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HYDRO SYSTEM

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SOLUTION

7 REASONS for Yellowing Leaves

plus

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“

To combat the excess heat, many growers employ mechanical devices, such as air conditioners or fans, to help keep temperature and humidity within the desired range.”

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Features

36 Flushing Your Hydroponic System: Water vs. Agents

by Chris Bond

Flushing is a requirement for all hydroponic and aquaponic systems. What may be up for debate, though, is whether plain old water or other agents work better.

40 Recycling Heat Between Dual Flower Rooms

by Eric Hopper

Indoor growers in colder climates benefit from heat generated by grow lights. They can also recycle any excess “waste heat” in the growroom to save money.

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“

The best way to overcome plant blindness is to increase our knowledge and exposure to them.”

from the EDITOR

TG Toby Gorman


Beyond the plants you grow in your garden, how tapped in are you to plants in general? Do you know the species of the tree in your front yard? Do you know the origins of the produce in your supermarket or farmers market? Are you aware of the indigenous and invasive species in your community?

As more and more people migrate to urban centres, our detachment from the plant world is increasing. This is concerning for a number of reasons, but largely because plants are critical for human health and, ultimately, our survival. They moderate the environment, they nourish us, and they provide important medicines.

There is a term for this increasing lack of acknowledgement of plants. In 1998 US botanists Elisabeth Schussler and James Wandersee coined the term “plant blindness,” referring to the inability to see or notice the plants in one’s own environment.

It is, to be honest, a general underappreciation of plants, and this nature-deficit disorder is on the rise while funding for plant research is on the decline.

The best way to overcome plant blindness is to increase our knowledge and exposure to them. This, in turn, will create an emotional connection to them, much like we do with animals. With this in mind, in this issue we introduce “A History of Your Food” on page 62. Since most of our readers grow food, it is an effort to educate our readers on the origins of the food we grow and consume, how crops and plants have been crossbred and developed by humans over millennia, and why the plants we grow are important.

In this world of screen time and technology, it’s important to keep engaged with the natural world. Growing and learning about the plants we consume and are surrounded by is a great way to appreciate them more. 

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bare ROOTS

Featured Contributors

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

EH **Eric Hopper** has more than 10 years of experience in the hydroponic industry as both a retail store manager and owner. He continuously seeks new methods and products that could help maximise garden performance. Eric resides in Michigan where he and his family strive for a self-sufficient and sustainable lifestyle.

Contributors

+ **Monica Mansfield**
Philip McIntosh
Dr. Lynette Morgan
Sally Nex



A PERMACULTURE



Permaculture is the design and creation of gardening ecosystems that are both self-sufficient and sustainable. The point of permaculture is to design a whole system that mimics natural scenarios in which a garden can sustain itself and the gardener. This process of gardening is organic, but it goes beyond simple organic gardening with a set of principles and a focus on working with nature instead of against it.

Derived from the terms permanent and agriculture, permaculture focuses on emulating processes found within natural systems. By mimicking natural scenarios and connections between plants, insects, animals, and soil biology, permaculture seeks to create a thriving ecosystem with minimal input from the gardener. Originally defined in 1974 by Bill Mollison and David Holmgren: The conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems.

Permaculture has since expanded its definition and now includes many branches: ecological design; ecological engineering; regenerative design; environmental design; construction; integrated water resources management; sustainable architecture; and self-maintaining agricultural systems modeled from natural ecosystems.

Check out Monica Mansfield's article on page 44 for more information.

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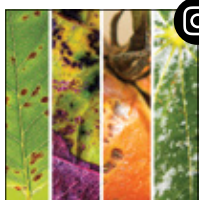
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branching OUT

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Well worth a read. We always have a bunch available, pop in and check them out!

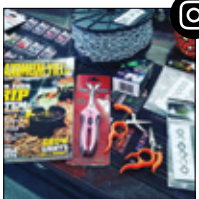


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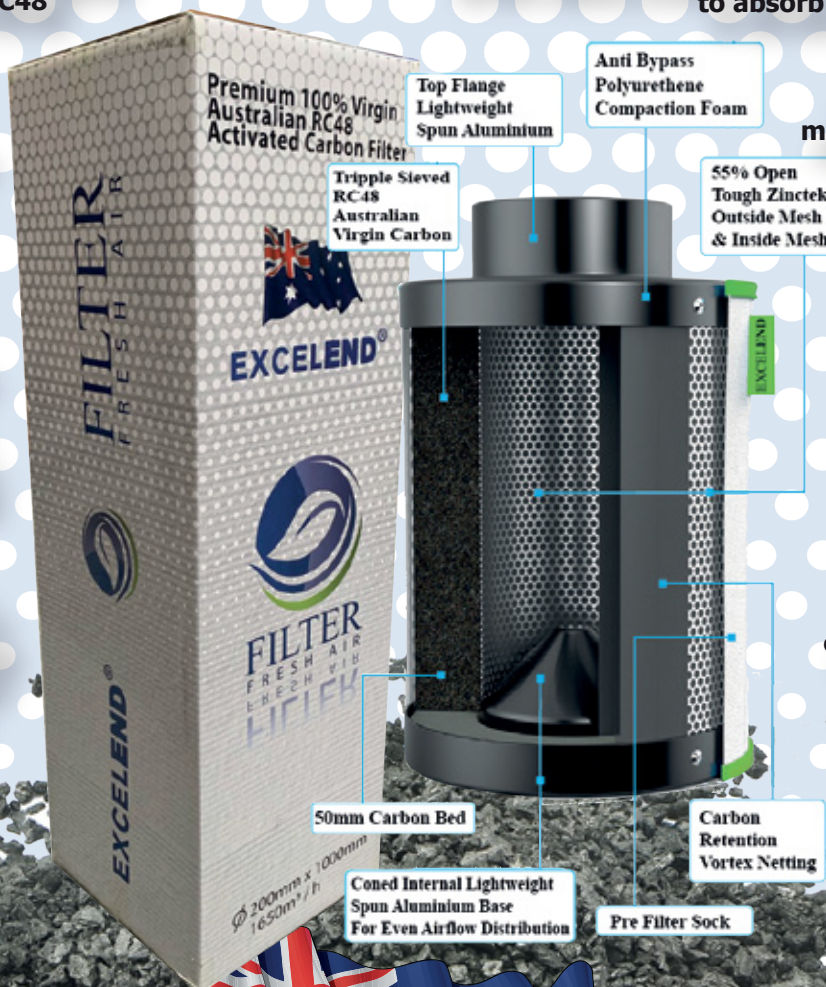
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DO YOU HAVE A QUESTION FOR A GROWER? Email editor@maximumyield.com to get an answer.

ask a GROWER

by Dr. Lynette Morgan

Q Can I use electrolysis for nutrient solution in a hydroponic system for increasing the dissolved oxygen levels? If I use electrolysis in my nutrient solution will it have any adverse effect on the nutrients?

a Electrolysis can be used to produce oxygen in a liquid – this is a well-known process often termed the “decomposition” or “splitting” of water. During the electrolysis process an electrical current of the correct voltage is applied across a positive anode and a negative cathode which are placed into the water.


The electric potential through the water causes hydrogen gas to be produced at the cathode and oxygen gas at the anode. During this reaction, twice as many moles of hydrogen as oxygen are produced. Basic electrolysis experiments such as this are often used as a science experiment for young students as the oxygen generated is usually quite visible as cloudy bubbles around the anode. This is also an industrial process, used to generate hydrogen gas and to a lesser extent, oxygen that can be collected from the surface of the liquid. While this may seem like a great way to generate oxygen and boost dissolved oxygen (DO) levels in a nutrient solution, there are a few drawbacks if you want to set up your own electrolysis system for this purpose. Firstly, the electrodes need to be of the correct, non-reactive material (such as titanium), as other metals will corrode and dissolve under electrolysis which could be rather toxic in a nutrient solution.

Secondly, the correct voltage for the solution must be applied as the current flowing and duration will determine the amount of gases produced.

And thirdly, there could be much more complex reactions that occur with the ions dissolved in the nutrient solution. It may seem more sensible to only apply the electrolysis to pure (RO) water and then add this to the hydroponic system to boost DO levels. However, pure water does not conduct an electric current well, so oxygen won't be produced.

For electrolysis to proceed at a good pace, salts or acids need to be added to the water to conduct the current (industrially, inexpensive sodium chloride may be used as what happens to this salt solution during the process is not important when the main objective is to simply collect hydrogen). In a hydroponic solution there are nutrient ions that will allow electrolysis to occur and generate H_2 and O_2 gases, however, these nutrient ions may then undergo redox reactions at an electrode themselves producing new solutes and gases. These may then react together to produce other materials. These side reactions could be quite complex and not well understood as nutrient solutions contain not only the ions derived from fertilisers salts but potentially many others from water supplies, supplements and boosters, acids, leached from substrates, as impurities in fertilisers and other sources.

The oxygen that is generated in solution is not all necessarily going to be available for plant use either – larger bubbles will quickly disperse, nanobubbles of O_2 gas are formed and will stay longer in solution, however, passing through pumps, irrigation equipment, substrates may cause the loss of some of these, and some of the oxygen and hydrogen may even reconver back to water.

For these reasons simply measuring the DO levels in the solution around the electrodes during electrolysis is not necessarily a good indication of the O_2 levels available directly around the root surface where they are of most importance. 

Dr. Lynette Morgan

LM **Dr. Lynette Morgan** holds a B. Hort. Tech. degree and a PhD in hydroponic greenhouse production from Massey University, New Zealand. A partner with SUNTEC International Hydroponic Consultants, Lynette is involved in remote and on-site consultancy services for new and existing commercial greenhouse growers worldwide as well as research trials and product development for manufacturers of hydroponic products. Lynette authored five hydroponic technical books. Visit suntec.co.nz for more information.

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Researchers Develop “Vaccine” for Tomato Plants

A new chemical “vaccine” for tomato plants switches on a defense mechanism to prevent localised infections from becoming contagious, a possible first step toward protecting harvests, researchers say. When plants come under attack from invading bacteria, viruses, or fungi, they mount a two-pronged response, producing both offensive chemicals to kill invaders and defensive chemicals to prevent infestations from spreading. A report published in *Science Signaling* details how scientists saved tomato and pepper plants from bacterial speck, the common name for a bacterial infestation that can spread from leaf to leaf, turning leaves yellow and ultimately killing the plants. Researchers treated uninfected leaves with a newly discovered and naturally occurring chemical called N-hydroxy-pipecolic acid (NHP) that triggered a series of chemical responses that made uninfected leaves less hospitable to pathogens seeking to invade. Many crop species have the genetic machinery to produce at least small quantities of NHP.

– futurity.org



University Seeks to Reduce Pepper Disease & Boost Production

A University of Florida (UF) researcher will lead a project to reduce the risk of bacterial disease while helping boost production of peppers like jalapenos, chilis, and bells. In 2018, bell and chili peppers were worth \$628 million to the US market. However, peppers face several diseases, like bacterial spot, that can severely damage production. Pamela Roberts, a UF plant pathology professor, was awarded a four-year, \$3-million grant to examine ways to prevent diseases and increase pepper production. “Bacterial spot is one of the most damaging and difficult diseases to manage on peppers,” Roberts says. “Yield losses in severely affected crops can reach 100 per cent.” With the grant, scientists will zero in on a pathogen called *Xanthomonas perforans*, one of the three species of *Xanthomonas* that cause bacterial spot. Researchers will also study ways to promote sustainable pepper production.

– ufl.edu



Hemp Renaissance in Bluegrass State

Surprising as it may seem, Kentucky once led the US in hemp production. That was back in the mid-1800s, when production peaked at 40,000 tons in 1850. Hemp was actually Kentucky’s top cash crop until 1915. Today, the state’s commissioner of agriculture, Ryan Quarles, wants the plant to once again become a part of Kentucky’s agriculture mainstream. “When people think of Kentucky, I want them to think the same thing they think about hemp like they do Idaho potatoes and Florida orange juice,” says Quarles. With hemp now being legal to grow in the US, Kentucky now has more than 1,000 farmers growing the plant, along with more than 200 companies involved in the sector. And the Bluegrass State expected well over \$100 million in Kentucky-grown and processed-hemp sales from 2019. Across America, the hemp industry is expected to produce more than \$1.9 billion in sales by 2022.

– forbes.com



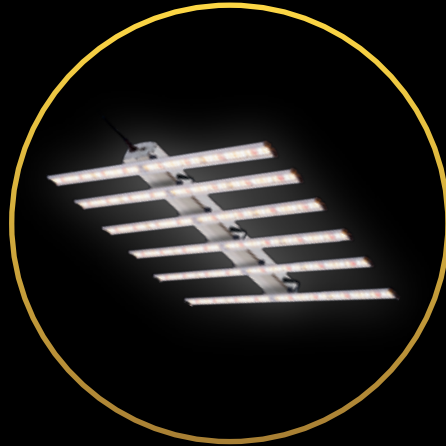


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Bagged Salad Products Producing New Diseases

Ready-to-eat salads have steadily gained popularity since their introduction in Europe in the early 1980s. This trend is expected to grow, marking opportunities for the fresh food industry but as the industry grows dynamically, so does the number of new diseases, like a new race of *Fusarium* wilt. There are many reasons for this increase according to a new review in *Plant Disease*. These seasonal products are grown under high crop density in five to six cycles annually in the same specialised farms with a lack of adequate crop rotation and a shortage of applicable fungicides. Additionally, international trade has moved crops away from their original environments to foreign soils, where they encounter new diseases. Sometimes, very low levels of seed contamination can lead to the rapid emergence of new diseases in new geographic areas, resulting in severe losses, disrupting the environment's biological equilibrium, and sometimes launching a devastating epidemic.

– hortidaily.com



Iceland Plans Massive Greenhouse Project for Fruits, Veggies

With research showing humans need to produce as much food in the next 40 years as we did during the previous 8,000 years, a municipality in Iceland is building a series of massive greenhouses. A company called Paradise Farms and Ölfus municipality (southwest Iceland) have signed an agreement involving the leasing of 124 acres of land for organic food production (mainly in greenhouses). The goal is to produce more than 5,000 tons of vegetables and fruits (including mangoes, avocados, bananas, and papayas) in the first year. Gunnar Þorgeirsson, head of the Association of Icelandic Horticultural Farmers, reports the plans call for one million square feet of greenhouse space, with the option of expanding to 5.3 million square feet. When asked whether growing exotic fruits in Iceland is realistic, Þorgeirsson responds, "It depends on (our ability to) obtain energy – electricity as well as hot water – at a reasonable price."

– freshplaza.com



FDA to Test Romaine Lettuce for *E. coli* Clues

After four outbreaks in less than two years where likely contaminated romaine lettuce contained deadly *E. coli* O157: H7, the Food and Drug Administration is turning to microbial testing for clues for the next year to try to figure out what's happening. The FDA reports it is now "conducting a small, focused assignment to collect samples of the raw agricultural commodity (RAC) romaine lettuce to test for salmonella spp and pathogenic *Escherichia coli*..." The year-long testing program will run through November 2020. Testing for Shiga Toxin-producing *E. coli* or STECS includes the microbial hazards associated with romaine lettuce consumption. The FDA will collect raw lettuce that is trimmed or washed in its natural form before processing. The four *E. coli* outbreaks infected a total of 320 people and were notable for their high hospitalisation rates. Five outbreak patients died.

– freshplaza.com



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★ **NATURAL SILICA** that is instantly plant available and won't effect your pH! Salicylic Acid creates thicker cell walls, with higher weight and water holding capacity for stronger branches, increased photosynthesis and flower yields.

★ **PERFECT FOR SOIL** contains a full range of over 20 organic trace elements inc. Zinc and Selenium, providing full spectrum plant nutrition. Saponins a natural wetting agent also helps penetrate dry hydrophobic soils.



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1 | Reiziger Peat Mix

Intended to push the boundaries of design and manufacture, Reiziger Peat Mix contains Sphagnum moss peat that is sustainably harvested from raised European peat deposits and blended with the most exceptional and purest ingredients: calcium, magnesium, coloured peat, coconut coir pith, and root-growth feed to give plants a quick boost to get them off to the best start. Its formula is remarkably effective, providing plants with the optimum balance of air and water resulting in strong roots to grow healthy, beautiful plants.

2 | Pro Grow UFO LEDs 100 & 200W

The new Pro Grow UFO LEDs blend top-bin SMD diodes from both Samsung and Osram for an outstanding efficacy of more than 2.1 $\mu\text{mol/s}$. Pro Grow UFO LEDs emit 4,000 Kelvin full-spectrum light with an industry leading CRI of 90. Coupled with ultra-reliable Optimum drivers, the lightweight and durable die-cast aluminium housings offer cool, fanless, and silent operation. Pro Grow UFO LEDs are available in both 100W and 200W configurations with outputs of PPF 210 & PPF 420 respectively. Available through Growhard.

3 | FloraMax Ca-Mg-Fe

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

4 | Saboten Scissors and Sharpener

Saboten, a Japanese company, now builds a range of scissors that will cut flowers and medicinal cannabis. Saboten scissors are designed for ultra-sharp trimming, harvesting, and processing, without damaging precious flower material. They are coated so as to not stick and Saboten has developed ingenious equipment for maintaining scissor hygiene during trimming including scissor holders, sharpeners, and solventless cleaning solutions. Saboten is the new world standard in scissor and blade excellence. Saboten is distributed by Stealth Garden Supplies.

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5



6



7



8

5 | DE Gnat Pest Control

DE Gnat is the ultimate solution for organic pest control. DE (Diatomaceous Earth) is a unique fossilised compound that's processed into a fine (food-grade) dust and also heated into granular pebbles. DE is unique as these fossilised minerals have microscopic jagged edges that damage pest exoskeletons. Simply apply the dust to the leaves and the granular as a layer over your substrate. This provides physical barriers that will interrupt the life cycle of pests at multiple stages. It's distributed by Stealth Garden Supplies.

6 | Insect Glue Trap for Pots

Insect Glue Traps are already well known for being the stickiest insect glue traps on the market. Insect Glue Traps now offer the Insect Glue Trap for Pots with a convenient mounting stick included. The size is a useable 6x8 centimetres and supplied in packs of eight. Insect Glue Trap for Pots will trap and clearly indicate the first sign of fungus gnats and other pests so you can implement effective pest control and limit crop damage. Insect Glue Trap for Pots are available through Growhard.

7 | Rosenthal's Zero Tolerance Pesticide

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

8 | FloraMax Clone Spray

FloraMax Clone Spray is a foliar spray that improves strike rate and rooting speed, while promoting vegetative growth in clones and seeds. Extremely safe and easy to use, Clone Spray also contains a wetting agent that aids in nutrient uptake and absorption. Fast becoming the choice of numerous commercial cloneries, users report "personal best" levels of performance and drama-free transitions into subsequent phases of growth. Clone Spray contains no plant growth regulators and will not burn your leaves.

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fulvics, vitamins, etc

“

*...the buds do not have a PGR look to them and they look natural almost
organic in their structure... the bud sites are huge and filled with resin!*

(USA Commercial consultant)

”

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9 | ExcelEnd RC48 Carbon Filter

A new product launch from Excelaire, ExcelEnd carbon filters provide the ultimate in odour filtration with a price breakthrough. The filters are made from the highest quality and packed with RC48 Australian activated carbon. These lightest units have the highest airflow with 55 per cent open mesh, coned internal bases for even distribution, anti bypass build, use of lightweight alloy, and boast a 100 per cent odour removal. ExcelEnd carbon filters are also triple sieved to reduce and remove ash content.



10 | Sleeps With The Fishez

Sleeps With The Fishez is a pH-neutral oxyacid of chlorine solution better known as hypochlorous acid. It acts as an oxidising agent and destroys harmful bacterial, fungal, and viral pathogens on contact. Regular use leaves hydroponic systems safe from infections and clear of biofilms and algae. Sleeps With The Fishez is an excellent mineral de-scaler preventing the build-up of salts in feed lines, spray heads, growing mediums, and pots. It can be used to control Pythium, Fusarium, sooty mould, and powdery mildew. It's available through Growhard Australia.



11 | Cyco Kleanse

Cyco's Kleanse is a salt-clearing agent formulated to solubilise most micronutrients, cationic nutrients, or metals in a growing environment. Kleanse can be utilised during the growth and bloom period to flush the root system from accumulated mineral salts, while feeding the microbial life in the substrate with needed carbohydrates. It's used throughout the vegetative and flowering periods of plant growth to provide a clean rhizosphere that aids in mineral uptake. Cyco Kleanse is a unique and purposefully formulated cleansing agent for use with the Cyco Platinum Series line of plant nutrients.



12 | Bio Diesel Supernatural

Supernatural is a new, premium organic root and shoot stimulant made from a blend of organic sea algae extracts and Bio Diesel's famous bio stimulants. Supernatural (0-1-1) will help your plants create massive lateral feeder roots and increase nutrient uptake with an immediate plant response. Supernatural, which is compatible with all nutrient programs, is ideal for correcting plant stress and trace element deficiency and can be used in soil, hydroponics, coco fibre, clay balls, or any inert hydroponic media.

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WEEK 6

The flower is forced into a new flowering cycle after the first cycle has ended. Results are visible in 2 days

The flower starts new cell division



WEEK 7

The flower becomes noticeably bigger as the new flowering process grows on top of the existing flower

Bigger Results



WEEK 8

The flower is much bigger and heavier with a tighter overall density. Essential oil production is increased which could increase yield up to 30 % or more

CHEMIST'S CORNER

House & Garden Shooting Powder and **House & Garden Top Shooter** are extremely powerful stimulators so only use them if your plant is significantly healthy as they are a very strong agent that demands much from the plant.

Do not use either product with any PK based Additives ie. Top Booster.





FLUSHING YOUR HYDRO SYSTEM

WATER **VS.** AGENTS

by Chris Bond

Whether or not to flush is not the question. This is as true for your personal bathroom habits as it is for your hydroponic system – flushing is a must.

Flushing a system is a requirement for all hydroponic and aquaponic systems. What may be up for debate, though, is whether or not to use plain old water or whether other agents would work better. Let's look at some of the options.



“IN GENERAL,
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BASICS OF FLUSHING

The flushing of any hydroponic system is done as a practical matter. Any operator of a hydroponic system that does not at least occasionally perform this measure will ultimately fail at growing anything due to the buildup of bacteria, algae, etc., that finds its way into even the most expertly managed hydroponic systems. Most systems, while they are in use, need to be flushed at a minimum of every one to two weeks. Some growers flush their system between crops; others do it every time or every other time they wish to add nutrients to their reservoirs. Frequency of flushing will be dictated by the needs of the system to keep it clean and the preferences of the individual grower.

In the decision making process of deciding to use agents, it is important to consider the reasons for using them. Most, and arguably all (who aren't seeking the contrary for research purposes) growers would like to make sure their plants are integral components of healthy, living systems, thriving in a clean environment that reduces the incidence of disease pressure or other external stressors of plant health. Make sure to understand the differences between cleaning versus trying to eradicate all bacterial or microbial life. The difference between sanitation and disinfection is the difference between wiping things down to collect debris and using a product that acts as a bactericide, virucide, algacide, or other antiseptic.

In general, a flush of your hydro system between crops with some sort of chemical or biological agent should be viewed as an opportunity to kill anything and everything so nothing carries over between crops. If, however, you want to perform that same type of flush when there are still plants in the system, that approach will likely kill all your plants, but more on that later.

FLUSHING AGENT OPTIONS

The range of products available to clean out your hydro system with a flush can be overwhelming. Arriving at a choice by asking what someone else uses may not help to narrow down your selection. Visit any message board on the topic and you will see almost as many different opinions on what to use and when to do it as there are individual growers. There are plenty of products and each can work for your situation depending on your system and budget.

There are many options for flushing your system that you may already have in your kitchen or bathroom. Some growers use simple hand or dish soap when they do a flush between crops. One drop per four litres is a common ratio for these DIYers. Other common and effective options include bleach or hydrogen peroxide — more on those below. Your media, however, may dictate what type of agent would work best for your scenario. If you use coco or stonewool, you may want to consider a flushing agent with enzymes to break down any dead root or other biomass that may have accumulated there.

There are growers who swear by using just water for flushing. They typically use reverse osmosis (RO) water, distilled water, deionized water, or any other aqua with a neutral pH (7.0). In an otherwise clean system, this may be all that's required. Remember, though, you cannot see all the potential contaminants in a system. Just because it looks clean, doesn't mean it really is.



“HYDROGEN PEROXIDE

can be used in a hydro system to increase the sanitation level and will not harm the plants.”

FLUSHING WITH OR WITHOUT PLANTS

If you notice plants in your hydro system are starting to look sickly or show signs of stress, you may be tempted to try and flush your system while your plants are still in it. Your plant leaves may be curling, getting brown spots, or if you accidentally add too much of a particular nutrient or are noticing some algae in your water — but your plants still look otherwise unaffected — it may be time to do an unscheduled flush. This can be done while your plants are still growing in the system if done carefully. Do not try to use any flushing agents not approved for use with plants if you are leaving your plants in place during a flush. The plants will absorb the chemicals and at best will kill them. Worst case, it won't kill them, but the plants will have absorbed the chemicals and the end consumer will end up eating them. If flushing with plants in your hydro system is the best course of action, there are a couple of options.

Hydrogen peroxide can be used in a hydro system to increase the sanitation level and will not harm the plants. Hydrogen peroxide will help the plant by providing additional oxygen to the roots. This is true so long as the amount used is not excessive. Start with food-grade hydrogen peroxide which is usually in a 35 per cent concentration. Dilute this with 10 to 12 parts deionised, RO, or distilled water to reduce the concentration to about three per cent hydrogen peroxide. Add one to two teaspoons (five to 10 millilitres) of the diluted solution per each gallon (four litres) of water in your system. Adding vinegar is another possibility, but this can be tricky if care is not exercised. Vinegar will lower your pH, so keep that in mind, but it won't harm your plants if diluted enough. Dilute white vinegar down to a similar ratio of the hydrogen peroxide of one to two teaspoons (five to 10 millilitres) per four litres of water. Be prepared to adjust the pH accordingly, though.

FLUSHING SALT AND NUTRIENTS FROM SOIL

Flushing is sometimes a necessary step in soil culture too. If salts have built up or the plant has received an overdose of nutrients, it can often be saved with a flushing of clean water if caught and acted upon in time. A volume of water at least three times the volume of the container is recommended to try and leach out the unwanted nutrients or other foreign substances. Plants grown in soil culture that do not get flushed when salts build up are prone to root rot or other diseases that will kill the plant or affect the yields.

Some growers flush their soil-grown crops as a matter of course during the last couple weeks of the plant's bloom so that it will be sure to use up all its stored nutrients.



They cut off the fertiliser supply or switch the irrigation to water only so that it cannot get any additional nutrients and will be forced to invade its stores. It is important to use pH-appropriate water during this phase, so plants can be sure to absorb all those available nutrients. Water with pH that is too high or too low can make the present nutrients unavailable to the plant even if the nutrients are there in sufficient amounts. If growing hydroponically and the grower wishes to do this, nutrients should be withheld for only the last couple of days pre-harvest.

In between crop cycles, the choice to use agents is up to each individual grower. In nature, the cycle of water flow usually does an adequate job of keeping things clean. A growroom or a hydroponic set-up is not exactly the spitting image of a diverse, thriving ecosystem. Cleaning agents such as bleach, hydrogen peroxide, vinegar, or any other number of commercially formulated agents will do a more thorough job of sterilizing your equipment and increasing its useful life.

PRECAUTIONS

Remember, if you are using anything other than plain water there are safety considerations. Just because a cleaning product is labelled as "natural" or "organic" does not make it safe to use. Fire can be natural and organic, as is quicksand, poison dart frogs, and salmonella. Be sure to read the label of any product carefully and observe any requirements for personal protective equipment and note the signal word (Caution, Warning, or Danger). When it comes to anything labelled as a pesticide, which includes many industrial cleaners, reading the entire label's contents

"IN BETWEEN CROP CYCLES,

the choice to use agents is up to each individual grower.

In nature, the cycle of water flow usually does an adequate job of keeping things clean."

is not just good practice and common sense, there is a legal requirement to do so. Wear gloves when handling any cleaning material and if there is the potential for splashing on your face or eyes, wear safety glass or a face shield.

Keeping a clean, sanitary and, when appropriate, sterile system is critical for the health of your plants and those that might be eating them, but it is not worth risking your personal health to achieve it. 🍷



RECYCLING HEAT

BETWEEN DUAL FLOWERING ROOMS

by Eric Hopper

Indoor growers in cooler climates can benefit from heat generated by grow lights and use the excess warmth to save money. Eric Hopper explains how to recycle the heat and reduce costs in the process.

All indoor gardens are unique. However, there is one thing most indoor gardens have in common: excess heat. The artificial lighting systems are notorious for emitting a lot of heat. To combat the excess heat, many growers employ mechanical devices, such as air conditioners or fans, to help keep temperature and humidity within the desired range. Even modern horticultural lighting systems, which are more efficient at converting electricity into usable light, emit enough warmth to create excess heat issues for growers. Depending on the geographical location of the garden, some horticulturists get a break from battling the excess heat during the winter months. These growers can take advantage of the cold air outside and draw it into the grow space to effectively cool the environment. However, growers who live in cooler climates may experience a different form of inefficiency as they use electric or gas heaters to maintain the proper temperature in the garden when the lights are off. Though heat is generally viewed as waste by indoor horticulturists, there are times when that heat can be recycled to maximise the overall efficiency of the garden.

Recycling “Waste” Heat

An indoor grower who lives in a climate where it is necessary to heat the “lights off” period of their flowering room stands to gain the most benefits from a heat recycling setup. To successfully implement this, a grower must have two flowering rooms operating on opposite 12-hour light cycles. The heat is transferred from the room with its lights on to the room with its lights off. To ensure the heat transfer is in sync with the light cycle, the exhaust fan(s) should be programmed to correspond with the light timer. In other words, when the lighting equipment is on in flowering room #1, the heat that is being created by the lighting equipment is ventilated into room #2, where the lights are off. When the light cycle switches, the ventilation system switches as well so that the room in its “lights on” cycle is always providing heat to the room in its lights off cycle.

Without a heat recycling setup, an indoor horticulturist living in a colder region would have to rely on a heating device to maintain an ideal temperature within the flowering room during the lights off cycle. However, when using the heat recycling method, a heating device would only need to be used as a back-up system. Most sophisticated indoor growing facilities are equipped with automated heating and cooling systems. During the winter months, these systems can alternate back and forth from air conditioning (during the lights on period) to heating (during the lights off period). Although growers in colder regions get a respite from excess heat during the winter months, they end up paying just as much to heat the growing space during the lights off period as they would to cool it during the other seasons of the year. Instead of alternating from cooling to heating equipment in one flowering room, a grower can opt for a dual flowering room setup. This allows them to divert the excess heat from flowering room #1 to maintain optimal temperatures in flowering room #2. Over the course of the entire season, a dual flower room setup with heat recycling can reduce the cost of heating and/or cooling equipment and, in turn, increase the grower’s overall return on investment.

“

THE IDEAL TYPE OF GARDEN FOR HEAT RECYCLING

is an indoor garden with a closed air-cooled reflector ventilation system.”

However, some indoor gardens are more suitable for heat recycling than others. The ideal type of garden for heat recycling is an indoor garden with a closed air-cooled reflector ventilation system. A closed air-cooled system takes fresh (cool) air from outside the garden space and draws it through the lighting fixture(s), which, in turn, cools the lighting fixture(s) and reduces the ambient temperature of the growroom. As the air passes through the reflectors, it becomes heated. Normally this heated air would be exhausted outside. In a heat recycling system, the heat is reused in the other flowering room during its lights off period.

Each closed ventilation system will need its own fan that is ducted directly to the adjoining flowering room. When employing a heat recycling system between flowering rooms, light leaks are a major concern. A flowering room’s dark cycle should always be kept as dark as possible and should never be interrupted by light. To avoid light leaks, a black interior ducting should be used, and the ducting should be bent into a U-shape between the rooms. This will stop any light from reflecting through the ducting.



**“ THE LONGER A DUCT RUN,
THE MORE RESISTANCE.**

This resistance reduces the fan's power and ability to move air.”

Ducting Length

Another important consideration when setting up a heat recycling ventilation system is the overall length of the exhaust ducting. The longer a duct run, the more resistance. This resistance reduces the fan's power and ability to move air. Because of this, the most efficient and effective way to recycle heat from one grow space to another is to have the two grow spaces adjacent or very close to each other. If a longer duct run is required, it may be necessary to increase the fan size so it has enough power to adequately move the heated air. Assuming the grower has or can build two adjacent flowering rooms, an additional fan, ducting, and a relay or flip light controller are the only pieces of equipment needed to create a heat recycling system.

Relay or Flip-Box

A relay or flip-box lighting controller allows two lamps to be powered by a single ballast (on opposite 12-hour photoperiods, not simultaneously). The ballast connected to a flip-box light controller operates continuously. A 12-hour cycle timer triggers the relay within the flip-box and the ballast's output power is routed from one lamp to the other. Put another way, every 12 hours, the flip-box lighting controller's relay switch engages and the light cycles of the two blooming rooms alternate. In addition to the benefit of recycling heat from one growroom to another, flip-box light controllers allow an indoor horticulturist to operate two flowering rooms on half as many ballasts. Essentially, these devices allow two light bulbs, on opposite 12-hour light cycles, to be operated by one ballast. For example, a grower with a 20-light flip-box light controller could operate a maximum of 40 lamps from 20 ballasts. Just about all flip-box light controllers are integrated with, or directly connected to, a timer which ensures the two flowering rooms' photoperiods will never overlap and remain on perfect 12-hour lights on and 12-hour lights off cycles.

Back-Up Cooling Device

In the rare instance too much heat is exhausted into the lights off garden space and the temperature exceeds the desired range, another cooling device, such as an air conditioner or an additional exhaust fan, can be used as a fail-safe. A small exhaust fan equipped with a cooling thermostat is all most indoor gardens will need as a backup cooling device.

Recycling heat within a dual flowering room setup is one of the best ways an indoor horticulturist, who lives in a cooler climate, can improve his or her garden's overall efficiency. Instead of redirecting the excess heat outside, a grower can take a few steps to implement a heat recycling system. Sometimes small growroom changes can compound to big savings. When applicable, heat recycling is one of those small changes that can result in immediate benefits.

Specialised equipment, such as a flip-box lighting controller, further increases the efficiency of heat recycling dual flowering room setups. Indoor growers are always looking for methods to increase their return on investment through heightened efficiency. For many growers, a dual flowering room, complete with heat recycling and a flip-box lighting controller, is the most effective and efficient method for indoor cultivation during the winter months. 🍷



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HOW TO USE PERMACULTURE GUILDS

to turn your garden into a Food Forest

Gardening can be back-breaking, labour-intensive work. Wouldn't it be nice to pass some of our chores on to nature? Permaculture is a style of gardening that does just that, so you have more time to enjoy your garden.

by Monica Mansfield

Permaculture utilises connections between plants, insects, animals, and soil biology to create a thriving ecosystem with minimal input from the gardener. These self-sustaining ecosystems can take five to seven years to fully develop, but you can still reap healthy harvests as they grow and mature.

These food forests follow the patterns of nature. In fact, many permaculture principles come directly from observing how plants grow together in the forest. No one tends to the forest, yet it is lush and vibrant. Permaculture strives to replicate this in your backyard.



PERMACULTURE GUILDS

One of the main methods used in permaculture is creating polycultures and guilds instead of planting rows of just one crop. When you plant multiple plants together, each one serves various functions to support the entire plant community. When you plant a row of one crop, you must pull weeds, fertilise, and spray pesticides. However, when you plant a guild, you group plants together that do these jobs for you. This lightens your work load and gives you more time to enjoy your garden.

The most common guild is the Three Sisters used by Native Americans. Corn, beans, and squash are planted together to grow healthier plants and maximise yields.

In the Three Sisters guild, the beans are hosts for bacteria that convert nitrogen from the air into a form plants can use. The corn acts as a trellis for the beans, secretes sugars in the root zone that feed the bean's nitrogen-fixing bacteria, and provides some shade for the squash plants. The squash sprawls between the corn and beans, acting as a ground cover, suppressing weeds, and conserving moisture in the soil.

THE LAYERS OF A GUILD

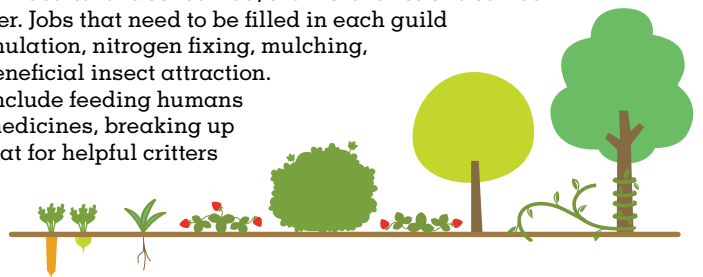
Permaculture mimics the forest, so it likes to fill in all the empty spaces between the lowest bushes to the tallest trees. Nature doesn't waste space. When choosing plants for your guild, you'll want to think the same way. Be sure to choose plants for each of the following layers: tall trees, small trees, bushes, herbs, ground covers, roots, and vines. A small garden can have as few as three layers, while a complete food forest will contain all of them:

- **The tall tree layer** consists of trees that are 15 metres tall and larger. For an edible garden, this overstory can include full-sized fruit and nut trees such as apple or pear. The trees should allow enough light through their leaves to reach the lower layers.
- **The small tree layer** contains trees that fit snugly underneath the tall tree layer. Dwarf and semi-dwarf fruit trees are perfect here, as are almonds, figs, and pecans. In a smaller garden, you can eliminate the tall tree layer and make the small tree layer the overstory.
- **The shrub layer** fits nicely underneath the small tree layer and usually consists of flowering, fruiting, and wildlife-attracting shrubs. These can include rosemary, blackberry, elderberry, cranberry, and blueberry.
- **The herb layer** sits even lower to the ground and includes plants such as chamomile, chives, comfrey, fennel, oregano, sage, and yarrow.
- **The ground cover layer** fits nicely in the spaces between each plant. This layer suppresses weeds and offers a habitat for friendly garden critters. Ideal ground cover options include strawberries, nasturtiums, clover, and creeping thyme.
- **The root layer** fills space below the soil. Options include garlic, garlic chives, horseradish, hardy ginger, and potatoes.
- **Vines and climbing plants** make good use of vertical space, climbing the trees and filling in all of the remaining gaps. Ideal options include grape, cucumber, hardy kiwi, melon, pea, and scarlet runner beans.

THE FUNCTIONS OF A GUILD

Each of the seven layers should be made up of plants that fulfill different functions. As far as permaculture is concerned, the more functions served by each plant, the better. Jobs that need to be filled in each guild include nutrient accumulation, nitrogen fixing, mulching, repelling pests, and beneficial insect attraction.

Additional functions include feeding humans and animals, herbal medicines, breaking up the soil, creating habitat for helpful critters like frogs and snakes, and cleaning heavy metals from the soil.



**“BE SURE TO CHOOSE PLANTS FOR EACH OF THE FOLLOWING LAYERS:
tall trees, small trees, bushes, herbs,
ground covers, roots, and vines.”**

“Each plant serves multiple functions,

AND BENEFITS THE ENTIRE ECOSYSTEM.”

Nutrient accumulators send their taproots deep into the soil and mine for minerals such as potassium, magnesium, and calcium. When these plants die back, their leaves drop and decompose, feeding the soil in the process. Nutrient accumulators include plants such as dandelion, plantain, chicory, and yarrow. Certain nutrient accumulators can even be used to clean up heavy metals, such as lead, at contaminated sites.

Nitrogen-fixing plants have rhizospheres that are home to nitrogen-fixing bacteria. These bacteria take nitrogen from the air and convert it to a form that plants can use. Nitrogen-fixing plants include peas, beans, vetch, lupines, alfalfa, and Russian olive.

Instead of hauling mulch to your garden, you can simply incorporate plants that will mulch in place. Comfrey, artichokes, rhubarb, clovers, and nasturtiums are all excellent options. You can chop and drop these plants multiple times throughout the season and they will compost in place. These green manures will feed the soil as they decompose, conserve moisture, and encourage healthy and diverse soil life.

Instead of spraying pesticides, you can add plants to your guilds that will act as natural pest repellents. Nasturtiums planted around fruit trees will repel borers and are effective against whitefly. Alliums, such as garlic and chives, are regarded as a natural, broad-spectrum insecticide. Many herbs repel a variety of pests, including basil, lavender, mint, dill, parsley, thyme, oregano, and bay leaves.

No guild is complete without plants to attract beneficial insects and pollinators. Almost any flower that produces pollen or nectar will do this job well. Flowers attract both pollinators that will help fruit set, and predators, such as predatory wasps, that will dine on pests. Not only do flowers play a functional role in your garden, but they add dashes of colour and beauty to your landscape. Butterfly weed, clover, coriander, dandelion, and fennel will attract lady bugs to your garden. Dill, fennel, and coriander are edible while also attracting predatory wasps. Butterfly bush and fuchsia will attract birds that will gobble up the eggs and larvae hiding in the holes and crevices of fruit trees.

COMPANION PLANTING

When designing your guilds, it is good to put plants together that are known to mutually benefit one another. For example, onions, leeks, rosemary, and sage planted near carrots will repel carrot flies. Carrot roots excrete a substance that stimulates the growth of peas.

Be sure to double check companion planting advice with current scientific studies. Many old-time companions have been proven not to be beneficial at all. For example, marigolds have long been regarded as pest repellents. While this is true of some varieties, other varieties actually attract pests, so it is wise to do your homework.

APPLE TREE GUILD

Now that you understand the main principles of a permaculture guild, let's look at how to create a guild around an apple tree. The apple tree serves as the guild's central element, providing food to humans. You could substitute it with any fruit or nut tree. The tree should be pruned into an open shape so light can reach the understory below.

We'll plant daffodils around the drip line of the tree. They contain a toxin that repels animals like deer and gophers, and their bulbs will suppress the growth of grass underneath the tree. We could also add garlic and chives as added protection against pests.

Inside the ring of daffodils, we'll interplant comfrey and artichokes. Their leaves supply nutrient-rich mulch, while providing the gardener with food and medicine. Comfrey's flowers will also attract pollinators.

Dotted among the comfrey and artichoke, we'll add yarrow, nasturtiums, dill, and fennel. We'll even allow plants normally considered weeds, like dandelion and plantain, to grow. The dandelion, yarrow, and plantain act as our nutrient accumulators. The nasturtiums will serve as mulch and pest repellent. The dill and fennel will attract beneficial insects. The nasturtiums, dill, fennel, dandelion, and plantain are all edible, while the yarrow, dandelion, and plantain can be used medicinally. To fill in the rest of the gaps, we'll grow clover and fava beans as ground covers. These are our nitrogen fixers. The clover can also be chopped and used as mulch.

As you can see, each plant serves multiple functions, and benefits the entire ecosystem. Health and yield will be greater than if any one of these plants were grown alone.

Now that you have a basic understanding of these guidelines and principles, you can start to create guilds at home and turn your vegetable garden into your very own food forest. 🍷



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HYDRO LAB ANALYSIS TESTS

and how to use them



Getting a lab water analysis test is a sensible step to help avoid potential growth issues.

While we know hydroponics can provide advanced and balanced plant nutrition, sometimes a little reassurance or detective work is required when it comes to the analytical side of growing. Using laboratory testing of water, nutrient solutions, foliage, and growing mediums are all useful tools for both small and large growers alike and in these modern times are becoming standard practice in many indoor systems. Laboratory testing is not as technical as it seems; a small sample is collected and sent away with the results usually returned within a few days. What can be confusing, however, is the interpretation and use of this valuable data to better optimise growth and plant performance or to simply identify a nutritional issue. Lab testing can not only help with diagnosis of plant problems, but assist with basic adjustments to nutritional programs, determine the suitability of a water supply for hydroponic production, or ensure food safety guidelines are being met with microbiological testing.

Types of Lab Tests

The basic lab tests used by hydroponic growers are water, nutrient solutions, and foliar mineral levels. There are less common tests such as sap testing, analysis of growing substrates (widely used in the nursery industry for container mixes), and microbiological testing for the presence of food safety pathogens such as *E.coli*, which applies more to commercial growers.

These tests are carried out by agricultural testing laboratories that must meet certain standards for accuracy to ensure reliable results. The first step in obtaining any hydroponic analysis is to contact an agricultural lab and check their requirements for sending samples. Some labs will provide sampling kits including bottles for water/nutrients and bags for foliar samples to help prevent contamination, however, many just provide instructions on sample size, containers, packaging, and delivery methods to ensure the sample reaches the lab in good condition. Once analysed, the lab will provide a report for each sample — basic reports may only contain the levels of variables tested, however, some labs may provide an interpretation or guidelines to optimal levels for the crop being grown.

Water Testing

Unless reverse osmosis (RO) or distilled water is being used for a hydroponic system, a water supply analysis is always a good idea. Even growers who consider their water supply to be of high quality often find surprises in their water analysis, many of which can usually be corrected or adjusted for. Most water supplies, particularly those based on well water or municipal supplies, do have some minerals present and it is always an advantage to know other parameters such as the pH, EC, and alkalinity.

“THE BASIC LAB TESTS

used by hydroponic growers are water, nutrient solutions, and foliar mineral levels.”



If you're a hydroponic grower, getting your water, foliar minerals, and nutrient solutions tested and analysed by a lab is something all cultivators should do to ensure ultimate crop health and production.

by Dr. Lynette Morgan



Foliar mineral analysis helps distinguish between deficiency disorders and other issues such as disease (this lettuce is showing advanced potassium deficiency).



Foliar analysis of healthy plants can help determine the required nutrient levels and ratios when growing a new crop where little nutrient formulation information is available.

A basic water supply analysis should test for: TDS (total dissolved solids), EC, pH, alkalinity, nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulphur (S), magnesium (Mg), sodium, chloride, iron, manganese, zinc, boron, and copper, which are of importance to hydroponic plant nutrition. While the presence of low levels of macro elements such as N, P, K, Ca, Mg, and S in a water supply is not a concern, high levels of these will require adjustment of the nutrient formulation to keep the solution in balance. In most water supplies Ca and Mg are the most common elements found, while N, P, and K are much less likely to be at plant-usable levels. Water analysis reports that show a high pH and moderate to high alkalinity (which is the strength of a high pH) give growers valuable information on how pH may need to be adjusted. Highly alkaline waters are best treated with acid before they are introduced to the hydroponic system, which provides a greater buffering capacity and less acid will be required overall to keep pH levels down over time.

Foliar Analysis

Foliar analysis is another useful tool for growers that can provide insightful and valuable information on the nutritional status of a hydroponic crop. Foliar analysis samples need to be collected correctly to be accurate; this involves taking leaves at the correct stage of growth, often the youngest mature leaf, combined from several different plants to ensure a representative sample is being tested. These are then sent directly to the lab before the leaves can deteriorate.

“**REGULAR FOLIAR ANALYSIS** does provide long-term information on how minerals levels change through the crop life cycle and when nutrient formulation adjustments should be made.”





	 LETTUCE	 TOMATO	 ROSE	 STRAWBERRY
N %	3.1-4.5	4.5-5.5	3.0-5.0	2.6-3.5
P %	0.35-0.60	0.40-0.70	0.25-0.50	0.25-0.35
K %	4.5-8.0	4.0-6.0	1.5-3.0	1.0-2.0
Ca %	0.80-2.0	1.20-2.0	1.0-2.0	0.70-1.50
Mg %	0.30-0.70	0.40-0.70	0.25-0.50	0.25-0.40
S %	0.20-0.30	0.60-2.0	0.25-0.70	0.15-0.35
Na %	0 - 0.30	0.08-0.15	0.0-0.10	0.02-0.10
Fe (ppm)	50-100	80-200	60-200	100-200
Mn (ppm)	50-300	50-250	30-200	200-500
B (ppm)	25-55	30-60	30-60	30-100
Zn (ppm)	25-250	30-60	17-100	30-80
Cu (ppm)	7-80	15-50	7-25	5-12

TABLE 1: Typical foliar mineral levels by hydroponic crop.

Foliar analysis is used for a couple of different reasons. First, it can routinely monitor nutrients in the plant tissue to help sustain growth and avoid nutritional disorders in the crop that impact yield. Second, it can be used as a diagnostic tool to identify nutrient deficiencies, toxicities, or imbalances when plants appear to be underperforming or showing strange symptoms.

While foliar analysis gives an insight into the current nutritional status of a plant or crop, it doesn't reflect what the plant is taking up at the time of testing. Foliar mineral levels are representative of the nutrients being taken up at the time tissue was forming, and for some slow-growing species that may have been several weeks previously. Regular foliar analysis does provide long-term information on how minerals levels change through the crop life cycle and when nutrient formulation adjustments should be made, particularly when plants move into the flowering and fruiting phases.

Foliar analysis reports returned from the lab usually state macro elements (N, P, K, Ca, S, Mg) as a percentage and micro elements as either ppm or mg/Kg which are equivalent. Some lab reports will use a comparison chart to indicate how the results stack up against optimal levels for the plant species tested; otherwise growers need to carry out their own comparison. There are many references for the ideal foliar minerals for commonly grown hydroponic crops and these may differ slightly from source to source, often the ideal level is stated as a range within which normal healthy tissue should fall (Table1).

Nutrient Solution Analysis

Sending samples of nutrient solution to an agricultural lab for analysis is a common practice with commercial growers, however, smaller systems also benefit from this particularly where recirculation of the nutrient solution

is in use. Much like a water analysis, nutrient solution samples are collected in clean, rinsed bottles and sent off to the lab as quickly as possible. Samples can be kept under refrigeration, if necessary, before shipment. The most commonly analysed samples are of nutrient leachate — that is the nutrient solution that drains from the base of growing containers/slabs or beds. These samples give valuable information on how levels of each of the specific nutrient ions change as the solution flows through the root system, thus identifying any deficiencies, accumulation of elements, or general changes in balance of the nutrient formulation due to plant uptake. Samples of nutrient taken from recirculating systems such as NFT, DFT, raft/pond type systems should be carried out after the solution has been in use for at least a week to assess how the balance of nutrient ions is changing over time. Data from these analysis reports then can be used to make adjustments to the nutrient solution — elements that are declining over time can be boosted and any accumulation, particularly of any unwanted elements such as sodium, can be identified. Use of solution analysis allows a grower to determine when a recirculating nutrient solution requires replacement to bring the balance of elements back in line with optimal levels. Solution analysis also allows a check to be made of system equipment such as EC and pH meters and probes. Samples should be tested for EC and pH with the grower's meters before being sent off to the lab;

“**USE OF SOLUTION ANALYSIS ALLOWS** a grower to determine when a recirculating nutrient solution requires replacement to bring the balance of elements back in line with optimal levels.”

Mixed crop systems using recirculating nutrient solutions can have rapid changes in nutrient ratios which are quickly picked up by solution analysis.



Nutrient solution or leachate testing is a useful diagnostic tool when symptoms start to appear.





Lab analysis of potting or container mixes is often used in the nursery industry for the production of ornamental plants.

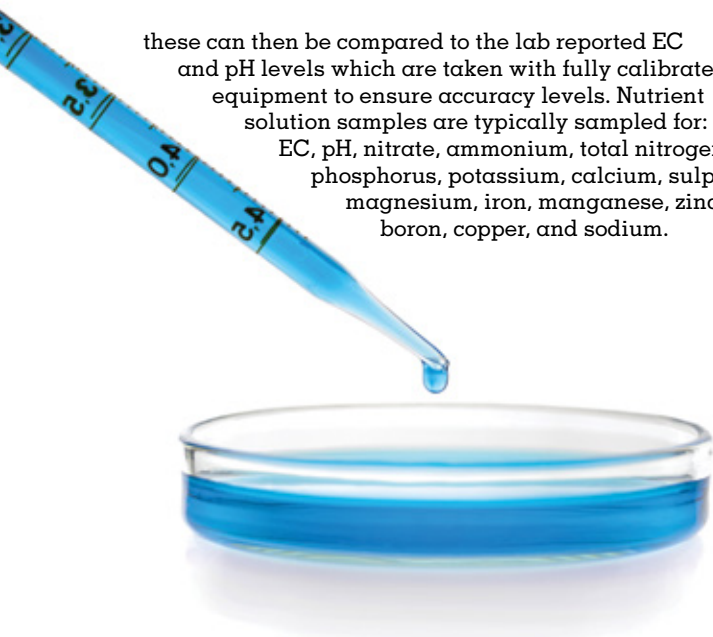


Solution testing is particularly important with fruiting plants to ensure sufficient potassium is always present for good fruit quality.

“**KEEPING GOOD RECORDS** of regular laboratory analysis reports is another important aspect of crop testing.”

these can then be compared to the lab reported EC and pH levels which are taken with fully calibrated equipment to ensure accuracy levels. Nutrient solution samples are typically sampled for:

- EC, pH, nitrate, ammonium, total nitrogen, phosphorus, potassium, calcium, sulphur, magnesium, iron, manganese, zinc, boron, copper, and sodium.



Nutrient solution analysis returned from the lab usually states the level of each element in either parts per million (ppm) or mg/l (milligrams per litre) which are equivalent. These, as well as pH and EC, should then be compared back to the ideal levels of each element that the original formulation or nutrient product contained. So, if a nutrient solution was used that contained 150ppm N and the analysis of the solution came back with 145ppm N, then this indicates the initial level was approximately what the crop was taking up. If the analysis report returned a much lower level, then this indicates N needs to be increased in the nutrient solution to account for the higher uptake rate. Along with nutrient levels, unwanted elements such as the accumulation of sodium or any trace elements in the water supply can be checked with analysis reports, allowing replacement of recirculating solutions when levels become too high, thus reducing the risk of toxicity and growth issues.

Keeping good records of regular laboratory analysis reports is another important aspect of crop testing and allows trends to be seen as plants move through their life cycle or respond to different growing conditions. If cost is an issue, the most important lab test for any grower is the water supply; this can determine if water treatment is necessary, if any adjustment is required for nutrient solutions, and can help identify potential growth issues before they occur. [🔗](#)



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YELLOW ALERT

7 REASONS FOR YELLOWING LEAVES

by Sally Nex

Yellow leaves are part of nature's process but yellowing can mean trouble for your plants. Sally Nex examines seven reasons why leaves go yellow and ways to get your plants back on track.

Yellow is an alarming shade to find in the greenhouse, especially when you're not expecting it. From a limey pallor to the startling lemon of truly sick foliage, yellow leaves glare out like warning signs against the lush deep greens of healthy foliage.

The trouble is, yellow leaves are the plant health equivalent of a headache — a general symptom that could mean anything. Throbbing temples in humans can be caused by a brain tumour or just a good party the night before. To get to the bottom of exactly what's wrong, a doctor must investigate further, and it's the same with plants: while yellow leaves are cause for concern, you'll need to find other symptoms before you can decide on a treatment.

Essentially, when a leaf turns yellow, it is dying. We're all familiar with the process: it happens every fall, as deciduous trees get ready to slip into dormancy for the winter and shed their foliage. Previously green leaves turn spectacular shades of red, orange, or yellow as they die, then detach from the tree and float to the ground.

The fall leaf drop is when trees reveal their 'true' colours. The green pigment in most leaves is a chemical, chlorophyll, which enables the plant to photosynthesise and turn sunlight into sugar. As the leaf dies, a layer of cells form along the base of the stalk attaching it to the plant, effectively sealing off the pathway of sugar from leaf to plant. The leaf stops photosynthesising, levels of chlorophyll drop, and the leaf reveals the underlying pigment — usually yellow carotenoids (also responsible for orange carrots and yellow corn). Eventually, this colour also fades and becomes the brown of dead tissue (or the necrotic black of rot).

So, a yellowing leaf is a natural process. But in a healthy plant in midsummer, when leaves should not be dying, it's also a signal something is up. There are lots of possible causes, so we've put together a symptom checker of the seven most common reasons for yellowing leaves to help you decide what's wrong, and what to do about it.

1 Mineral Deficiency

Feeling pale, a little jaded, under the weather? All are symptoms of anemia, or shortage of iron.

It's the same for plants: when plants are short of the minerals they need to thrive, they do the plant equivalent of going pale — their leaves turn yellow.

Most soils contain a good mix of minerals, but they aren't always available to your plants. Acid-loving blueberries grown in alkaline soil are unable to absorb iron; forget to feed plants in pots and they quickly use up the nitrogen in the potting compost and start to starve. Waterlogging and drought can lock up minerals away from plants, too.

Other symptoms to look out for:

- **Green veins on older leaves:** Yellowing leaves with green veins could mean magnesium deficiency, sometimes caused by over-feeding. Apply Epsom salts as a foliar spray every two weeks.
- **Brown, crispy leaf edges and green veins on young leaves:** This is iron deficiency, common in acid-loving plants grown in alkaline or neutral soils. Grow in pots of ericaceous compost instead.
- **Spindly growth:** Yellowing, weak, slow-growing plants are often short of nitrogen. Put it right with a good feed of nitrogen-rich liquid feed, followed up with a slow release feed and mulch.
- **Purple tints:** Yellow leaves blotched with purple can mean potassium deficiency, especially if plants aren't fruiting well. Remedy with a dose of potassium-rich liquid tomato feed.







THE TROUBLE IS, yellow leaves are the plant health equivalent of a headache – a general symptom that could mean anything.”

2 Virus Infection

Luckily for gardeners, viruses aren't as common in plants as they are in humans. But they work the same way: tiny microscopic parasitic organisms infiltrate a plant's system cell by cell, distorting and stunting growth and turning leaves yellow, mottled, striped, and streaked.

There is no cure, so the only way you can deal with a virus is to stop it from infecting your plants in the first place. Viruses can be carried by aphids and other insects, so keep on top of pest control; weeds also act as host plants. Dip pruners in disinfectant between plants as a precaution, too.

Other symptoms to look out for:

- **Mottling:** Common in cucumber mosaic virus, which infects cucurbits (cucumbers, squashes, and pumpkins) and potatoes as well as many other plants.
- **Crinkly leaves** accompanied by mottled yellowish patches could mean tobacco mosaic virus, which can affect tomatoes, eggplants, and peppers. The edges of the leaves can also dry out.
- **Stunted, twisted growth:** Most viruses will cause plants to look odd — twisted, curled leaves, sometimes streaked white, or stunted stems, plus brown patches on fruits are all virus symptoms.

3 Fungal Diseases

The world of fungi is a mysterious place. There are billions of them, all mostly beneath your feet, from microscopic mycorrhizal soil fungi to giant *Armillaria ostoyae*, one of which is now the largest living thing in the world; its underground mycelia covering almost four square miles of Oregon.

Sometimes, as in powdery and downy mildews, the fungal growth will be obvious — in this case, as a dusty coating on the leaf. Mostly, you won't see the fungi infecting your plants; all you'll notice are the symptoms, which often include yellow, sickly-looking leaves.

Other symptoms to look out for:

- **Rusty orange patches:** Rusts first appear as orange spots; affected leaves then turn yellow and die prematurely. There's no cure, but you can slow the spread by picking off affected leaves.
- **Wilting:** If an otherwise healthy plant yellows and then wilts, suspect *Verticillium* wilt, a fungal disease which infects water-carrying vessels so plants die of thirst. Once it's in your greenhouse borders, you'll have it for years; grow in containers or grow bags of clean compost instead.
- **Black spots:** Yellow rose leaves with black or dark purple spots are a sure sign of blackspot. Prune out infected stems and pick up and dispose of fallen leaves carefully; some types, especially older species type hip-bearing roses like *Rosa rugosa*, are less susceptible.

4 Pests

Plant leaves yellow when under attack from sap-sucking insects because they are literally having the life sucked out of them. Colonies can number thousands of microscopic creatures, every one of them plugged into your plants' veins like so many leeches. It's no wonder they turn pale.

Turn affected leaves over and look on the undersides, as this is where any pests will be hiding. Sometimes you'll find them on the shoot tips, too, where the leaves are tender and tiny bug mouthparts don't have to work so hard.

Other symptoms to look out for:

- **Cobwebs:** You'll need a magnifying glass to spot red spider mites, but their silk-like cobwebs are a giveaway. Spray with insecticidal soap or release the biological control *Phytoseiulus persimilis*.
- **White moths:** Whitefly are invisible while plants are undisturbed, but brush the leaves and they flutter up in clouds. Your best defence is a biological control like the parasitic wasp *Encarsia formosa*.
- **Wilting:** This usually means damage at the root level. Suspect cabbage root fly maggots — easily prevented by laying a cardboard collar around seedlings — or vine weevil grubs, especially in container-grown plants. Tip plants out and wash the roots clean of compost, then repot. Or prevent damage with the biological control nematode *Steinernema kraussei*.

5 Weather

We all get a little haggard in a long winter; it's no coincidence that you're more likely to fall sick in chilly, damp conditions when you're uncomfortable and run down.

It's much the same for plants, especially in these days of increasingly dramatic changes in our climate. Extreme weather conditions can happen any time of year and they're really tough for growing plants. Heavy rain can flood the soil, drowning roots and washing out nitrogen completely. Long, hot, dry spells lock up nutrients so roots can't get at them. And frosty days freeze and damage vulnerable plant cells.

All these conditions cause leaves to turn yellow, so sometimes when you're faced with a sickly-looking plant, it's a good idea to look up at the sky.

Other symptoms to look out for:

- **Standing water:** Poorly drained soils waterlog easily, filling soil air pockets with water and drowning roots. Digging in organic matter helps open up heavy soils, or you can install drainage pipes.
- **Scorched leaves:** Yellowing leaves with brown, scorched tips in summer often mean your plant is gasping for water. Water new plants particularly well in the year after planting as they haven't yet sent roots into the soil.
- **Frost:** Yellowing leaves in winter could be cold-induced chlorosis, caused by soil microbes slowing down in cold weather so they don't deliver nutrients to plants. They usually recover but covering plants with horticultural fleece and cloches keeps them warmer longer.



6 Weedkiller

Sometimes, we are our plants' own worst enemies. A slip of a spray gun, the wind blowing in the wrong direction, and a splash of herbicide lands in the wrong place. Result: yellow leaves. Protecting nearby plants with sheets of cardboard helps, but it's better for them and the environment not to spray at all.

Herbicide damage can happen indirectly. Aminopyralid is a herbicide commonly used on grazing pasture and can end up contaminating manure, causing serious damage when used, unwittingly, by gardeners. Source manure carefully; if you can't be sure, a test sowing of susceptible plants like fava beans will tell you if your batch of compost is clean or not.

Other symptoms to look out for:

- **Stunted growth:** Stalled growth and yellowing leaves are classic signs of general broadleaf herbicide damage. Prune off affected leaves as quickly as possible, and water thoroughly to dilute chemicals.
- **Curled leaves:** When seedlings emerge with distorted, fernlike leaves that curl in on themselves, it's likely you've been using manure contaminated with aminopyralid. Ditch affected plants, as they won't survive. The chemical breaks down in soil, so after a year compost should be safe to use.
- **Brown patches:** When leaves yellow in patches which die back leaving the rest of the leaf healthy, your plants may have been exposed to a contact herbicide such as diquat, which kills only where it touches. It's sometimes used by farmers to clear fields prior to sowing. Rinse thoroughly with water and if the plant is only lightly damaged it should recover.



WHILE YELLOW LEAVES

are a cause for concern, you'll need to find other symptoms before you can decide on a treatment."

7 Normal Aging

Yellowing leaves look alarming — and sometimes they are. But just occasionally, plants need to lose a leaf or two. We're familiar with the fall leaf drop, but what's less well known is that evergreen trees do this too, shedding a few older leaves gradually through the year. Brassicas (like cabbages, calabrese, and sprouts) also do this naturally as they mature.

As long as you can't see any other more sinister developments, such as wilting or the loss of young leaves, there's nothing to worry about. This is a perfectly natural process, known as senescence, in which the leaf stops growing or photosynthesising as the plant no longer needs it. It loses its green colouring, dies and then drops away, leaving the rest of the plant to grow on as normal. It's worth picking up the yellowing leaves, so they don't become havens for fungal diseases like botrytis — but otherwise, you don't need to do a thing.

When you spot that yellow warning light among your plants, it's worth sitting up and taking notice. But you'll need to look closer to find out what's really ailing them. Once you're confident of your diagnosis, act quickly, apply the right medicine, and in most cases, the patient will make a full recovery. 🍷



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The Horticulture Lighting Group sells LED lighting products for the horticulture lighting industry. The company sells LED lamps, modules, and heatsinks. All their LED modules are custom designed. Their latest QB 288 V2 LED module is made by Samsung in South Korea. Horticulture Lighting Group uses high-efficiency white light LEDs for its products. Co-founders Amit Chandna and Stephen Johnson took the time to answer our questions.

What prompted the merge between Johnson and Northern Grow Lights?

Johnson Grow Lights and Northern Grow Lights were both startup companies that were going on their second year as lighting companies. These startups gave Amit and myself a great exposure to the industry, helped us understand LED technology, efficiency, and what the customers are looking for. We saw an opportunity to work together on research and development of a new revolutionary lighting source for horticulture. We decided that it would be mutually beneficial to merge our resources and started Horticulture Lighting Group in 2016.

Was it a smooth merge or were there some growing pains?

Transition to working together was easy as we had been collaborating for the previous six months. We shared similar values and goals, and that helped us overcome the problem of living in different states.





“

These startups gave Amit and myself a great exposure to the industry, helped us understand LED technology, efficiency, and what the customers are looking for.”

How many people were employed by Horticulture Lighting Group at the beginning? What were their roles?

In the beginning, it was only the two of us (Amit and Steve) working eighteen hours a day on finishing the Quantum Board™ QB304 LED module design.

What did you first produce?

After the merger, we continued to sell the old product line together. Over time, we slowly replaced the old products with newer, higher-quality, higher-efficiency, and lower-priced products. The first fixture Horticulture Lighting Group produced was the HLG 550. The first product produced was the QB304 Quantum Board™ LED module design.

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

Being self-funded was a big challenge. We insisted on the company staying privately owned while we concentrated on what we felt was most important. When we launched the QB304 Quantum Board™, the adoption rate was very low and it was a unique new product. Over time, we were able to convince customers to try our products through our exceptional price, efficiency, and reviews. We started retailing our LED modules and that helped us fund the company.

What are you doing to gain market share and recognition?

Innovation, exceptional customer service, exhibitions, and advertising. Horticulture lighting is a fast-growing market. We are one of the top companies in the industry and have always faced a risk of copied products. We love

to innovate and bring newer, better products to market to lead the way. Currently, most of our customers are from word of mouth. We appreciate all our customers that have stood behind us and shared their success stories with others. We have plans to start selling Horticulture Lighting Group clothing on our website. We have exhibited at MJBizCon in Las Vegas, as well as Cultivate, NECANN, and Indo Expo. We also advertise with social media, Google, and in magazines.

Has Horticulture Lighting Group moved or expanded since the beginning?

Our company started with operations just in Ohio. We now have an account manager, customer support manager, shipping manager, production manager, and a small team of help production. We currently work directly with Samsung to make our most popular LED module, QB 288V2. We recently invested \$500,000 in an SMT production line in Tennessee. This line will help us reduce lead times, allow more flexibility, and enable us to overcome limitations of the machines our suppliers currently use.

What are some of your best-selling products?

Our best-selling product is the HLG 550 V2 lamp. We also sell a lot of small lamps and LED components like the QB 288V2.

What product(s) are you most proud of?

We take pride in all the products designed at Horticulture Lighting Group. We are most proud of HLG 550 V2 as it is the first ETL/CSA-certified fixture we make.

“Our strengths lie in innovation in LED tech as well as our understanding of light and its effects on plants.”

How good is the HLG 550 V2?

The HLG 550 V2 set a new record for horticulture lighting. It tested at 2.5 $\mu\text{mol}/\text{joule}$, making it one of the most efficient lights currently available. Through its simplistic design we are able to offer a high-efficiency lamp at a very competitive price. It covers up to a 4x5-foot space for flowering, is ETL/CSA-certified, and offers an exceptional value to commercial and home growers.

Are you partnered with Samsung?

We have been working with Samsung for over a year. We currently buy most of our LEDs from Samsung and they also help us make one of our LED modules. LEDs are constantly improving and this relationship with Samsung helps us ensure we can get the most recent and highest quality LED products to our customer. Recently, Samsung visited our facility and we are working towards strengthening our partnership.

Where do you distribute?

We currently sell our products at several online and brick and mortar stores in the US. We also have distributors in the EU, UK, Australia, and Canada.

How many people now work for the company?

We currently employ five employees at our new warehouse and three other employees who assemble our lamps. We hope to employ more local people soon.

What are your company's strengths?

Our strengths lie in innovation in LED tech as well as our understanding of light and its effects on plants (especially cannabis and hemp). Innovation and a very committed and hard-working team of employees.

What are some of your proudest moments?

Turning a profit. We had been working on getting our HLG 550 lamp ETL/CSA-certified for months and when that happened in November 2018, it was one of our proudest moments. We are also excited our SMT production line is up and running.





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

The horticulture lighting industry is fast growing. There are a few bad players in the industry who have given LEDs a bad name and it has been an uphill battle to convince some customers to give our LEDs a try. As this industry is new and not regulated, we see a lot of companies making false claims and advertising. We believe in science and transparency. We share independent lab reports on our website for our products. We report our efficiency numbers in horticulture metric PPF or μmol of photons, and not the traditional lighting metrics (like lumens).

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


The truest words of wisdom I can offer are the ones that lead me in both business and life: Treat others the

way you would want to be treated. We strive to provide a superior customer experience and offer a great product at a fair price.

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

We carefully choose the employees we work with. We do not micromanage our employees. We take a few employees to exhibitions when we travel. This helps them talk directly with customers and understand the industry. Our most recent exhibition was in Las Vegas and it was a great bonding experience for the team as we set up our booth and explored the local area.

Does your company participate in any community service?

Our company is transitioning from a small to a medium-size business. Given the 10- to 12-hour workdays and family commitments, we currently do not participate in any community service. 

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a brief HISTORY OF CORN

by Philip McIntosh

If one were to name the most important food plants on Earth, corn (*Zea mays*) would have to be near the top of most lists. Known as maize in many parts of the world, corn was just a humble grass when humans began cultivating it as far back as 10,000 years ago in central Mexico.



Corn likely originated from a plant called teosinte (*Zea luxurians*), which still exists, but you wouldn't recognise it as being much like the sweet corn found in grocery stores. Teosinte does have tassels on the male flowers much like corn does, but the female cobs contain few widely spaced seeds. It was a place to start, though, and through generation after generation of human selection, teosinte was slowly transformed into the crop plant we know today.

Christopher Columbus often gets the credit for introducing corn to Europe, but other New World explorers also came into contact with it. Starting in the late 1400s, corn began making its way around the world. Early on, with the Americas being an exception, corn was considered a lowly sort of food, suitable for the poor, farm animals, and perhaps prisoners. It remains most popular in the part of the world where it originated and rose to become one of the Three Sisters (along with climbing beans and squash) of early Central and North American agricultural societies.

Corn is not hard to grow, stores well, and is well-suited to mechanised production and processing methods. About 93 per cent of all corn grown in the US is genetically modified for resistance to insect pests or herbicides (or both). There are six distinct varieties of corn, each for a particular use:

- **DENT CORN** | Perhaps better known as field corn, it is used as animal feed and as a feedstock for many corn-derived products.

- **SWEET CORN** | The kind you eat on the cob or buy in a can.
- **FLINT CORN** | Smaller, fewer kernels with a hard, glossy outer shell. Less commonly grown in the US.
- **POPCORN** | A type of dent or flint corn with a hard kernel that bursts open as internal water vapour expands after heating.
- **FLOUR CORN** | Has a soft kernel that is easily ground into flour after drying.
- **POD CORN** | Can be any of the above types but has individual husks around each kernel. For decorative use only.

Is it possible to escape the long reach of corn? It wouldn't be easy since more than 4,000 different products are made from it. Sure, you've got your corn chips, but many other foodstuffs and non-food products contain ingredients derived from the noble corn plant. These include fresh, frozen, or canned corn, popcorn, cornmeal, cornstarch, high fructose corn syrup, and cooking oil. Most gasoline in many countries is augmented with ethanol, up to 10 per cent for regular gas and 85 per cent for flex fuel, fermented using corn. If you are into 3D printing, you have probably used a plastic filament called polylactic acid (PLA) which — you guessed it — is derived from corn. Whether for eating or for making something else out of it, corn remains one of the most important agricultural products in the world. 🌽

distribution LIST

retail stores are listed alphabetically in each state

ACT

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

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

NEW SOUTH WALES

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

VN Hydro
8 Robert St.
Belmore NSW 2192

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

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

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

NORTHERN TERRITORY

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

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

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

QUEENSLAND

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

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

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



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



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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

North Queensland Hydro Supplies
Shop 28/20-22 Fleming St.
Townsville QLD 4810
(07) 4728 3957

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

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

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

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

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

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



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

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

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

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

SOUTH AUSTRALIA



Adelaide Hydro
Shop 3,267 Goodwood Rd.
Kings Park SA 5034
(08) 7230 5907
adelaidehydro.com.au



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TASMANIA

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

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

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

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



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

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

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

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

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

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

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

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

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

VICTORIA

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

AAA Lush Hydroponics
2-4 The Arcade, Junction Village
Melbourne VIC 3100
(03) 9314 8088

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

**F.L.O.W. Plants
and Environments**
66B Chapel St.
Windsor VIC 3181
(03) 9510 6832

Fastway Hydroponics
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ten FACTS ON SQUASH

by Philip McIntosh

Squash in all their colours, shapes, sizes, and flavours, appear early in the agricultural record.



- 1 **All squash** are currently considered members of the genus *Cucurbita* in the family *Cucurbitaceae*.
- 2 ***Cucurbita pepo*** is the most well-known squash with several recognisable varieties including pumpkin (*C. pepo* var. *pepo*), summer squash (*C. pepo* var. *longa*), crook necked squash (*C. pepo* var. *torticolia*), zucchini (*C. pepo* var. *cylindrica*), and acorn squash (*C. pepo* var. *turbinata*).
- 3 **There are more than** a dozen species in the genus *Cucurbita*, but only five or so are cultivated for food.
- 4 **Some well-known** squash relatives, also in the *Cucurbitaceae*, are the gourds, watermelon, cucumbers, and luffa.
- 5 **Squash can perhaps** be considered the first of the Three Sisters of Mesoamerican agriculture, cultivated as far back as 8,000 to 10,000 years ago, before either maize or beans.
- 6 **We know** this from the analysis of ancient seeds, fruit rinds, and other plant remains found in a cave in the state of Oaxaca in southern Mexico.
- 7 **One way** to practically classify the different kinds of squash from a growing perspective is by dividing them into summer and winter varieties.
- 8 **Since all squash** generally grow during the summer and are not cold tolerant, the terms "summer squash" and "winter squash" are kind of misnomers. It has more to do with when the fruit ripens and how well they store.
- 9 **Summer squash** such as zucchini and the yellow varieties ripen earlier and should generally be eaten soon after harvest, while winter varieties like acorn squash and pumpkins grow later into the summer and can be stored longer.
- 10 **The fruit and seeds** are not the only edible parts of a squash plant; the flowers can be eaten in a variety of ways.

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