally made to fit six- to eight-inch pieces of ducting and feature a "bungee-like" material which can be synched down on the inline fan or ducting to create a relatively tight seal for light leaks. Also, wire, rope, or retractable cordage mechanisms work nicely for hanging the inline fan on the tent frame. When the carbon filter, hoods, and inline fans are properly situated within the grow tent, connect them all with ducting. With this schematic, the inline fan pulls the fragrant, hot ambient air out of the tent canopy area while simultaneously cooling the hoods—to finally exhaust both to the exterior of the grow tent.

The geographical locale as well as seasonality of the indoor cultivation operation in question will greatly influence a gardener's choice concerning expulsion options for the hot air expelled from a grow tent through the exhaust system. In the cooler fall, winter, and spring months in much of North America, exhausting a grow tent directly into a home will likely be a welcome source of heat. However, in the warm summer months as well as in tropical climates, the added heat of exhausting a grow tent directly into one's home can make for a rather uncomfortable living situation due to excess warmth. That being said, grow tent gardeners can opt to position their set-ups near a window as to exhaust the hot air directly out of living spaces. But, this option can easily eliminate much of the operational discretion which most tent cultivators value. To solve this predicament, one can counteract the added ambient temperature resultant from grow tent's exhaust with a home's AC system—this can prove quite costly in the heat of summer.

"WHEN SITUATING the inline fan for the exhaust system, it should be hung off the ceiling support of the interior tent frame while being simultaneously positioned next to one of the exhaust ports on the wall."

Wall Fans

As seen with traditional indoor grow room operations, proper airflow and circulation are an essential element in a successful tent-grown crop. However, while in a retro-fitted, wood frame room one can simply hang wall fans on a wall, canvas tent walls don't provide this infrastructure. However, one can get smaller "clip-on" fans which can simply be attached to the tent frame. Secondly, simple free-standing circulating fans can be used in grow tents without the hassle of trying to situate them upon a wall (if the square footage of the operation allows for this option).
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Lighting
As seen with traditional grow room set-ups, a good place to start planning a grow tent’s interior organization is with lighting. This is because the type of lights one uses for their indoor garden directly influences their options for air-cooling as well as exhausting. For example, the use of double-ended high pressure sodium lights is discouraged in most grow tent cultivation scenarios because these lights put off an extreme amount of heat and they don’t come with air-cooling options. That being said, fluorescent, LED, and air-cooled HPS lights can be simply hung from the roof of the interior frame of a grow tent using ropes, chain, or retractable cordage mechanisms. However, air-cooled HPS lights should be hung in a position which will function in conjunction with an exhaust system.

“The use of double-ended high pressure sodium lights is discouraged in most grow tent cultivation scenarios because these lights put off an extreme amount of heat and they don’t come with air-cooling options.”
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There are hundreds of products on the market claiming to stimulate, boost, enhance, or promote root growth, but with all the hype, how can you figure out what really works and what is a waste of your precious dollars? There are products on the market that are designed to stimulate root growth, but you need to know what you are looking for before getting suckered by pretty packaging and unverifiable claims.

Why Use Root Promoters?
Most growers, from hobbyists to professionals, use rooting promoters as a matter of course when propagating plants. It may make one ponder the need, though, since plants have evolved to develop root systems on their own (otherwise they would have gone extinct or never developed to begin with). While that is certainly true in nature, the propagation of plants introduces a wide range of variable and artificial conditions that a plant cutting’s natural counterpart may not ever encounter. The natural counterpart has the benefit of numerous symbiotic relationships with beneficial flora and fauna; they are also not operating on anyone’s time table but their own.

Though plants naturally produce their own root promoters, there are a variety of ways a motivated grower can stimulate root propagation safely and effectively. But which ones are most effective? Chris Bond explains how to separate the facts from the hype.
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In general, rooting promoters—be they hormones, stimulators, or other growth aids—are designed or gleaned from nature for their ability to aid in a plant’s need to develop a healthy root system quickly. Other benefits of using root promoters, besides reducing the time it takes for a plant to initiate root development, are that cuttings treated with root growth stimulators typically have a higher survival rate than non-treated cuttings and that the number of roots produced per cutting is increased. Another benefit, mostly for commercial propagators, is that the use of root promoters generally increases the uniformity of the cuttings’ root systems. This is important when keeping all container sizes uniform.

The Real Stuff

Plants naturally produce root promoters of different types called auxins. Auxins help to encourage or regulate plant growth through the processes of either cell enlargement or cell division. They can direct the growth of one area of a plant while restricting the growth to another, depending on where its resources are needed. Any legitimate rooting hormone or root growth stimulator will have this in one form or another. For developing roots from propagated cuttings, look for a product containing the naturally occurring hormone indole butyric acid (IBA). This auxin helps the plants to develop new roots.

If you are transplanting a young plant that already has roots, but you want to stimulate more lateral roots, find a product containing the manufactured hormone naphthylacetic acid (NAA). Some rooting promoters on the market contain both IBA and NAA. Other real and synthetic plant auxins do exist, but they are not as efficient as they break down quickly and are of little long-term benefit to the plant.
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Phosphorous is one of the nutrients needed by plants in large amounts, and one of its many functions is to aid in root development. Some root stimulators may contain phosphorous, but you can also use a separate phosphorous product on its own. A word of caution about phosphorous: any amount not used by the plant ends up leaching out and often ends up in waterways. This causes unwanted and sometimes dangerous algae blooms. Make sure that you really need it and that your plants can use all the phosphorous that you give it. When in doubt, test the phosphorous levels of your media to see if your plants already have enough available to them. The same can be said of nitrogen. Nitrogen fertilizers may be sufficient to help your plant develop new roots as the process of your plant adjusting to its new home can require additional nutrition. Be careful about over-fertilizing.

Regardless of which formulation you select for your rooting promoter, be careful not to contaminate or otherwise compromise the contents. Do not dip your cutting or plant into a bottle of root stimulator. This can introduce any number of unwanted pathogens that can then be spread to your other plants with each subsequent dip. Prepare the desired amount separately, and keep the original container tightly closed when not in use. Do not save or reuse root stimulators that have already been in contact with your cuttings or transplants.

**Mycorrhizae**

Though not a growth hormone, mycorrhizal fungi has been known for hundreds of years to benefit plants’ roots. The mutually beneficial relationship between this fungi and a plant’s root system is complex. In general, beneficial bacteria are stimulated, which in turn produce growth-enhancing chemicals within a plant. The fungi feed on carbohydrates and proteins that are released by the roots of a plant, and the networks of beneficial fungi, which can go on for miles underground, can act as an extension for the roots’ ability to draw much-needed nutrients. Roots that have a complex mycorrhizal relationship are more resistant to root diseases, pests, and negative cultural conditions like drought or poor soil aeration.

Mycorrhizae has become widely available on the market. You can obtain it in liquid, granular, or powder form. It may also be embedded into soilless media. It should be observed, however, that the use of fungicides on your plant to prevent certain fungal diseases may negatively affect the beneficial fungi existing in your plant’s root network. If you purchase a mycorrhizae product for root development and a fungicide, you may as well save your money and not buy the mycorrhizae until enough time has elapsed from your fungicide treatments.

"**THE FUNGI FEED** on carbohydrates and proteins that are released by the roots of a plant, and the networks of beneficial fungi, which can go on for miles underground, can act as an extension for the roots’ ability to draw much-needed nutrients."
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Vitamin B1

You don’t have to look hard in the root promoting marketplace to find thiamine (vitamin B1), which is touted as either the ultimate root growth stimulator or as a cure-all for transplant shock. There are no verifiable studies to support these claims. Plant research in the mid-20th century considered several auxins that were mixed with vitamin B1 and these compounds were indeed found to promote root growth. It has repeatedly been proven since that it was the auxins alone responsible for the root development, not the thiamine.

Vitamin B1 does have a place in plant development, however, but it is usually abundant enough in nature that additional doses are unnecessary. It is beneficial to add vitamin B1 to sterile media where there is no natural thiamine for the plant to use, but there are few other situations where it is actually needed.

Organic and Non-chemical Alternatives

If you are concerned about using artificial hormones or just aren’t sure which product to use, you can make your own organic root promoter by using willow tree branches and leaves. Fast-growing trees like willow produce large amounts of auxins. Willow tea, or willow water as it is called by some, is easily prepared with young, thin, willow branches. To make a gallon of willow tea, cut four cups worth of thin branches with leaves into one to two-inch sections.
Boil one gallon of water. Add the cut branches and leaves to the boiling water and let them sit until the water has cooled to room temperature. Sieve out the pieces and the auxin-rich water can be used immediately to water your cuttings. Unused amounts can be frozen and thawed for later use. (If you cannot locate a willow tree to borrow a few branches from, you can make the same concoction with other rapid growers like poplars or silver maples.)

If you do not want to make your own organic root stimulator, you can find some on the market that have been approved for organic gardening by the Organic Materials Review Institute (OMRI). Look for the OMRI stamp on labels of root stimulators to ensure that what you are buying is in fact organic.

IF YOU ARE concerned about using artificial hormones or just aren’t sure which product to use, you can make your own organic root promoter by using willow tree branches and leaves.

Another long-standing and proven natural product for aiding in root development for cuttings is honey. Regular, straight-from-the-pantry honey is a natural antiseptic. While it does not act as a rooting hormone, it protects your cuttings so that they can develop their roots without the risk of succumbing to disease. There is some indication that the sugars in honey are also beneficial for root development.

Herbicides
What do herbicides have to do with root stimulators? Surprisingly, a lot. Unknown to many gardeners, several types of herbicides are actually nothing more than plant auxins. Common weed killers containing the compound 2,4-D work by stimulating plant growth. In the case of plants treated with herbicides containing these compounds, they cause the affected plant to essentially grow themselves to death, much like a cancer. For root stimulation, these compounds are used in far weaker concentrations. This does not mean that you can use any weed killer in a diluted strength to put on your cuttings. Even at a highly weakened rate, they might inhibit other growth functions of your cuttings. The point of mentioning herbicides here is to let you know you should not be alarmed if you recognize something typically used as an herbicide among the active ingredients on a bottle of root promoter. Lethality is a matter of dosage; even water is toxic if you consume enough of it.
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Lighting is one of the most critical factors when it comes to growing healthy plants. Whether growing indoors or outdoors, color temperature can have a major impact on your plants’ height, leaf size, and harvest. Not all plants are the same and they may react differently to different color spectrums; however, some principles affect all the plants in your garden.

Light can be expressed as a wave. Imagine the ripples that form on a pond when you throw a pebble into the water. This is very similar to what light waves look like. The size of the waves, or wavelengths, vary depending on where the color of the light falls on the electromagnetic spectrum. Red light such as radio, microwave, and infrared wavelengths are wide, long, and contain less energy. Violet light such as UV, X-rays, and gamma rays are short, narrow, and high energy.

**Kelvin Color Temperature Scale**

- 10,000K — 10,000K = Blue Sky
- 9,000K — 7,000-7,500K = Cool White
- 8,000K — 6,000K = Cloudy Sky
- 7,000K — 5,500-6,000K = Day White
- 6,000K — 4,800K = Direct Sunlight
- 5,000K — 4,000-4,500K = Natural White
- 4,000K — 4,000K = Clear Metal Halide
- 3,000K — 3,000K = 100W Halogen
- 2,800K — 2,800K = 100W Incandescent
- 2,700K — 2,700-3,200K = Warm White
- 2,200K — 2,200K = High Pressure Sodium
- 1,900K — 1,900K = Candle
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The spectrum’s wavelengths are measured in nanometers, and it ranges from zero to 5,000,000,000 nm. Visible light, which falls between red and violet light, and is a small slice of the entire electromagnetic spectrum. All the colors of the rainbow fit in the very narrow range of 400-700 nm. All of these colors together create white light, and they are separated into individual colors when they pass through a prism (this is why rainbows appear when sunlight passes through water droplets). This section of the spectrum has the most impact on plant growth, although more recent studies are showing that infrared and UV rays play a role as well.

“ALTHOUGH A PLANT can grow under red lights alone for its entire life cycle, indoor growers usually prefer shorter, bushier plants due to limited vertical space, and have found that using a fuller spectrum of light will produce a higher yield come harvest.”

The visible spectrum ranges from 400 to 700 nm. The higher the numbers, the shorter the wavelengths.

UNDERSTANDING THE SPECTRUM

It is important to understand how color temperature is measured when shopping for an indoor grow lamp. Kelvin measures a light’s degree of warmth, ranging from zero to 10,000 K. Cooler blue lights will have a higher temperature, and warmer red lights will have a lower temperature. The temperature of daylight is about 5,600 K.

Light plays an essential role during photosynthesis. In the photosynthesis process, plants convert light, carbon dioxide, water, and minerals into glucose and oxygen. Plants primarily use the red and blue spectrums of light in varying amounts during this process, depending on their stage of growth.

Although different plants prefer different light spectrums, in general, certain spectrums perform specific tasks. Blue light in the 400-500 nm range promotes root growth and intense photosynthesis. Red light in the 640-720 nm range stimulates stem growth, flowering, and chlorophyll production.

Sunlight contains the full spectrum of colors, though the wavelength will vary according to the time of day or year. Spring sunlight is more violet and high energy, encouraging the vegetative growth of plants, whereas fall sunlight has a warmer color temperature and lower energy, producing the fruit and flowers for a fall harvest. You can also see the color spectrum change throughout the day as the sun changes position in the sky, which is what creates vibrant red and orange sunsets as the day winds down.
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“IT WAS FOUND that the dry weights, crispness, sweetness, and shape of plants treated with the red-blue-white LED and fluorescent lamp were higher than in plants treated with only red-blue LEDs.”

STUDIES IN LIGHT

In a 1997 study published in the *Oxford Journal of Experimental Botany*, wheat was grown under red LEDs with and without supplemental blue lighting, and was then compared to wheat grown under white daylight fluorescent lamps. The study found that wheat grown under red lights alone demonstrated less development during vegetative growth, grew longer stems and leaves, and yielded fewer seeds than wheat grown under white light. Wheat grown under red LEDs with supplemental blue fluorescent lighting produced similar growth and yield to wheat grown under white light. The study concluded that wheat can, in fact, complete its life cycle under red LEDs alone; however, larger plants and greater seed yields are produced with the fuller spectrum of light.

A 1987 study published in *Scientia Horticulturae* studied the effects of blue, natural, green, yellow, and red light in chrysanthemums, tomatoes, and lettuce. It found that blue light reduced the dry weight, height, and leaf area in the plants compared to other light spectrums. Green and yellow light enhanced the leaf area of tomatoes compared to natural light. They also found that blue light produced darker green leaves than natural light, whereas green and yellow light produced light green leaves.
Easy to use. Easy to customize. The Safer® Brand five-part nutrient kit lets you give your plants exactly what they need, exactly when they need it. Suitable for soil or hydroponics.
A 2012 study published in *Scientia Horticulturae* investigated the influences of three different qualities of light on lettuce. They used a red and blue LED; a red, blue, and white LED; and a fluorescent lamp. It was found that the dry weights, crispness, sweetness, and shape of plants treated with the red-blue-white LED and fluorescent lamp were higher than in plants treated with only red-blue LEDs. Once again, a fuller spectrum of light throughout the plants’ life cycle yielded better results than blue or red light alone.

As a gardener, it is critical to recognize the importance of lighting in your garden. Outdoors, you as the gardener must consider which plants grow best at your latitude. You also need to consider your garden’s microclimate and how much sun is received at certain times of day. You might find it helpful to shade certain plants at certain times depending on your location and which plants you’re growing. Indoors, you must choose the correct grow lamp for each part of a plant’s life cycle, keeping in mind that blue light will enhance vegetative growth and a fuller spectrum lamp will enhance the overall yield and quality of your harvest.
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The trick to successful indoor berry crops is understanding the physiology and natural life cycle of the plant so that flowering, pollination, and fruiting all go according to plan. While hydroponic strawberries are not an uncommon crop and relatively easy to grow, other berry crops require a little more investment in time and effort. However, they are highly rewarding. Hydroponic blueberries, cranberries, and raspberries can all be produced on a limited scale with soilless greenhouse cultivation—many in high tunnels to extend the harvest season and improve fruit quality—but they can also be grown indoors.

Hydroponic Strawberries

For those new to berry production, strawberries are the ideal crop with which to gain some experience. The plants are readily available, small, compact, and available in a range of different fruiting types and cultivars that produce fruit relatively quickly. Strawberry varieties fall roughly into two different categories: the short-day and day-neutral types.

Most of the outdoor strawberry types are short-day varieties. These initiate flowers under the shorter day lengths (less than 14 hours) and cool conditions of winter in temperate climates. They then flower and fruit as temperatures warm up in spring.

Day-neutral varieties are often used by greenhouse and hydroponic producers, as they can be manipulated to crop out of season if sufficient warmth and light are provided. Day-neutral strawberry varieties are given an artificial “chilling” period to initiate flower and then induced to flower and fruit with warmer temperatures.
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Hydroponic growers can buy chilled runners or plugs (called “frigo” or “pre-conditioned” plants), which have had a period of four to eight weeks under refrigeration (34-37°F). Or, growers may chill their own stock by wrapping the clean runners or small plants in damp paper and plastic, and placing them in a refrigerator for four to six weeks. Either way, the artificial chilling replicates the cold conditions of winter, which is especially great for those in tropical locations or where winters are very mild. Once planted out into the warmth and light, the plants resume their spring growth pattern of foliage development. They flower relatively quickly, followed by fruiting.

While pre-conditioned runners or plugs are available almost year-round in some regions, this type of planting stock is raised pretty much exclusively for outdoor gardeners and thus is often only available in spring. Indoor growers therefore may need to consider raising their own planting stock if they want to produce berries out of season. Strawberry plants are relatively easy to propagate from runners produced at the end of the fruiting season, and there has been a recent development of large fruited types that can be raised from seed.

Hydroponic systems for strawberry production are diverse. With a suitable, high intensity lighting set-up, strawberries can be grown in vertical stacks or towers, which make an impressive display when in fruit. However, care needs to be taken on the lower levels of vertical systems, where light and air flow are often restricted, resulting in lower yields and increased occurrence of fungal pathogens.

The strawberry plant is particularly sensitive to moisture and crown/root rot is the number one cause of strawberry plant deaths. Beginners are advised to try their first strawberry crop in a free-draining, media-based system, such as perlite or a 50/50 coconut fiber/perlite combination. Even rockwool cubes can work, provided they are well-drained. This way, the plant can be easily positioned with the crown just above the surface of the media. Drip irrigation systems are preferred, as ebb and flow can cause salt buildup around the crown, which also leads to problems.

Strawberries can be grown well in nutrient film technique (NFT), aeroponics, and various modifications on these systems, but plants need to be well supported so they don’t slip down into the nutrient flow. Only clean plants—i.e. not those coming...
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While strawberries may be the simplest for new growers to master, the more challenging blueberries, raspberries, and cranberries should not be overlooked as indoor fruit. If grown well, they can be not only highly productive but a real taste sensation.

From soil—should be used so that root rot pathogens are not introduced into the system. Solution warming is useful at 68°F, particularly when starting new plants that have recently been given a chilling treatment. The recommended EC levels for hydroponic strawberries vary depending on the environmental conditions and growing system. EC levels in NFT are recommended to be between 1.4-1.8 mS cm⁻¹, while levels of 1.4-3.0 are more common for those in media. A minimum EC of 1.8 is necessary during the harvest period to maintain good fruit quality from all systems. Running EC and potassium levels at moderately high levels is one way of concentrating both sugars (brix levels) and the aromatic volatiles that contribute to the distinctive strawberry flavor and aroma.
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One of the main considerations when growing strawberries and other berry crops hydroponically is pollination; outdoors, this is carried out by bees, other insects, and the wind. Indoor growers can manually pollinate strawberry flowers with a small hair dryer on a cold setting directed at each individual flower, or by gently brushing the inside of each open flower with a small brush. Hand pollination needs to be carried out every day immediately after the first flowers open to ensure good fruit set as the pollen only remains viable for two to three days after the flowers open.

Cranberries, Blueberries, & Raspberries

Blueberries, cranberries, and raspberries are less commonly grown in a hydroponic set-up than strawberries; however, they are suited to soilless production and benefit from the protected environment of an indoor garden. Cranberries are naturally a bog plant with long, trailing stems bearing fruit. For this reason, they are ideally grown in an elevated system, three to four feet above the floor, where the stems can trail directly downwards. Dwarf blueberry cultivars, which have been bred to grow in containers, are now widely available and can produce high yields of good quality fruit. Dwarf varieties grow to around two to three feet in height and can be pruned to control size. For those with limited space, dwarf blueberries are the most suitable crop as raspberry canes require more vertical space to develop and leaf out. Raspberry canes grow upright. They are tied into place with fruit-bearing stems trained into position and pruned to keep the canopy open for air movement and disease prevention.

Raspberries are categorized into two main types: primocane (fall bearing or everbearing types) and floricane (summer bearing). For hydroponics, primocane types are recommended, as these produce fruits at the top of first-year canes over a long harvest season. They also require less growing space and support than floricane types.

As with strawberry plants, these berry crops are more suited to containerized, drip-fed, substrate-based hydroponic systems. This is both to ensure over-saturation of the root system does not occur, and to facilitate the ability to move the plants when they require chilling or become too large for the space available.

Berry crops don’t require high levels of heat and will grow in similar conditions as many other fruiting plants. Temperatures of 72-74°F during the day and 68-70°F at night are ideal. For maximum fruit quality and sugar levels, the light requirements are similar to those of tomatoes and capsicum, and plants benefit from a long day length to push up the daily light integral.

Nutrition for all berry crops is similar. A well-balanced vegetative formulation is required in the early stages after initial bud break, followed by a bloom or fruiting formulation that is high in potassium once fruit set has occurred.

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earlier in the indoor garden. Also, berries that are protected from birds, insects, and the elements also tend to be larger, of excellent quality, and high-yielding.

Another important aspect of indoor berry growing is the requirement for pollination assistance. As with strawberry, these blueberry, cranberry, and raspberry flowers require pollination to set fruit. Greenhouse growers can purchase small portable hives of bees to carry out pollination, but a small indoor garden will require manual pollination. With blueberries, it can be an advantage to have two different cultivars and to cross-pollinate between these.

Hydroponic berry cropping indoors has become a somewhat new trend, made more feasible by the development of dwarf, compact cultivars and varieties with low chill requirements. While strawberries may be the simplest for new growers to master, the more challenging blueberries, raspberries, and cranberries should not be overlooked as indoor fruit. If grown well, they can be highly productive and a real taste sensation.

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You know the expression “no pain, no gain.” Well, while trimming, pruning, and pinching sound like painful procedures, they are exactly what your plant needs to grow big and strong, says Alan Ray. Here’s how to do it right and why.

GROUND CONTROL

Some plants spread out and remain close to the ground as they grow, while others reach for the sky. These growth patterns are predetermined by nature and when left alone, plants pretty much follow their imprinted programming. However, plants are readily adaptable and can be trained to change direction to better suit their environment and create more space in the garden area.
For example, if you have vining veggies like cucumbers, melons, tomatoes, or squash and you need horizontal space, you could redirect your plants’ growth pattern. Even though vining plants have a natural tendency to spread out, you can get them to grow upwards by staking them or giving them a trellis or wire cage to grow. This easy solution creates more space and helps grow a healthier plant.

WHY PRUNE AND PINCH?
The two most common horticultural techniques for directing your plants’ growth are pinching and pruning. These trimming techniques include the removal of straggly limbs and vines, the deadheading of spent flowers and leaves, and more aggressive interventions like the removal of entire branches. They are also often necessary procedures. These gardening techniques control growth patterns and foliage density, as well as influence the direction in which a plant grows. They also serve to improve the plants’ overall health while increasing the quality of its fruits and vegetables.

IN A PINCH
Pinching is generally less aggressive than pruning and is a hands-on job. To pinch a plant, you must do just what the term implies: pinch. Between your forefinger and thumb, you literally pinch off the smaller flower buds, stunted fruit, suckers, and/or weak leaves. You’ll want to pinch the plants’ leaves right above the leaf nodes on the branch.

What results is a natural compensation. A plant with too dense of foliage will produce less fruit or flowers, and the same holds true in reverse. After pinching, the plant’s energy is redirected to the remaining fruit, flowers, or leaves. If you want a shorter and bushier plant, pinch on a regular basis. It forces the plant to focus on density rather than height.

On food-bearing plants, pinching will result in less produce come harvest time (we’re only talking a few less fruits or vegetables with a small garden). However, the flowers or fruit that do set will be larger, tastier, and often of better quality than those that would have grown if the excess leaves and buds remained on the plant.
“PINCHING young suckers is recommended over snipping them as pinched plants heal faster, thus reducing the chance of disease.”

PRUNING

Like pinching, this technique redirects a plant’s energy. Pruning is proven to increase production, help resist disease, and improve the quality of fruit. Pruning also allows for more sunshine to reach the lower and inner portions of the plant, as well as enhancing airflow, thereby reducing the chance of mold and mildew developing. Pruning is usually more aggressive than pinching and requires tools. To remove gnarly limbs, flowers, vines, and stems, you require a pair of sharp scissors or clippers.

PLANT SPECIFICS

Tomatoes

Tomatoes grow on a vine and its suckers grow off that main vine. These suckers, if left to grow, become full stems. As mentioned, a plant with too many stems focuses too much of its energy toward leaf production. So first, cut back the vines, leaving only one or two. Then for fruit-bearing plants, it is recommended you pinch off a third to a half of all suckers. Pinching young suckers is recommended over snipping them as pinched plants heal faster, thus reducing the chance of disease. With determinate tomatoes, which produce all their fruit in one swift cycle, you’ll want to pinch only those suckers that appear right below your first fruit cluster if you wish to create a stronger plant.
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“PRUNING” the suckers ensures the leaves stay drier, which lowers the chance of infection.

Also, when unsupported, tomato plants tend to spread out on the ground. Down there, any water splashed on the leaves can spread bacteria and fungus and increase the chances of root rot and leaf spotting. Pruning the suckers ensures the leaves stay drier, which lowers the chance of infection. One study involving a Namibian hydroponics system showed unpruned tomatoes were more susceptible to early blight than their pruned counterparts.

On a side note, we have a hung jury when it comes to pruning tomatoes. Most, but not all, experts agree that determinate tomatoes (which produce all their fruit in one swift cycle) don’t really need pruning as they will do what they do regardless. It is generally accepted, however, that indeterminate varieties (tomatoes that produce all season long) benefit greatly from pruning and pinching. Bottom line, it is the gardener’s call to make.

Cucumbers

First, stake your cucumbers on a pole or wire cage; something around four feet tall works well. When the plant reaches the top of the cage or trellis, merely pinch off those fuzzy little tips to maintain its size. (Interestingly, cucumbers that grow curved on the ground will grow straight when hanging).

Squash

With winter squash, hold off pruning until three to five fruits appear, then snip the end of the vine two leaf nodes after the last fruit, using sharp cutters. With summer squash, cut the plant back until four main vines remain. When pinching, experts recommend leaving all the female flowers on if possible, while leaving a few male flowers to remain for fertilization. Also, squash required is a little pinching on occasion to remove the dead flowers or sick leaves.

Herbs

Chives, oregano, basil, thyme, and other herbs flower. Be sure to pinch the buds before they flower or as quick as you can after as some herbs become bitter after flowering.

Admittedly, this is a crash course on pinching and pruning, but the overall technique applies to most flowering and fruit-bearing plants. In general, these procedures allow for better airflow, which reduces moisture, lets in more sunlight, and helps the plant to focus its energy into producing bigger and better tasting fruit, vegetables, and/or flowers while influencing the direction a given plant is growing. A world of more plant-specific information is available online and in your local library that is designed to make this year’s garden your best yet. So, get to pruning those fruit-bearing veggies and herbs because when it comes to gardening, it’s amazing what you can do in a pinch.
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Within the hydroponics industry, there are two main types of feeding regimes: organic and non-organic nutrients. Both these feeding systems pass nutrients into a plant’s vascular system via the roots. There is, however, another way into the plant's vascular system. A secret way in. This secret way is foliar feeding. A commonly overlooked method used in vegetative and flowering stages, foliar feeding allows for nutrients to pass into the vascular system through direct leaf and stem absorption. This can be a powerful ally to supercharge your plants for bumper yields. However, there is a catch. If it is not carried out correctly, it can have such a detrimental effect on your plants that they could be dead within 24 hours.

The Secret Way In:
FOLIAR FEEDING

Besides through the roots, there’s another way to get nutrients into a plant’s vascular system: foliar feeding. But like any good secret entrance, there’s a catch...

by Rich Hamilton
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So, let’s have a look at the dos and don’ts of foliar feeding in the vegetation and flowering stages of your plant’s life.

The Don’ts

DON’T USE A FOLIAR SPRAY WHEN YOUR LIGHTS ARE ON

If you are growing in an environment with a powerful artificial light source, the last thing you want to do is to cover your plant in a liquid while the light is on. The plant cannot absorb the freshly sprayed liquid fast enough. The first thing that’s going to happen is that the liquid will act as a lens, amplifying the heat from the lights and burning the leaf. Second, the plant will choke. Usually, when a plant gets too hot, its stomata open to release heat, gas, and water to cool down. However, it will not be able to breathe or self-regulate if the leaf is covered in a liquid that is causing its surface to burn.

DON’T USE A FOLIAR SPRAY IF IT WILL BE DETRIMENTAL TO YOUR GROWING ENVIRONMENT

Foliar feeding increases the humidity within the growing environment. This is great while your plant is in its vegetative stage, but it can be a problem when your plant is in flower. During the flowering stage, your humidity is already high. Environment is such an important factor in modern hydroponics that I personally wouldn’t do anything to mess it up.

DON’T USE AN OVERLY CONCENTRATED FOLIAR SPRAY

When using a foliar spray, make sure you read the instructions twice and stick to the dilution rates on the label. In fact, I’d even recommend over-diluting the foliar spray just to make sure that you don’t use a mix that could be too strong for your plant (after all, all plants are different).

The Dos

DO USE A FOLIAR SPRAY AT LIGHTS OUT

The best time to use a foliar spray is at lights out. When a plant enters a dark period, its leaves take around 15 minutes to relax. It’s during this time—right after the lights turn off and before the leaves relax—that the stem and leaves are in their most effective absorption period. Spraying your plant at this point also means that it has the maximum amount of time to absorb the nutrients. If you were to spray your plants too close to lights on, the plant could still be wet when the lights come on. This would have the same negative effects on the plant as if the foliar spray was applied when the lights were on as discussed previously.

DO USE PROPER TECHNIQUE WHEN FOLIAR SPRAYING

Cover the plant’s leaves and stem with a light spray. Remember, less is always more, as your plants need to absorb all this liquid before the lights come back on. If the leaves are dripping wet, you have used too much. It may take you a few attempts to get it right. A great tip is to use a foliar sprayer that can be adjusted to expel a fine mist. Again, the finer the mist, the better it will be for the plant to absorb. There are also spray bottles that can be used upside down, which is great for getting into tight spaces and spraying the bottom of leaves.

DO USE FOLIAR ABSORPTION TO YOUR ADVANTAGE

Foliar sprays are great for tackling nutrient deficiencies. For example, if your plant starts to show signs of calcium and magnesium deficiency while you are running a nutrient-rich feeding regime, you could look to use a cal-mag foliar spray at lights off every five days to rectify the issue. This way you don’t have to change your standard feeding regime. This is especially useful if there are multiple plants in your system and only a few are showing signs of a deficiency. The deficient plants can be directly treated with a foliar spray without jeopardizing the other plants’ feeding schedule.

There is a great range of foliar nutrient feeds out there. Some reduce internode spacing in the vegetative stage by creating more branches, some increase the number of flowering sites while the plant is in the flower stage, and some help with the overall health of your plant by combatting deficiencies, pests, and diseases. The list goes on.

So, the next time you grow, consider using the secret way in to help take your plants to the next level.
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Every season has a unique characteristic that separates it from the others. After the rebirth and growth of spring comes the summer heat, and it can often spell trouble for gardeners who want to grow throughout the year.

As most people in the Northern Hemisphere know, summer officially begins on June 21 and ends September 22. In the US, national temperatures vary throughout the season, but overall it’s hotter than the rest of the year. While more northern states may not feel the brunt of the heat, southern regions suffer the highest temperatures. High temperatures coupled with long periods of direct sunlight can scorch gardens, leaving them withered and crispy. Most vegetables suffer adverse effects from temperatures of 85°F and higher. However, gardening is more than possible during the hottest days of summer; it just takes extra attention, effort, and heat-resistant plants. It’s critical to understand the summer threats to your garden and how to avoid them.
What to Avoid

First, avoid using cool weather vegetables. Usually green and leafy vegetables such as kale, broccoli, lettuce, and cilantro thrive in cooler environments or during the fall and winter seasons. Utilize tools like the USDA Hardiness Zones map to identify what zone you are in and identify which vegetables prefer those temperatures.

Direct sunlight is essential for most plants, but your garden’s exposure to prolonged direct sunlight needs to be carefully monitored. Extended periods of direct exposure during the hottest months will dry out your garden at an accelerated rate. If soil remains dry for extended durations of time, cracks can form in your produce. More specifically, these cracks in the vegetables’ skins are symptoms of repeated dehydration and rehydration of the soil, which can easily happen during the summer months.

Wilting is another sign, though less serious, that something isn’t right in your garden. Gardeners who can catch their plants wilting have time to water and save them. (Also, keep in mind that leafy plants can wilt a little during the day’s peak heat, in which case there is nothing to be done except wait.) Wilting may be unavoidable, but don’t make the mistake of wetting your plants leaves in hopes to relieve them. Water on plant leaves and stems, compounded by the heat, invites fungus, mold, and bacteria to form. Additionally, the water acts as a magnifying glass and intensifies the sun’s effects. Contrary to popular belief, watering your garden isn’t about wholly showering plants from top to bottom. To safely and more effectively hydrate your plants and relieve them from the heat, water at ground level.

“HIGH TEMPERATURES coupled with long periods of direct sunlight can scorch gardens, leaving them withered and crispy.”

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Preventative Measures

Avoidance is only half the battle. Knowing how to prevent the summer's heat from overwhelming your garden is the other. Maintaining a 90°F environment can be accomplished through a combination of shading, consistent watering, and weeding.

The golden rule is to keep your soil moist. Maintain moisture throughout the soil by watering up to twice a day if necessary. Water in the morning when the water can best infiltrate the soil and again in the late afternoon if the soil is feeling crusty. Water at the base of the plants for maximum absorption.

As mentioned, watering your plant's leaves can be more damaging than beneficial. Instead, shade your garden with a maneuverable protective screen, which saves water lost to evaporation and can reduce the temperature surrounding your garden by 10 degrees. A white sheet, netting, or something akin to a porch screen will afford your garden an appropriate amount of protection without overdoing it. Just make sure the shade is placed a few feet away from the plants to allow for airflow.

Finally, reduce the competition. Your garden is full of thirsty roots, competing for every bit of water they can find. Unwelcome weeds can sprout up and siphon water away from your preferred plants, slowly choking them to death. To combat this, simply pull out weeds when you go to water your plants before too many can take root. A little work here and there will produce better results than waiting for your garden to be consumed.

Recommended Plants

All avoidance and preventative methods may mean very little if you're trying to grow the wrong plants within the wrong season. Some plants simply won't grow in certain temperatures, so choosing what your garden will be comprised of is important.

Tomatoes, corn, and squash are great vegetables for the summer months. In fact, they thrive in higher temperatures. They still need shade, water, and general maintenance, but these vegetables are genetically built to manage the summer heat.

Gardening during any season has its challenges, but summertime can be one of the most brutal. Heat dries up the soil and burns a plant's sensitive leaves. However, the secrets to growing during the hot summer are simple: keep your plants shaded and well hydrated.
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The general mindset is that the ingredients are the most important factor in determining whether a fertilizer can be considered sustainable. While there is no doubt that the ingredients play a major part in the level of sustainability of a given fertilizer, it doesn’t stop there. We must also consider how we use said fertilizer, as well as our method of waste disposal.

It is important to keep in mind that “sustainable” does not necessarily mean the same thing as “organic” or “natural.” Within the realm of modern growing, sustainability refers to how well the inputs and processes of a grow maintain an adequate level of production to meet demand while preserving the integrity of the environment and protecting consumers. It is driven by a minimalist approach of using only what is needed to reduce waste.

**Ingredients**

Those advocates of the organics movement would say it’s important for a sustainable fertilizer to be made of organic materials. While that’s not necessarily false, you must remember that organic isn’t the same as sustainable. When measuring the sustainability of a product, you also must consider the potential toxic trace elements contained in the fertilizer’s ingredients. Take organic rock phosphate, one of the most ubiquitous sources of phosphate-based fertilizers, for example. This ingredient can contain high levels of arsenic. If not used properly, fertilizers containing it can possibly cause the accumulation of heavy metals. Growers should also be conscientious of their waste management practices to help preserve the environment (more on that below).
On the opposite side of the spectrum, there are plenty of synthetic fertilizers available that are safe and sustainably driven. When choosing one, avoid fertilizers that include any non-essential plant ingredients such as dyes and perfumes. Plants can’t take up unnecessary ingredients, which tend to end up as waste that is diffused back into the environment as potential contaminants.

Synthetic nutrients can be compared to many dietary supplements that people use in addition to the meals they eat throughout the day to achieve proper nutrition. When you use both organic and synthetic fertilizers in gardening, this is referred to as integrated nutrient management. This method, which can take some knowledge and practice to dial in, has the goal of optimizing the plants’ feeding schedule to a level that is most sustainable.

Another buying-point to look for in a sustainable fertilizer is the concentration levels and nutrient ratios of the formula. Blends that are highly concentrated are typically considered more sustainable as they require less water to manufacture. This point only holds true, however, if the nutrient ratios have been methodically calculated by the manufacturer. These formulas should be 100 per cent water-soluble so plants are able to uptake them without any additional products or potentially locking out selective ions due to inadequate mineral ratios. Multiple-part, crop-specific, and stage-specific formulas have the most potential for higher levels of sustainability due to the points mentioned above.

**USE AND DISPOSAL**

No matter if you grow in soil or hydro with organics or synthetics, there is a shared goal of reducing waste and potential environmental contamination. For those growing in a sterile, hydroponics setting, sustainable nutrient management is rather simple. Assuming you have chosen a nutrient regime per the standards above, the next step is knowing what to do with the unused nutrient solution. One relatively easy, sustainable technique involves running the unused nutrient solution through a reverse osmosis filter. The filter catches the leftover minerals, leaving the water virtually clear of particles. Once the filter becomes saturated, it can be discarded or taken to a hazardous waste disposal facility.

For those growing in soil, there are a few extra precautions to consider. As touched on before, nutrients and their possibly toxic by-products can build up in the soil over time. For container gardeners, it is wise to leach the soil during and at the end of each grow cycle to remove the salt buildup that could cause nutrient imbalances—which could negatively affect the production level of the crop.

To achieve sustainability while using fertilizer, it is not only important that growers remain conscious of their products’ ingredients, but they must find ways to optimize their production with sustainable techniques that have been tailored to accommodate all of their inputs and unique practices.
Engineer and efficiency expert Mel Bartholomew reinvented the backyard garden in the mid-1970s when he developed the concept of square foot gardening. It's a concept that still holds water today and is practiced by gardeners around the world. A little more than a year after Bartholomew’s death, Sara Elliott revisits why square foot gardening is so successful.

That lyrical inch worm measuring the marigolds has a nostalgic kinship with a square foot garden (SFG)—incremental tick marks play a big role in one of the most popular cultivation methods to hit backyards in the last few decades. The concept that small is beautiful and efficient has impacted political theory, the housing market, and even the backyard vegetable patch. Grab a ruler and let’s take a closer look at how thinking outside the row, and inside the grid, can help you construct a better plot in a smaller space with less work. Oh, if you happen to be a traditionalist when it comes to plants, leave your doubts at the gate. This isn’t your granny’s garden.

**THE WHO AND WHAT OF SQUARE FOOT GARDENING**

Mel Bartholomew, construction engineer and efficiency expert, is considered the father of square foot gardening. His reinvention of the backyard garden began in 1975 when he retired, moved to a new home, and started devoting his spare time to his own plot of land. Dissatisfied with the traditional row planting method used in agriculture and backyard “victory” style vegetable gardens, he began experimenting with other growing methods. Through trial and error, he discovered he could grow more plants in a smaller footprint while reducing his labor and efficiently using resources like water. To provide adequate nutrition to his crops, he developed a recipe for a lightweight, compost-rich, water-retentive growing medium made up of ingredients that could be sourced at any local garden center. This foray into organic, smarter gardening resulted in a best-selling book on the subject in 1981 and an equally popular public television series later.
THE FRAME

A SFG is pretty distinctive. It’s made up of an elevated box frame filled with a nutrient-rich media and outfitted with a gridded overlay. This frame can be made of wood, vinyl, cinder block, or stone. Basic units are available prefabricated, or they can be cobbled together in an afternoon from 1x6-inch untreated wood, deck screws, and lath strips.

The most popular overall size is 4x4 feet, with a height of six inches, but that can vary. Since an adult has an arm’s reach of about two feet, a 4x4-foot frame would allow for access from all four sides. For a frame with limited access, such as one positioned against a wall or fence, the width would max out at two feet. You get the idea. Although the width is limited, the potential length of a SFG isn’t. Frames of 4x8 feet and 4x12 feet are also popular. Many square foot gardeners use multiple box frames.

You’ll notice the height of a normal box frame is only six inches. That’s not a typo. Since the media provides all the nutrition plants need, hungry roots don’t have to dig deep to find sustenance.

The basic principle is to create a frame that can be separated into 12x12-inch squares using lath strips, rope, or other materials. Each square defines the growing space for an individual plant variety. A classic 4x4-foot SFG frame contains 16 growing squares. You’ll notice the height of a normal box frame is only six inches. That’s not a typo. Since the media provides all the nutrition plants need, hungry roots don’t have to dig deep to find sustenance. The exceptions are root crops, like potatoes and carrots, which will need a box height of eight to 10 inches. This height factor is one of the most controversial aspects of square foot gardening.
A Grid for Success

Nothing distinguishes the SFG as vividly as its grid. You know each box frame is divided into equal 12x12-inch squares, but don’t put your ruler down yet. Every square is then further divided, without an additional grid, based on the estimated size and plant variety it will contain. For example, one square can accommodate a single tomato plant, or it can house four strawberry, lettuce, or potato plants that only require six inches of space between them. That same square can be home to nine bush beans or 16 evenly spaced carrot, bunching onion, or radish plants.

Here’s a quick cheat when determining strategic SFG plant spacing:

- Six inches apart: four plants per square (two rows of two)
- Four inches apart: nine plants per square (three rows of three)
- Three inches apart: 16 plants per square (four rows of four)

You can typically place plants closer together than the recommendations on seed packets or seedling labels because they won’t be competing for resources. Overall height and bushiness at maturity do matter, though. We’ll discuss this in more detail in a moment.

This idea isn’t as revolutionary as it may seem. Gardeners have been making tight quarters more plant-friendly for centuries with the creation of window boxes and container gardens. This idea may also resonate with indoor gardening enthusiasts who employ hydroponics and other modern cultivation technologies to grow more plants in smaller spaces.

The Location

Once assembled, a SFG can be positioned on any surface that drains well. This includes lawn and unwelcoming soil. Because the media provides all the nutrients plants need to thrive, the composition of the underlayment isn’t very important. It is a good idea to put down weed cloth as needed, though, and to avoid placing a box frame where its freight of plants will be in competition with tree roots. Other good gardening principles apply as well, including choosing a spot with eight to 12 hours of light a day that’s out of the wind and doesn’t become boggy after a rain.

Frame spacing is also a consideration. Even though one of the big promises of square foot gardening is its ability to produce comparable yields in only 20 per cent of the space of a conventional garden, maintenance and harvesting still require access, which means creating space around one or more box frames.
What’s the best width for an access path? That would be about 36 inches. If you’re tempted to go narrower, remember plants will often extend somewhat beyond the borders of their frames as they mature. If you don’t want to wrestle with greenery all summer, give yourself enough space. Remember, you won’t be stepping into the boxes. That’s a good thing because you won’t be compacting the media, but it also makes planning efficient access more important.

THE FORMULA

The “soil” is arguably the most important component of a SFG, and over time, Mel Bartholomew changed his thinking about how to manage this element of his growing plan. In his first book, he recommended excavating a six-inch depression for the frame box and fortifying the excavated soil with amendments that would contain great nutrition, good moisture retention, and adequate drainage. When added back into the box, the treated soil would produce a 12-inch deep bed ready for planting. He eventually changed this approach to eliminate the garden soil requirement completely and reduce the bed’s overall depth to six inches. This change not only reduces labor, but it makes it possible to install an SFG almost anywhere there is good drainage. It also allows the gardener to create a consistently reliable, lightweight, pH-neutral mixture regardless of soil shortfalls and challenges, as well as reduces problems with weeds and soil borne pests and diseases.

The mixture itself is designed to be straightforward. It contains three ingredients measured by volume:

- 1/3 peat moss
- 1/3 vermiculite (coarse grade)
- 1/3 blended compost

This is a general purpose, no-fuss blend that provides good nutrition for most plants. Let’s take a closer look at these three ingredients.
Peat moss - The use of peat moss may raise eyebrows. It is not a renewable resource, and you may have a philosophical prejudice against using it. Once an SFG is established, though, it can be replanted season after season with little or no peat moss replenishment.

Vermiculite - Vermiculite has gotten some bad press in the last few years. It is mined in areas that may also contain asbestos, and there have been reports of asbestos contaminated vermiculite in the past. All processing is now regulated, so vermiculite supplies are widely considered safe to use. If you still have reservations, perlite is an acceptable alternative. Both retain moisture well and are sterile and inert.

Compost - The recipe calls for “blended” compost. This simply means compost from a variety of sources to maximize the number of nutrients in the final blend. Some options are worm castings, chicken manure, and mushroom compost. Check labels to make sure you’re getting a broad selection.

Of the three ingredients above, vermiculite is likely to be the hardest of the three ingredients to source, especially the coarse, agricultural-grade form that has the best water retentive properties. If you can’t find it at your garden center, it’s probably available through special order. When all else fails, you can purchase it online.

How much of the mixture will you need? A standard, 4x4-foot, six-inch high box frame will require eight cubic feet of the soilless blend.

If making this recipe yourself seems like too much work, special pre-blended SFG soil products are available.

THE PLANTS

Growing plants in a tight space has advantages, but it also presents some unexpected challenges. For sprawling specimens, regular pruning will be necessary. It’s also a good idea to add a trellis or other support to your box and choose at least a few vining plants or other varieties you can train to grow up instead of out. This makes general maintenance and harvesting easier. Placing taller plants in the northern-most section of the grid will also give shorter plants better access to sunlight.

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To further maximize space, consider staggering planting times. This way, some plants will always be immature, so the frame will be less crowded. A side benefit is that you’ll be able to enjoy lettuce and other fast-maturing produce and flowers all season.

IRRIGATION

Although the soil blend used in square foot gardening is moisture retentive, the mixture is still porous and lightweight, which can cause it to dry out more quickly than amended garden soil, especially during hot weather. A drip irrigation system works very well with an SFG set-up, but almost any watering strategy will do as long as it can adapt to weather changes and the increasing water needs of maturing plants. It’s important to keep an SFG uniformly moist at all times. Once it becomes dry, the porous mixture requires more water dwell time to rehydrate, making daily short duration watering less effective. During high summer, daily or even twice daily watering may be necessary in some locations. To reduce watering requirements and better accommodate plants with large root systems, some gardeners have modified the basic SFG model by electing to build deeper box frames. Popular options are 10 inches and 12 inches.

FERTILIZING

One of the benefits of square foot gardening is that fertilizing isn’t necessary. Adequate nutrition for the growth cycle of most plants is incorporated into the initial set-up. Further augmentation isn’t necessary for the course of a growing season. Before starting a new crop, or while preparing for a new season in a perennial garden, just add more compost.

WEEDS

Because the special media blend in an SFG is free of unwanted seeds, a new set-up requires little or no weeding, although second and subsequent seasons may see more weed problems. At the seedling stage, it’s easy to spot uninvited plants and eliminate them. Later, plants grow so closely together they tend to discourage weed growth.

PESTS

Pests can be a problem in any garden. Because a SFG gets crowded, it can be harder to detect pests early. Companion planting is a popular option, but it’s also important to take the time to inspect plants regularly and deal with outbreaks using organic or chemical treatments sooner rather than later. Because this type of garden takes up such a small area, it can be easier to add cover fabric or protective mesh framing, deterrents that would be unrealistic in a larger garden.

Even if you’ve never held a shovel or picked a ripe tomato, you’ve probably heard the term “square foot gardening.” It’s part of our modern lexicon and an example of how efficiency can improve just about anything, including the alchemy of growing a radish. If you don’t think a melon can flourish in six-inch deep soil or a squash plant can reign supreme in cramped quarters, Mel Bartholomew spent decades before his death in 2016 proving those very things were possible. He showed gardeners around the world what one square foot of growing area can yield with the right strategy, and that thinking small with big intentions can be one of the most resource-, time- and labor-saving ways to garden. Have you tried square foot gardening yet? If not, what are you waiting for?
As more of our food and herbs are grown through various hydroponic techniques, the question of which method—soil or hydroponic—most efficiently produces the healthiest plants that feature the best flavor and nutrients. Frank Rauscher is here to break it down.

WHAT IS A SOIL GROW?

Technically, soil is comprised of sand, silt, clay, and a sufficient amount of organic matter. Potting soil—which contains only a very minute amounts of actual soil particles, if any at all—is instead comprised of aged and green organic matter, with varying amounts of perlite or vermiculite, and some added plant nutrients. Many gardeners who grow in pots or raised beds are doing so in a potting soil grow media and would likely characterize it as growing in soil, not hydroponically, but it could technically be considered a “gray area” between the two growing techniques.
Before we begin comparing the two categories, it’s important to clarify just what we are calling hydroponic and what we are not. The decision often breaks down to whether plants are being grown indoors or out. However, this classification misses many significant points. If based on the original idea of the absence of true soil particles, this would improperly group many techniques incorrectly.

One aspect of hydroponic growing that is commonly noted is the increased control over various aspects like temperature, nutrient concentration, and even root-zone oxygen. This can be accomplished inside a grow tent or many types of greenhouses, but not really outdoors. The variation of nutrient concentration can most quickly be accomplished in deep water culture (DWC), as compared with other grow medias. This is due to the residual nutrient level in other-than-water type media remains and any change in that level is stabilized. In DWC, the entire reservoir can be rapidly changed over and the resulting nutrient formula completely different.

Let’s compare DWC with old fashioned “grow in the dirt” outdoor agriculture, which are probably the two extremes of hydroponic-versus-soil grow techniques. This dirt, we can assume, includes a good supply of organic matter in addition to the traditional soil particles.
KEY TO UPTAKE IS A LIVING GROW MEDIA

With either of these two techniques, there are some very critical parameters that will determine plant taste and human nutrition quality, in addition to plant vigor and health. A “living soil” is essential to obtaining the best results from our soil garden. The beneficial microbes, fungi, and bacteria that multiply and work in our garden are essential to plant nutritional uptake, and hence flavor, as well as nutritional output. The same is true of DWC—we need liquid nutrients continuously flowing past the root system to be alive with beneficial microbial life to assist in the development and uptake of vital plant nutrients.

Mycorrhizae fungi are an essential part of a root system’s ability to take up more nutrients from whatever grow media the roots live in. Bacteria are required to convert many nutrients into an available form. Within water culture, these fungi can be introduced but until they have attached to actual roots they do not increase in biomass. These microbes also require a consistent and adequate supply of available oxygen to survive. It does not take long for the vital microbial life to die off in the absence of oxygen.

Though flavor is to a great degree inescapably subjective, there is a science behind what impacts it. Tissue samplings can verify the nutritional content of a vegetable, removing the subjectivity aspect for the health aspect. Nutritional content within the plant root system will be directly related to the nutritional content of the plant tissue.

TASTE

If we are to review the “taste” aspect of the soil versus hydroponic question, we will need to look at just what makes the fruit or leaf of a garden crop taste good. What nutrients within a leaf, fruit, or root create the desirable flavors that most people want? We need to consider that the senses of taste and smell are subjective.

The primary flavor categories are: astringent, bitter, pungent, salty, sour, and sweet. The aspect of sweetness is easily measured within the roots or leaves of a plant. The rating factor for the level of these sugars, called brix, can be measured by a refractrometer.

Among the some of the other aspects of flavor is pungency or “how hot and spicy.” With peppers this is a major point, and to measure this, we look at capsaicin content. For this factor, a high-performance liquid chromatography measurement is taken and rated in Scoville heat units (SHU).

“THE BENEFICIAL microbes, fungi, and bacteria that multiply and work in our garden are essential to plant nutritional uptake, and hence flavor, as well as nutritional output.”
Sour foods are generally acidic. This quality can be measured, but it’s tricky. Sour does have other chemical properties and some foods can be acidic because they are pungent. Many people do not like to eat their vegetables, their phytonutrient content can make them bitter. These seem to have been produced by the plant though its evolution for self-protection. These phytonutrients are things like phenols, flavonoids, isoflavones, terpenes, glucosinolates, and other compounds that can help fight off cancer and produce positive health effects, but may not appeal to our sense of taste. Healthy plants produce more of these; this is what gives them the ability to fend off pests. Because of this bitterness, many large food suppliers or growers have sought to breed a lower level of these nutrients into their crops to improve desirability and hence sales. Though calcium is vital for the health of plants and humans, its content in veggies has also been thought to increase bitterness. A reduction in the supply of calcium to a plant will reduce its calcium content and lower bitterness, but is it appropriate to reduce calcium? Whether we realize it or not, the aspect of bitter within a vegetable adds to the overall richness and enjoyability of food and can balance out a dish that would otherwise be too sweet or salty.
What may cause a plants natural flavor to be amplified?

The healthier a plant is, the more of its natural chemicals and flavors will be exhibited. To say one technique of growing (soil or hydro) produces a less-bitter flavor than another takes this issue in the wrong direction. Bottom line: to obtain the maximum flavor and the healthiest produce, it is important to obtain optimum plant vigor by providing all the necessary nutrients.

Using the same soil to grow the same crops year after year diminishes the productivity of the crop as well as its flavor. The major cause of this is depletion of essential micronutrients in the soil, as well as the likelihood that microbe variety and count may have diminished. Remember that the life within the grow media is key to plant nutrient uptake. Various bacteria and fungi need to work symbiotically with the plant roots to produce vigorous, healthy, tasty produce.

System comparisons

The microbiology within the grow media is just as important no matter which system (soil or water) we choose. Though DWC offers the opportunity to quickly measure and adjust the nutrient mix and microbial life forms, it also requires a continual awareness of what is going on within the media. A healthy living soil media is much slower to respond to any change you make; because of this, maintaining stability can be easier.

Controlling nutrient levels and media microbiology is the essence of producing optimum flavor and health benefits. Ambient air and media temperatures also contribute to these factors, and these aspects can be controlled better in hydroponics. In the correct season (provided local climate allows), soil grows will typically neutralize this benefit to a great degree.

Anecdotal reports on flavor or health benefits on each of these growing techniques will continue to be debated (see reference QR link at the end of the article). As time and controlled studies continue there will exciting new things to learn. Current science would seem to indicate that either method can be used for optimum flavor and nutrition, when operated properly. Picking the technique that matches a particular grower seems to be the most important choice. How much time and expertise does the grower have available? Is the climate where the grower is located going to provide the necessary conditions for optimum plant health and vigor? As for the possible conflict between providing optimum health or best flavor, this is the growers decision and subsequent efforts that make the difference, not really which of these systems is used.
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Because of how the global food supply works, fruits and vegetables found in the grocery store are not as nutritious as they used to be. While not the silver bullet to solve the entire problem, hydroponics can play a role by providing healthier food, conserving resources, and reducing emissions.

According to the G7 Summit, the world’s population will exceed nine billion people by 2050, with most of the growth coming from developing countries such as China and India, as well as the continent of Africa. To keep up with this anticipated demand in food, production will have to increase by 70 per cent.
Dwindling resources will require innovation within the agricultural industry if this demand is to be met. Traditional farming practices use large amounts of resources, such as land and water, and leave a large environmental impact. It is estimated that 550 billion liters of water is wasted annually on crop production and areas once rich in resources now have limited supplies. So, what can be done to ensure future generations are left with the resources they need to grow enough food?

Trains, Planes, and Automobiles

The journey many of our favorite food staples such as tomatoes, lettuce, peppers, leafy greens, and herbs take to reach our local supermarkets can be a long and sometimes strange one. Often, hundreds of miles are traveled to get from farm to table. A study conducted by the Leopold Center for Sustainable Agriculture in Iowa compared the distance traveled between produce sold through Chicago’s Terminal Market, where bulk quantities of produce are sold by brokers, and a local farmers’ market (Ferry Plaza Farmers’ Market in San Francisco, CA). The study’s findings might be a surprise to many consumers:

<table>
<thead>
<tr>
<th>Produce</th>
<th>Terminal Market</th>
<th>Ferry Plaza Farmers’ Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>1,555 miles</td>
<td>105 miles</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>1,369 miles</td>
<td>117 miles</td>
</tr>
<tr>
<td>Grapes</td>
<td>2,143 miles</td>
<td>151 miles</td>
</tr>
<tr>
<td>Beans</td>
<td>766 miles</td>
<td>101 miles</td>
</tr>
<tr>
<td>Peaches</td>
<td>1,674 miles</td>
<td>184 miles</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>781 miles</td>
<td>98 miles</td>
</tr>
<tr>
<td>Greens</td>
<td>889 miles</td>
<td>99 miles</td>
</tr>
<tr>
<td>Lettuce</td>
<td>2,055 miles</td>
<td>102 miles</td>
</tr>
</tbody>
</table>

"THESE LONG distances traveled by food consumes large quantities of fossil fuels and emit great amounts of carbon dioxide."

It is estimated the average American meal travels 1,500 miles to its end destination. While this long distance may be a necessity for some crops, there are many instances where locally grown produce is available but still imported due to price, quality, and availability. Apples grown in New Zealand may be imported and sold in San Francisco, right next to the city of Sebastopol, known for its apple production. Sugar cane grown in Hawaii is processed in California, packaged in New York, and then shipped back to Hawaii, where it’s sold to consumers. These long distances traveled by food consumes large quantities of fossil fuels and emit great amounts of carbon dioxide. Our food transportation system currently consumes 20 pounds of fossil fuel for every two pounds of energy we receive as food. Globally, shipping food accounts for 30 per cent of all carbon dioxide emissions.
To prepare for the long journey from farm to table, produce is often picked unripe, as ripening produce will rot during transport. Farmers prevent this by picking tomatoes green off the vine and utilizing GMO seeds that do not contain the naturally occurring ripening chemical ethylene. By not allowing produce to ripen fully on the vine, much of the nutritional value and flavor is lost. This is the reason why supermarket tomatoes taste dull in comparison to those bought locally at farmers’ markets. Once unripe tomatoes reach storage, they are sprayed with artificial ethylene to trigger the ripening process, and it is here that they will sit for two to three weeks in cold storage before being shipped to supermarkets hundreds of miles away. Sanitizers and fungicides are also applied liberally during storage, again to prevent rotting. Taste, texture, and nutritional value begin to deteriorate, and it is said that canned and frozen produce (tomatoes, peas, corn, etc.) have more nutritional value than fresh produce, as they are allowed to naturally ripen before being processed.

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Viable Alternative?

Many within the agriculture community say they believe that hydroponics is the key to providing communities with locally sourced, fresh, and nutritious produce year-round. Although not a new concept, big agriculture has been reluctant to adopt hydroponics as a viable production alternative. But continual advancements of technology has brought hydroponics back into the discussion as a solution for the issues currently facing big agriculture.

Controlled environment agriculture (CEA) can be a viable alternative that can change the way we currently source our produce. Regions such as inner cities that cannot support traditional forms of agriculture can utilize CEA technology to provide local communities with fresh produce that would normally have to be shipped long distances. CEA farms can be located virtually anywhere and offer many advantages over traditional agriculture. Plants grow more densely—on average 500 square feet of hydroponics can produce 850 heads of lettuce, compared to 500 heads for soil farms of the same size. The quality and consistency that CEA produces eliminates much of the waste also associated with traditional agriculture, by producing desirable or shelf-ready produce regularly. Being able to grow throughout the year and having an extended growing season prevents shortages, provides predictable supply, and prevents price fluctuations. Less water is also utilized, anywhere between 60-90 per cent on average depending on growing method. Advancements in greenhouse technology is allowing hydroponic growers to utilize hybrid systems that take advantage of natural sunlight and renewable energy.
Although utilizing hydroponics may seem like a no-brainer, there are still obstacles this form of agriculture must overcome if it is to become a viable alternative to traditional farming methods. Financial limitations can be a deterrent as significant investment in pumps, lights, filters, fans, electricity, and nutrients must be made in addition to the common equipment required of traditional farming. Expert knowledge of hydroponic farming (chemistry, botany, plumbing, and farming) is a necessity and finding individuals with the required experience can be a challenge for many operations.

“BEING ABLE to grow throughout the year and having an extended growing season prevents shortages, provides predictable supply, and prevents price fluctuations.”

Controlled environment agriculture grown produce can also be more expensive, as the cost of running lights and other equipment must be considered in the final produce cost. But all is not lost. There are many pioneers throughout the world that are blazing the trail and pushing the limits on how we source our food.
“Although utilizing hydroponics may seem like a no-brainer, there are still obstacles this form of agriculture must overcome if it is to become a viable alternative to traditional farming methods.”

Hydroponics in Action
Located in New York City, Bowery Farms has become a poster child for locally sourced, sustainable agriculture operating in an urban environment. Its use of Controlled Environment Agriculture allows the farm to grow high-quality produce without the use of GMO seeds, chemicals, and pesticides, while also using up to 95 per cent less water than comparable forms of traditional agriculture. For Bowery Farms, vertically integrated hydroponics is the name of the game and allows staff to utilize automation technology to ensure quality and consistent product is shipped out daily. Full spectrum LED lighting line the facility, while monitors ensure lighting, nutrient strength, temperature, and humidity are at ideal conditions. Data is collected daily and sent to operators for any needed adjustments. Bowery Farms currently provides fresh produce for grocery chains Whole Foods Market and Foragers, while also supplying several local restaurants. Its produce line up currently includes baby kale, red and green lettuces, butter head lettuce, arugula, kale mixes, and basil. Each crop is tended to by hand and only harvested at peak conditions, ensuring the best flavor and nutritional value. All their products travel no more than 10 miles to their final destination.

Sundrop Farms, located in South Australia, has become a world leader in large-scale hydroponically grown agriculture. With the use of technology, it has taken a barren and harsh environment where traditional agriculture wasn’t possible and built a state-of-the-art facility that operates on sea water and renewable energy sources. Seawater is pumped from the Spencer Gulf into large tanks where thermal desalinization technology turns this unusable water to fresh water. Four, 12-acre greenhouses receive their operational energy from 23,000 mirrors that reflect the sun’s energy onto a central point, efficiently harnessing the sun’s power. Growing methods consist of coco coir blocks fed off a recirculating drip system. Much like other forms of large scale agriculture pests can become an issue, Sundrop Farms only uses beneficial insects and other natural means of dealing with these intruders, ensuring no residual residue is present after harvest. The company’s self-sufficient greenhouses are not affected by the changes in weather, drought, or energy that have impacted Australian agriculture in recent years, which allows it to operate on a single season production model. This results in produce with consistent quality and stable pricing arriving on Australia’s grocery shelves year-round. Currently, Sundrop has an exclusive 10-year contract with Coles Supermarkets, producing two truckloads of tomatoes each day and providing Australia with 15 per cent of its tomato supply.

Although there is much to be done and accomplished if hydroponically grown produce is to become a regular option on supermarket shelves, the future is bright and opportunity abounds for those willing to take the risk and become leaders in what has been a stagnant industry for years. With any luck, the food we love and cherish won’t have to travel so far to our homes in the future.”
Appraising his realm, under 200 lights Mr. Nova Green inspects the stages of his crop from clones through harvest. A moment to take it all in, from making the soil to hand selecting the nutrient inputs, and chasing it through until he has the perfect harvest and the perfect trichome production.

Meanwhile... so simple and so shadowy, to be carried air-borne through the ventilation system in the water, or on someone’s clothing...

waiting in dormancy for optimum conditions to strike! parasitic fungi wreaking havoc or bacterial invasion... very patient attackers searching for the open wound?

blind-sided by the sneak attack, striking the young and weak first the infection will spread to stems...buds...feasting everywhere, what will the damages amount to $$$$!

These noxious pests are susceptible. Do have weakness. Can be brought down. But not by a chemical weapon! Extracting a powerful OMRI certified rhizosphere bacteria companion® biological fungicide. There seems to be a glimmer of hope.

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So, you’re thinking about engaging in one of the oldest livelihoods in an area where there is very little arable land. Here are a few things you should know about urban farming before reaching for the shovel.

Urban farming is a fast-growing movement, especially in cities that have been devastated in recent decades by the departure of industry and the real estate crises. The practice lends itself to all kinds of beneficial social and economic activities, and it can truly be a force for good. Initiatives like community gardens can often tie a community together. It introduces fresh, healthy, locally produced food into food deserts, which are areas where there is limited or no access to healthy food. It can lead the way towards economic revitalization by providing jobs, even if only for the farmer. It can also serve as an educational instrument, with community classes centering on proper cultivation, harvesting, storage, and preparation of foods grown in the city’s fields. Finally, urban farming is also a great use for acres of vacant lots that most cities have and would love to stop paying for their upkeep.
Urban farming has environmental benefits as well. With all the steel, concrete, and asphalt in a modern city, there is often very little to buffer the absorption of heat and few places where carbon can be captured. Urban farms allow for carbon sequestration and can offer some buffering against the heat island effect of cities. Also, the more living foliage there is in the form of city crops, the more oxygen that is released back into the air.

Urban farmers must be both practical and creative with their use of space. Many urban farms are multi-faceted due to their restricted sizes. On the same property, there may be 5,000 square feet of raised production beds, a limited footprint greenhouse, a bee hive in the corner, and a few chickens running around. However, some farmers keep it simple. Some urban farms could just be focused on the production of greens or storage crops that can be grown in cooler weather and extend the season. Some may be entirely devoted just to small animal production, while others may produce honey and beeswax products. Cut flowers also provide an opportunity for a different type of farming.

Of course, municipal zoning laws also play a part in deciding what kind of urban farm you can start. There is often little restriction on growing food crops in your own backyard, but you might need to have a chat with city hall once you start considering adding animals or converting your front lawn into raised production beds. Before attempting anything, a trip to a council meeting or a visit to the city office where zoning codes are kept on file is a must. You do not want to put your time and treasure into an urban farm only to have it shut down because zoning laws don’t allow for it.
MANY URBAN FARMS are multi-faceted due to their restricted sizes. On the same property, there may be 5,000 square feet of raised production beds, a limited footprint greenhouse, a bee hive in the corner, and a few chickens running around.

obtained cheaply. Sometimes banks also offer vacant lots that previously had foreclosed homes on them. Other options may include renting cultivatable space from other businesses or non-profit organizations. Your county’s cooperative extension service may be a resource to start with if you are having difficulty locating land to start your agricultural endeavor.

Once you’ve obtained your urban land, there are a few things you need to do before starting a farm. Lots, especially those that previously had houses upon them, must have their soil tested for a wide range of toxins and contaminants that could still be lingering from old paint, pipes, and insulation. It is not uncommon for lead to be found in high levels in urban soils.

However, having lead or other toxins in the soil is not necessarily a non-starter. You could pay to have the contaminated soil removed and new soil brought in, but there are options to grow above the soil. A non-permeable barrier could be placed above the contaminated ground and a planting bed built upon it. It is imperative that there be no possibility of comingling the new soil with the existing soil. As time goes on, the existing soil can be retested at regular intervals to determine if the contaminants have left or been reduced to safe levels.

The water or public works department in most cities allow for obtaining permits to use fire hydrants. For a fee, a meter is placed on the hydrant so that the amount of water used can be recorded and charged for. While not impossible to work with if it is the only option, other opportunities should probably be explored first. If the land you’re farming is adjacent to another residence, you may be able to strike a deal with the homeowner. If they allow you to use their water, they may agree to be paid with a portion of your produce or accept a nominal fee to offset the increased cost on their water bill.

Lastly, if you intend to incorporate animals in any capacity, even just worms for compost or bees for increased pollination, you will probably require a permit of some kind. Many cities, to their credit, have relaxed rules regarding the raising of livestock within city limits due to the increased interest and demand for more urban farming. Cities can place limits such as the number of hens, roosters, rabbits, etc. you may have on your farm. Most restrict larger mammals, but perhaps you can be granted a variance if you can demonstrate how having a goat or a sheep would help your business and the community.
Now that the logistics have been addressed, you will need to determine your market (if you plan to sell your produce, that is). You don’t want to grow prize-winning tomatoes and carrots only to find that you have no place to sell them. If you opt for selling at retail venues, many cities or non-profits operate a public market. There is usually a fee to set up there, but you will be entering a marketplace that is already established and already has foot traffic. Other options include renting space at well-attended festivals or other privately run markets (such as those set up by churches and community centers), or by potentially starting your own on the land that you rent, if that is permitted by zoning. You will probably want to attend potential markets as a consumer to see what is already being offered. If there are carrots (or any other crop) as far as the eye can see, you will probably not want to grow them—unless you can offer a different variety or offer it at a time of year when it is not abundant.

The decision to farm, in an urban environment or not, should not be taken lightly. Like anything worth doing well, it is hard work and demands much of your time. Unlike the now-outdated notion that farming is the last resort for an individual unsuited for anything else, a successful farmer has to be knowledgeable in botany, geology, hydrology, plumbing, mechanics, and especially business. It is entirely possible to be an urban farmer and earn a lucrative wage. The highest chance for doing so requires some research into what is already in your particular market and what it lacks. If you can fill a niche with your locally grown products, you will be in a much better position to enjoy the fruits (or vegetables) of your labor and know that you are doing good and doing well for yourself.
There are so many mental notes that we all make throughout the season about wanting to do more of this, or less of that the following year, that without some sort of organized journal, many of these things may not ever come to fruition. Keeping a garden journal allows you the freedom of not having to remember everything about a past growing season when you are making decisions for a future one.

Much of the information that may prove to be useful can be found by contacting your local cooperative extension service, respective government agriculture agency, or established garden centers in your area. Historic weather information can also be found online or requested from state and federal weather agencies. The amount of information suggested here to include may seem daunting, overwhelming, or unnecessary to the average gardener just wanting some tomato plants on their patio, and for those folks it probably is. However, for any grower, hobbyist, or professional, learning from our mistakes is part of the garden journey throughout our lives. While every garden journal will be different, there are some categories of information that many gardeners would find helpful included in all of them.

The Write Way: How to Keep a Garden Journal by Chris Bond

While the maxim about only being able to improve that which we can measure may not always be accurate for all of life’s endeavors, it does hold up when talking about gardening. Chris Bonds walks us through the gentle art of garden journaling.
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For any grower, hobbyist, or professional, learning from our mistakes is part of the garden journey throughout our lives.

THE PLANNING PHASE
Why do you even want to grow anything? Are you looking to recreate your grandmother’s back yard? Create an efficient, clean, food system for your family? Looking to create inspiration for your landscape paintings or portraits? Whatever the reason for planting anything, it is worthwhile to write that reason down, and it’s probably wise to do this in the beginning of the journal. It will help keep you on track when making later decisions. It may also prove to be a later sense of joy or bemusement as you try and remember what it was many years ago that you were striving to do with your garden space.

The planning portion of a garden journal should contain some basic information about your growing area. Things to include:

- Historic date of last frost for the season.
- Elevation of your planting site(s).
- Direction(s) faced.
- Hardiness zone or other information about the average and historic highs and lows in your growing area.
- Site conditions—this includes such things as soil type, which is a good idea to have tested prior to planting, and characteristics of the site (is it open, sunny, shaded, etc.)
- Knowing these facts will help to inform you on all of your other planting decisions for both the current and subsequent years, such as deciding which types of plants to select for your garden or when to plant them.

STARTING SEEDS
This section may be entirely overlooked if you will not be starting any plants inside before planting them directly in the garden. If, however, you want to get a jump-start on the planting season, you may opt to start some of your garden plants in seed trays (or other containers) inside, for transplant later in the season. Information that you may want to put in your garden journal for future reference could include:

- The date(s) that your plants were seeded.
- The seed variety, supplier information, batch number, and germination rate. This information may be useful to refer to if you happen to have a crop failure or if there is any kind of seed recall.
- The type(s) of containers seeded into, rate of seeding (how many seeds per row, etc.) and the media used. If not a commercial seed-starting mix, then include a list of amendments used and quantities of each. This information will be helpful if doing any post-mortem on seed types that did not do well.
- Information about the growing space such as temperature, humidity, and direction it faces, or grow lights used. Did you use other growing aids such as heating mats or temperature sensors?

PLANTING RECORDS
Now for the fun part. In this portion of your garden journal, record all pertinent information about the plants you are transplanting or the seeds that you are sowing. Note the following:

- Date for planting/sowing each type of plant.
- Indicate whether it was directly seeded, and if so, include the same information as in the previous point above. If transplanted, indicate where it was purchased from and save any tags that may have come with it. By law, it should indicate the original source and whom it was grown for. For example, it may say “grown by XYZ Greenhouses for ABC Garden Center 2017.”
- Where in the garden it was planted.
- How many were planted? This could be individual plants, flats, rows, or whatever measure seems appropriate.
- Any immediate post-planting care should be recorded such as watering, fertilizing, staking, mulching, etc.

GROWING SEASON NOTES
This may be a matter of individual choice, but any treatment or care given after the initial planting can be recorded in this section. Depending on your plant choices and growing conditions, this could be the shortest or longest section of the garden journal. In this portion of the journal, include information like:

- Growing season temperatures (lows and highs) by day, week or month.
- Rainfall or other precipitation amounts during the growing season. Any particularly unusual weather event, such as a late or early season snowstorm, a tornado, flood, or hurricane should be included as well.
- Amount, frequency, and method of irrigation.
- Any amendments or fertilizers used throughout the season as well as their manufacturer, date purchased (they have a limited shelf life) and rates of application.
- Just as with amendments, any pesticides used, whether conventional or organic, should be recorded. Detail the product used, its active ingredient (on the label), date used, weather conditions, amount used, where it was used, target species of concern, and manufacturer information on the label.
This may seem excessive information to obtain, but a pesticide label is a binding, legal document. It is a good idea to save copies of them on anything that you opt to purchase or use.

**HARVEST/YIELD DATA**

Depending upon your point of view, this may well be the fun part, as it represents the “fruits of your labor,” the “sweat of your brow,” or, you know, the vegetables from your garden. Keeping good records here will help you decide if you made the correct choices for varieties or if you need to make some changes for the following season. It may seem like a lot of work, but if growing food is anything other than a casual hobby, this is important to know:

- **Date(s) of harvest for each type of crop.** This can then be cross-referenced with the planting dates to see how long it took from seed to harvest.
- **Pounds or kilograms of each crop.** If you do not possess a scale, then at least count how many items of each and their relative sizes.
- **The disposition of the crops.** If you are not selling them, why would you care where they go? Because unless your intent is to donate the produce or give it all to family and friends, you may realize that you are producing way more than you need to be. This might mean that you can scale back your time and investment the following season or that you need to make additional plans for what to do with the bounty (freezing, storing, canning, baking, etc.)?

**POST-SEASON THOUGHTS**

After the final harvest at the end of the season, it is good to keep records of what was done. It is easy to put it off, but can be difficult to recall later what it was that you actually did with the space. Leave room in your journal to record things like:

- **What was done to the site after the last harvest?** Was it tilled? Did a cover crop get seeded and if so, how much and what? Was the garden left as-is?
- **Was any compost or other amendment added to over-winter?** Again, if so, what, how much, and where did it come from? Did you leave any crops in the ground for future winter harvest such as root vegetables?
- **Make sure to note anything else at this stage in the journal on general thoughts for the past season, or the one ahead.** This does not mean you are bound to it, but it may be useful when starting the planning phases of next year’s garden journal.

Include pictures, doodles, anecdotes, dirt smudges, or anything that makes it yours. It is a planning tool for your individual site and could become a treasured family heirloom in the future.
HOW TO START A “LEMONADE STAND” FARM:
The Beginner's Guide to Starting a Microfarm

Sometimes, you’ve got to start with a lemonade stand before opening a store. Same goes with farming; sometimes, you’ve got to start small before you go big.
Today, more people want to grow their own food than in decades past. The desire to grow food for their families and their communities calls hundreds to garden or farm. The rising demand for local food, a more stable food system, and sustainability also gives new farmers plenty of motivation.

However, growing food isn’t always easy. It can get complicated by a variety of climates or a lack of knowledge (the dreaded brown thumb). Of those wishing to foray into commercial farming, many find that the project’s sheer size is impeding. Land and space are expensive, relocation is a strong demotivator, and funding is not easy to come by. For aspiring growers facing these obstacles, a new start up model is required.

No matter if the goal is commercial system or a modern victory garden to feed a family, one promising option that some new growers have used is to start small with a “microfarm.” It only requires a small budget and a bit of patience, and new farmers can always scale up their operations as money from the microfarm’s sales trickles into the bank.

Strengths of the Microfarmer

Starting small and growing organically has several benefits. First, a microfarm requires a smaller capital expense than a large system. This means that new farmers don’t have to fundraise or lien as much on the front end. Fundraising and debt can be a burden on a new business, and the freedom of owning a growing operation outright is the preferred method for many people.

Second, a microfarm offers a training ground for new farmers to test out their growing system (or systems). Management, sales, and regulations are also easier to navigate on a revenue level of $5,000 per year than on a $50,000 per year level. This low-stake environment gives farmers a place to make mistakes and get the riskiest parts of the learning curve out of the way while boosting their confidence. During this trial phase, farmers can also feel out the farming lifestyle and see if farming is a good fit for their strengths and personality before committing. Scaling up from a microfarm to commercial-sized operation is less stressful and has a lower likelihood of failing.

Finally, starting with a microfarm allows farmers to get a foothold in niche markets before relying on big demand to power their production. After selling to a few clients in niche markets, farmers have built up their brand and reputation in the community, tested products, honed their best growing practices, developed a customer base, and perhaps even built up capital to help with scaling costs. These advantages can give microfarmers a strong head start when it comes to profitability.

How it’s Done

Microfarms often focus on high-dollar specialty crops because they don’t produce large enough quantities to provide staple veggies like lettuce or tomatoes. As a result, they almost always sell to niche markets. This is why microfarm planning should begin with local market research. The key question is, “Who has a produce need that I can satisfy?”

To find a market, get face time with potential customers and ask questions. Are there holes in a restaurant’s menu that need filling, or dream dishes that only a specialty product can make happen? Do market surveys reveal interest in any potential crops? Plan a business around any sales opportunities these questions uncover.
Also, look at the experiences of other microfarmers for inspiration. Here are a few options to consider:

**Microgreens**
Microgreen growers grow crops like kale, cabbage, radish, amaranth, and many more. Unlike other crops, microgreens are harvested before the greens mature (often before the first true leaves appear). The result is delicate, tender greens with a pop of flavor and color. Microgreens are often used as a special addition to salads, sandwiches, or as a garnish. Restaurants that pride themselves on unique, high-quality ingredients are great prospects for microgreens sales, as well as adventurous farmers, market-goers, and CSA members.

Microgreens make a great fit for microfarms since they are high-margin, fit into niche markets, and can be grown on a very small scale (a few trays per week is a fine starting size). The upfront investment is low—just a few hundred dollars to get started—so a return on investment (ROI) can be seen in a few months.

**Aquaponics**
Those growing for family and friends might choose aquaponics to power their microfarm. If paired with the right crops, an aquaponic system could also serve a small niche market for specialty herbs or any other crop for which the farm has demand. Also, aquaponics can be tough to operate at a commercial level, so starting with a small-scale system like this is a smart idea. Depending on set-up costs, the ROI on an aquaponic farm could be a bit longer.

**The Kratky Method**
The Kratky method is a great system for beginners because it is as low-maintenance as they come. While Kratky isn’t recommended for large-scale farms, it can support a single-farmer operation quite nicely. Kratky systems are low-cost to set up and are usually built on a do-it-yourself scale using simple bins or wooden beds with a liner. Kratky systems support small-statured crops the best, with pricing dependent on the system size.

**Living Wall**
If you’re looking for a microfarm that produces food and looks good, a living wall is a great option (it can double as a display system for live sales). It is also a great fit for anyone who wants to grow vertically to save space. These vertical systems come in different sizes and some systems can expand, allowing growers to start small and scale up with the same technology. Most farmers growing for sale choose to raise high-margin greens and herbs.

More and more farmers are using the microfarm approach to start growing food for themselves and their communities. Not only does it remove barriers to entry, but microfarms allow farmers to scale up their operations if all goes well.

You can learn more about Bright Agrotech and starting a microfarm at [brightagrotech.com](http://brightagrotech.com).
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Since the 1980s, the city of Negril, Jamaica, and its surrounding areas have been a favorite spot for tourists. The relaxed attitude, warm sunny weather, sweetly infectious reggae music, beautiful scenery, and abundance of fresh local food likely play a part in that. Built in 1972, the Rockhouse Hotel is one of the original hotels established in the west end of the city.

I have been travelling to the island, solo and with family, since I was an infant. The Rockhouse, which is Green Globe Certified, has that historical “wow” factor that legends are made of; past guests include The Rolling Stones, Bob Marley, and Bob Dylan.

In the last two years, the Australian owners of the Rockhouse set out to build a microfarm on-site to better serve the guests of the hotel and the restaurants. I met Bolly, the farm manager, on a rainy Friday afternoon as hotel guests were taking part in a dance reception. He agreed to give me a tour and provide some insight into the farm’s origins, its purpose, and future potential for the Rockhouse and its surrounding community.
Above: The hotel juice bar uses more than 50 per cent farm fresh greens grown on-site while between 15 to 30 per cent of the Rockhouse’s two restaurants food supply is derived directly from the farm. Right: The farm cultivates between 12 to 20 crops including cilantro, thyme, mint, basil, dill, and oregano, as well as calaloo, Scotch bonnet peppers, arugula, and lettuce. Bottom: The farm is irrigated through a network of drip headers fed from 13 thousand-gallon, UV-treated rain drums.

**Jamaica Lacks the Same Access to Commercially Manufactured Amendments, Supplements, Liquid Fertilizers, and Other Plant Products that North American Farmers and Growers Take for Granted.**

The farm is across the street from the main hotel and restaurant property, and occupies roughly one-third of an acre. It is built upon the principle of organic raised beds and planter boxes, which are thoroughly irrigated in the hot Jamaican sun via pressure compensating drip tape. Drip tape is commonly found on small to midsize fruit and vegetable farms, and is a great water saving approach to irrigation. The farm’s crops are utilized in both the hotel’s restaurants, and at any given time the farm cultivates between 12 to 20 crops depending on the time of year and crop succession plan. Main crops include common culinary herbs like cilantro, thyme, mint, basil, dill, and oregano, as well as calaloo (a spinach-type relative of the invasive pig weed farmers deal with in North America), Scotch bonnet peppers, arugula, and lettuce.

Bolly enthusiastically describes the farm as “only natural Ital, and all organic,” referring to traditional Jamaican cuisine, and proudly goes into detail describing the formation of the original wooden planter boxes and subsequent future raised beds. The original planter boxes provided a framework to explore growing basic crops like herbs and leafy greens, while giving the growers a palette for experimenting with soil and compost fertility inputs. In a span of just over two years, Bolly and his crew have expanded to employ more than 40 raised beds, growing a wide array of food and medicinal crops. With severely rocky ground, a large initial load of topsoil had to be trucked in to establish the first crops. The ground was manually leveled and evened out with picks and shovels, with the spent rocks and boulders used to construct the raised beds. On average, the beds are about 15 inches high, four feet wide, and 25 feet long.

The farm is intelligently irrigated through a network of drip headers fed from 13 thousand-gallon, UV-treated rain drums. The drums are propped up roughly 10 feet above the level of the garden beds to negate the need for a pump in the garden area by feeding water or nutrient solution through gravity. The property was designed to maximize collection and storage of rain water to minimize its footprint on the environment while remaining profitable. All additional rainwater from the rest of the hotel’s property is collected in a main underground reservoir and periodically pumped to the farm every month. The sustainable approach to water preservation and irrigation was diligently planned from the start.
Above: The Rockhouse offers a luxurious setting and delightful food, combined with a groundbreaking model of local sustainability. Left: The restaurants are able to utilize other on and off crops in a tastefully inspired, always changing menu.

“We have a road system at the front of the property,” says Bolly. “We drain water from the paved, trenched area into collection tanks, which then pump and filter the water into our raised rainwater harvesting tanks. We also harvest water from storeroom and workshop roofs in the area.”

When probed about the use of fertigation, (injecting liquid fertilizer through the drip lines), Bolly admitted the farm was not yet utilizing this practice, and planned to add it to the cultural plant care regime in the future when resources become more available. Jamaica lacks the same access to commercially manufactured amendments, supplements, liquid fertilizers, and other plant products that North American farmers and growers take for granted.

Bolly therefore relies on a potent, in-house compost blend that the team has perfected over the years. All kitchen scraps (including animal waste) are thrown into large open wooden crates bound by threaded mesh. A collection of carbon-rich materials like leaves, sticks, coconut husks, and scraps from tree pruning are added to the nitrogen-rich kitchen scraps with the addition of effective microorganisms. The team aims for a 5:1 carbon-to-nitrogen material ratio for optimal decomposition. A tarp covers the crates, which are routinely turned throughout the week. “Every year it gets a little better. A little richer. More fertile,” says Bolly.

The farm also forgoes the use of most pesticides, resorting to only natural botanical-based remedies like neem oil or capsaicin. Bolly methodically intercrops the beneficial pest preventative marigold within many of the raised beds as a form of pest management. The callaloo is planted as to bolt and become shady in time for when spinach and chard need extra protection from the sun. Basil is found growing with tomatoes to improve flavors of both crops and to allow shade for the basil. Scallion (green onion) are found scattered amongst several crops to benefit from the strong allium scent which commonly deters some pests in the garden.

Some insect pressure is inevitable in this system of farming, but the crops did not seem to mind the odd pest here or there.

Since the farm’s inception, one of the primary goals is to utilize the crops in the restaurant’s supply chain to minimize unnecessary travel costs associated with buying certain crops out of town or out of parish. The restaurants are able to rely on the fact they will never have to source certain crops, and effectively utilize other on and off crops in a tastefully inspired, always changing menu. The hotel also offers a juice bar to other travelers along with its guests, which uses more than 50 per cent farm fresh greens grown on site. Roughly between 15 to 30 per cent of the Rockhouse’s two restaurants food supply is derived directly from the farm. The hotel effectively manages and maintains the crops at a significantly reduced labor cost compared to cost of overhead food expenses, while furthering the autonomy of the organization as a whole.
A premium setting and luxurious accommodations ensure a stay at the Rockhouse will be memorable.

"Since the farm’s inception, one of the primary goals is to utilize the crops in the restaurant’s supply chain to minimize unnecessary travel costs associated with buying certain crops out of town or out of parish."

When asked about the future and what could be done to improve the overall operation and performance of the farm project, Bolly says an exclusive farm to table restaurant is in the works. The hotel aims to construct a small dining area built to have a panorama view of the garden beds for guests from the hotel to participate in seasonal, creatively curated meals in addition to engaging educational lectures. Bolly and the farm team are always on the hunt for new genetics and crop varieties to trial for the western part of Jamaica. Seed acquisition in Jamaica, like fertilizer input selection, is quite limited. The farm has had to rely a lot on visitors bringing down seed packets to build up a unique bank of seed diversity.

The Rockhouse Hotel and its microfarm are strong examples of what can be achieved at the local level when it comes to food production. In a short time, the team has been able to establish a model for other organizations to follow to better serve their customers and member of the local community. By cultivating produce on site, the Rockhouse has further been able to tap into new modes of sustainability and stewardship while providing the freshest organic crops for its patrons.
Les Urbainculteurs was born in 2009 in Quebec City, Canada. Our first urban garden was on the rooftop of Lauberivière, our first partner, who run the biggest homeless shelter in the capital. Vegetables and herbs were growing just up the kitchens, allowing the organization to have access to fresh food and not to depend exclusively on donations.

During an event, co-founder Francis Denault worked on building some gardens for children in salvaged half-barrels. This is where the idea originated, to set up gardens all over town, and why not on the rooftops? What then followed was a series of chance opportunities and hard work, which led to partnerships, contacts, and ultimately the realization of a crazy dream.

Urban agriculture was then very little known and no example existed in Quebec on which to rely or to give in reference. Everything was still to be tried.

Francis, who co-founded Urbainculteurs with Marie Eisenmann, did not have any background in gardening or agriculture before starting the business. Marie had a background in politics and journalism. At the time, she was editor-in-chief of outdoor life magazine Espaces. Francis was working as an eco-counsellor for waste management during events.

Again, as urban agriculture was new, there was no specific legislative framework: rooftop gardens were not permitted nor prohibited. There was no precedent, and the fact that the founders weren’t trained in agriculture didn’t help. There was a lot of trial and error as they tried to find an efficient and affordable cultivation method, and one that was well-adapted to the urban environment. We now use Smart Pots: fabric containers that are light and resistant, and which allows the plants’ roots to fully develop, thus producing healthier and stronger plants.

Since 2009, Les Urbainculteurs have worked towards the development of productive and innovative urban agriculture in the Quebec area, on rooftops and terraces, or directly in the ground. As a non-profit organization, their mission is to promote gardening and urban agriculture by taking action, raising awareness, and offering products and practical solutions for growing in the city. Communications officer Marie-Hélène Dubé tells Maximum Yield about how it all began.
At the beginning, it was mostly Marie and Francis, and two or three others from time to time. Everybody was doing a bit of everything, as a team. We found out that hard work always pays. Marie’s background in communication and journalism, as well as her cheerful and upbeat personality, have certainly helped too. But if we had to pinpoint an event that most helped to promote Les Urbainculteurs, I’d say it was the publication of an article about our organization in Les Affaires, a magazine that specializes in economics, finances, and business. We also were offered a lot of support and visibility from Justin Keating, owner of Hotel du Vieux-Québec, who was one of our very first customers.

From our first year, where we had very few major projects, we have now grown more each summer. From our first activities focusing on gardening, we have diversified what we offer to include consulting, conferences, and workshops, and the sale and distribution of gardening equipment. Our expertise has grown in stature and we even hosted a TV show, Les Urbaincultrices, for two seasons. Now, during the summer, Les Urbainculteurs employ a dozen workers, with four that work year-round.

In terms of the ideology behind the company, we are convinced that urban agriculture is a solution for future challenges. The urban environment has such potential, and as it is now where a large proportion of people live, it is also an environment both vulnerable to climate change and lacking in greenery. Urban agriculture adds life, freshness, and beauty, has a tangible impact on the effects of climate change, and brings food production closer to its place of consumption.

The promotion of urban agriculture is at the heart of Les Urbainculteurs’ mission, it is our raison d’être. We mainly promote it by taking action, creating urban vegetable gardens and edible landscapes throughout the city, from terraces to roofs, courtyards, and balconies. We also promote it through education and raising awareness, and by offering the products we find most appropriate and effective for urban agriculture.

The response from the community has been substantial. After the initial doubts around the feasibility of our project, the community rallied to the cause. Les Urbainculteurs quickly became serious interlocutors for the Interdisciplinary Federation of Ornamental Horticulture of Quebec. In addition, our first highly publicized project was a roof garden with Lauberivière, which is an important shelter for homeless people in Quebec City.

Our proudest moment came in 2013, when the National Assembly of Quebec approached us about creating a large vegetable garden in front of parliament. This summer is our fifth season utilizing this symbolic space as a way to showcase urban agriculture. The commitment of the National Assembly is truly encouraging and passes on a strong message to the citizens, in addition to consolidating urban agriculture as a fundamental trend, not a passing fad.

We also received a call last summer in early July (which is very late, of course, for agriculture), asking if we could install a large garden in the inner courtyard of the Grand Théâtre de Québec. We had to install 50 big bag beds—a type of pot 50 inches in diameter and 100 gallons in volume—in an old wading pool where rain tends to accumulate. It was pouring rain on the day of the installation. Finally, despite the late date of planting and the fact that the maintenance of the garden was based on volunteers (whom we accompanied), this vegetable garden quickly became magnificent and prolific.

The green that it adds to all the concrete is welcome and the crops are redistributed by a charity organization to benefit families in need. How could it be better? Well, the garden should double in size this year.

“Urban agriculture adds life, freshness, and beauty, has a tangible impact on the effects of climate change, and brings food production closer to its place of consumption.”

Our team is awesome because it is very diverse. It brings together academics specialized in biology and ecology, as well as people we met through voluntary workers from Lauberivière. Every day—but especially during spring, when we install the gardens—our team faces incredible challenges, sometimes by carrying dozens of bags of soil by hand, up three flights of stairs, or even up a ladder and through a trapdoor. More than anything, our team gathers enthusiasts of plants and food with a joyful and hard-working bon vivant.

Overall, we have learned that we can remain true to our mission while achieving commercial success, and that it is possible to do so by offering something simple and affordable, without having to use sophisticated and expensive gadgets.
Good Green Earth Company

BUSINESS NAME
Good Green Earth Co.

BUSINESS ADDRESS
48 Dunnett Dr., Barrie, On. L4N 0J6

PHONE NUMBER
705-984-6208

WEBSITE
goodgreenearth.ca

NUMBER OF YEARS DOING BUSINESS
3

With a focus on composting organic waste, Good Green Earth lives up to its name by using centuries-old sustainable biotechnology called Bokashi, where beneficial microorganisms are used to compost organics, eliminate harmful pathogens naturally, and create healthy soil that produces strong, productive, disease-free plants. Company founder Gary Crowell explains the reasons behind starting Good Green Earth.

HOW DID YOUR BUSINESS GET ITS START?

It started out as a necessity to deal with our own home organic waste. We found that traditional composting wasn’t very effective and our organics green bin had its own inherent issues, including the smell and bugs. We began work on creating a product that would be specifically for the grower, using probiotic principles in soil and plants. The result is a living organic soil amendment that infuses the soil ecology with essential nutrients, vitamins, minerals and beneficial microorganisms. We started marketing the Bokashi Compost System and Bokashi culture mix as a sustainable solution to the organic waste and landfill problems, while at the same time creating a premium compost. In the beginning we started out small, working out of the home, producing the mix in the garage, and then moved out to the farm where there was a lot more room and resources.
WHAT IS YOUR COMPANY’S PHILOSOPHY?
To provide an environmentally sustainable alternative to chemicals, pesticides, and toxins, and to regenerate our soils with all the essential elements necessary to create and sustain a strong, productive, disease-free garden. We continue to strive to find new solutions to today’s problems with regards to our air, soil, and water.

BRIEFLY SUMMARIZE THE PRODUCTS YOU MANUFACTURE.
Bokashi PRO-GRO is a living, organic, fermented, soil amendment that builds a strong disease- and pest-free soil food web, resulting in strong, productive plants. Bokashi Plus Culture mix is a probiotic soil amendment, compost accelerator, and natural odor control using beneficial microbes in a fermented wheat bran base. Bokashi Compost System turns all food scraps, including meats, cheese, and small bones into nutrient-rich compost within weeks with no foul odors or bugs. This rich compost has twice the nutrient value and moisture of traditional compost, with none of the inherent issues associated with regular compost.

WHAT MAKES YOUR PRODUCTS UNIQUE?
We produce the only probiotic bio-intensive soil amendment that can be used with organic or conventional growing methods. Bokashi PRO-GRO actually kills pathogens and coliforms in the soil and plants as well as create a density of nutrients and minerals that is absent in most soils and in all soilless mediums. This product can be used through all stages of growth, from rooted clone, vegging, through to flowering cycles. It can also be used with synthetic nutes and will cut down on fertilizer usage. It also has applications in a soil mix, as a top dressing, or as a tea and foliar spray. The run-off is highly beneficial to the environment.

HOW HAS THE BUSINESS EVOLVED OVER THE YEARS AND WHERE DO YOU DISTRIBUTE?
We recently partnered with Home Hardware to market our Bokashi Compost Systems and Bokashi Plus Culture mix nationwide under the My Good Green Garden product line. We currently sell our products through Homegrown Hydroponics, online at goodgreenearth.ca, and are about to expand into the US.

WHERE DO YOU SEE THE COMPANY IN 10 YEARS?
We expect to scale up our Bokashi composting sector to include institutional and commercial organic waste programs. We want to be a leader in the probiotic gardening products community and educate the public on how to get back to growing our medicine and food the way it is meant to be done. We want to put back into the soil what we take out, leaving no negative mark of our existence on this good green Earth.
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Interested in carrying Maximum Yield in your store? Distribution is available by contacting BWGS, Florida Hydroponics, General Hydroponics, Humboldt Wholesale, Hydrofarm, National Garden Wholesale/Sunlight Supply, Nickel City Wholesale Garden Supply, Tradewinds, and Urban Agricultural. Already a distributor?

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Abscisic Acid (ABA) functions in many plant developmental processes and can be involved in stress responses as well. Philip McIntosh breaks down the importance of this plant hormone.

**ABSCISIC ACID** one of the “classical” plant hormones, and although it is an acid, it’s role in plants is not directly related to regulating pH. It’s more complicated than that (of course!).

**ABSCISIC ACID** was characterized in the early 60s and is named after its role in the process of abscission. Abscission is the shedding of leaves over winter by deciduous plants.

**ABSCISIC ACID** is also known for its “anti” effects in relation to other hormones. For example, auxin inhibits abscission, ABA promotes it; gibberellins promote elongation, ABA inhibits it.

**SOMETIMES CALLED** the stress hormone, ABA is involved in many plant responses to unfavorable conditions such as drought, extreme cold, high soil salinity, and others.

**STOMATA CLOSE** to limit transpiration when ABA binds to receptors on stomatal guard cells, triggering a cascade of events leading to loss of guard cell turgor.

**UNLIKE SOME** other plant hormones, which exist in a myriad of related chemical forms, there is essentially only one abscisic acid (ABA).

**ITS EFFECTS** on plant growth and development are many, including regulation of the opening and closing of stomata, stimulation or inhibition of root development, dormancy of buds and seeds, protection from dehydration, and many others.

**ABSCISIC ACID** is part of the apical dominance system. As auxin moves down from the plant apex, ABA moves up from the roots to work in synergy to maintain the dormancy of lateral buds.

**SOME PLANT** pathogenic fungi also produce ABA. Perhaps this helps the fungus by suppressing plant defenses.

**ON THE** other hand, it is also thought that ABA stimulates the activation of genes important in plant wound responses.

"10 facts on..." by Philip McIntosh
You reap what you sow.

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