IDENTIFYING AND PREVENTING PLANT VIRUSES

MAXIMUM Y

NOV/DEC 2021

A COMPLETE GUIDE FOR THE MODE

THE IMPORTANCE OF HYDROPONIC ELECTRICAL CONDUCTIVITY

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TOWERING SPIDERS

DUTCH BUCKET SYSTEM

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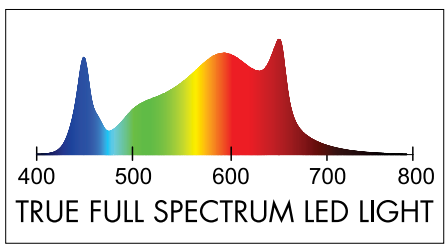

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THE CHOICE OF HYDROPONIC CRAFTSMEN.

“Sometimes the world just feels better when you’ve got bright, colourful plants surrounding you in your house or apartment.”

from the **EDITOR**

TG **Toby Gorman**

Growing at home has never been more important than now. As links in the world’s supply chain for just about everything from food to bicycles start to show signs of stress or have already broken, being self sufficient is an increasingly important skill.

Recently, I received an email from one of my favourite garden retail outlets that it could take up to a year for them to fulfill my order. Of course, I had to pay for my order first, then wait months for it to arrive. To me, that was a warning sign of things to come for all goods and services. Inflation is also a growing concern. Things are going to be a lot more expensive soon.

Fortunately, growing a garden, indoors or out, is not only the perfect way to be self-sufficient, it’s also a great distraction from those global issues we can’t control.

In this issue, we have a number of articles that will help you maximise your self sufficiency in the garden. On page 42, Chris Bond provides some sage advice on how to best harvest hydroponic lettuce so that you will always have a supply of healthy, nutritious leafy greens on hand.

On page 50, Kent Gruetzmacher explains how to set up a very simple Dutch bucket system, allowing you to easily grow just about anything you want with very little effort and money required. “Dutch bucket hydro systems have grown increasingly popular in the horticulture space due to their simplicity and versatility, as well as their environmental safeguards. Also known as ‘bato buckets’, Dutch bucket hydroponic systems are a great option for both home growers and commercial producers,” writes Gruetzmacher.

Finally, sometimes the world just feels better when you’ve got bright, colourful plants surrounding you in your house or apartment. We asked Rich Hamilton to select five decorative plants you can grow hydroponically, and he delivered with five choices that will clean the air around you, improve your mental health, and look good doing it. You can find that on page 46.

The world can be a challenging place to navigate, but when you’re focused on things that make you feel happy and are good for you, like gardening and growing your own food and plants, it always feels like everything will be just fine.

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Featured Contributors

GC **Grubbycup** has been an avid indoor gardener for more than 20 years. His articles were first published in the United Kingdom, and since then his gardening advice has been published in French, Spanish, Italian, Polish, Czechoslovakian and German. Follow his gardening adventures at his website *grubbycup.com*

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

Contributors

+ **Chris Bond**
Kent Gruetzmacher
Eric Hopper
Philip McIntosh
Rich Hamilton

A RECIRCULATING HYDROPONICS

Hydroponics is an inclusive term for many different growing methods which involve delivering a nutrient solution to a soil-less media. **Recirculating hydroponics** (a.k.a. closed-loop hydroponics) setups are the most environmentally friendly growing options due to the continuously recycled water and nutrients. The water conservation benefits of recirculating hydroponics systems are particularly attractive in dry climates.

Water conserving growing methods are one of the central benefits of controlled environment agriculture (CEA) and hydroponics. The alternative method, drain-to-waste (a.k.a. feed-to-waste), delivers a nutrient solution to the medium and the excess solution is allowed to drain away to disposal. Drain-to-waste systems have features which make them easier to operate but the water conservation benefits of recirculation systems often outweigh the benefits of drain-to-waste.

Deep water culture (DWC), ebb and flood, nutrient film technique (NFT), the Dutch bucket system, and even aeroponics, are all forms of recirculating hydroponics. Drip systems can be utilised with both recirculating systems and drain-to-waste systems.

Check out Kent Gruetzmacher's article on page 50 for more information.

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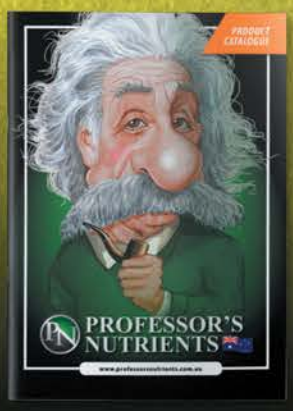

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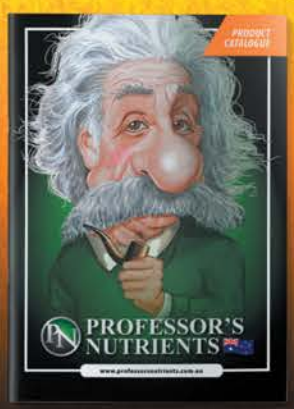

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DO YOU HAVE A QUESTION FOR A GROWER? Email *editor@maximumyield.com* to get an answer.

ask a **GROWER**

by Eric Hopper

Q. I've been growing using hydroponics for the last year and have had okay results. A friend suggested I keep a journal. I am hoping you can advise me on what kinds of things I should be documenting to help my garden be more successful.

– Evan P., Bend, Oregon

A. Thank you for your question. A gardening journal is a useful tool for any type of garden, but it is especially valuable for hydroponic gardens. Hydroponic gardening is revered for its rapid speed of growth and efficiency in nutrient solution usage. Things happen quickly in a hydroponic garden and problems are no exception. To minimise or eliminate potential issues, a hydroponic grower must monitor his or her hydro system on a regular basis. Keeping a detailed garden journal is one of the best ways a grower can improve the performance of their hydroponic garden. After collecting data from different grow cycles, a grower is then able to make subtle changes and compare the data to see the effect(s) of those changes. For example, increasing or decreasing the PPM of the nutrient solution at various stages of growth may increase or decrease the garden's overall performance. With proper documentation, it is easier to pinpoint which subtle change increased (or decreased) the performance of your garden.

With hydroponic systems, it is important to monitor/document everything involved with the nutrient solution, such as pH, PPM, water level, water temperature, irrigation intervals, and dissolved oxygen (DO) content. The nutrient solution in a hydroponic system is much more than just "water" for your plants. The pH, PPM, temperature, and DO content all play major roles in the plant's ability to uptake nutrients. With a good digital tester, these parameters can be tested and documented in less than five minutes. Each time these variables are tested (preferably multiple times per day), they should be logged in the garden journal. Close monitoring and documentation of these factors will allow a grower to see any changes and/or any patterns that may develop. Equipped with this information, a grower can adjust the nutrient solution more accurately and proactively. For example, let's say the pH of the nutrient solution always decreases out of the desired range at the beginning of each light cycle. After seeing this pattern develop over multiple days, a grower could preemptively adjust the pH so it remains within the desired range at the beginning of each light cycle.

It is also a good idea to record all the major influential components of plant growth in your garden journal for an indoor garden as well. Light, air, water, nutrients, and atmospheric conditions all affect plant growth. Data collected regarding these parameters will help a grower make informed decisions about the optimal ambient temperature/humidity for various stages of growth, when to change bulb/light fixtures, and when to clean/replace air filtration devices, such as carbon filters.

I hope this answers your question.

Keep on Growing,
Eric Hopper

EH **Eric Hopper** has more than 18 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.

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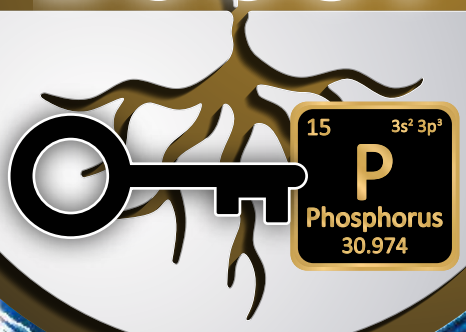

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FACTS

Grower Nets Turmeric Gains Via New Method

CV Prakash dedicated his free time during the lockdown last year to find ways of making growing turmeric (*Curcuma longa*) more profitable for farmers. He has trained more than 12,000 people in soilless farming techniques since 2008. During his research into growing the Salem variety of turmeric at his CV Hydro training center in Chikkasandra, Bengaluru, from May 2020 to January 2021, Prakash found that his specialised and unique hydroponic farming methods generated spectacular results. At the CV Hydro training centre his crops generated a curcumin content of 5.91 percent – nearly double the standard three percent found in the Salem variety – and the highest yield was up to 18 pounds from a single grow bag. Prakash cultivates the popular spice in grow bags (sizable porous bags made of high-density polyethylene) packed with coco-peat instead of growing in soil. His turmeric crops are grown in simple net houses as turmeric is a shade-loving plant.

– hortidaily.com

Drone Bee Works its Magic

With drone technology becoming more and more important in the agriculture sector, it's no surprise a new drone, the Polybee, has arrived to pollinate inside greenhouses. "Pollination can help you define your yield potential but whether or not you achieve this depends on how well the farm is being managed and if you can close the feedback loop on each plant," says Siddharth Jadhav, founder and CEO of Polybee. Polybee is a spin-off from the National University of Singapore that specialises in microdrones for pollination in controlled environment agriculture. Polybee has developed a method of pollination that works for strawberries, peppers, tomatoes, and eggplants in both indoor farms and greenhouses. These crops self-pollinate and typically use bumblebees to dislodge pollen from anthers and onto the stigma. Whereas bumblebees pollinate by landing on the flower (evidenced by little "bruises" on the flowers), Polybee uses aerodynamically controlled pollination to dislodge the pollen.

– hortidaily.com

Carnivorous Plant Discovered in Canada

Researchers at the University of British Columbia (UBC) have identified the first new carnivorous plant in 20 years. In collaboration with the University of Wisconsin-Madison, researchers discovered that the *Triantha occidentalis* found in Cypress National Park in B.C., a species of false asphodel, had a genetic deletion commonly found in other carnivorous plants. The researchers then noted that, unusual to carnivorous plants, it was the stem of Triantha that had sticky red hairs that trapped small insects such as midges and flies. The plant produces a digestive enzyme called phosphatase, which allows it to feast on the insect. Sean Graham, a professor in the department of botany at UBC, described the plant as "innocuous" and "sweet looking." However, if you look closer, Graham noted these plants will often have small insect corpses littering the stems. While Triantha relies on small bugs for food, it also depends on larger pollinator insects such as bees and butterflies to reproduce. According to Graham, these pollinators are not bothered by the stickiness of the stem.

– cbc.ca

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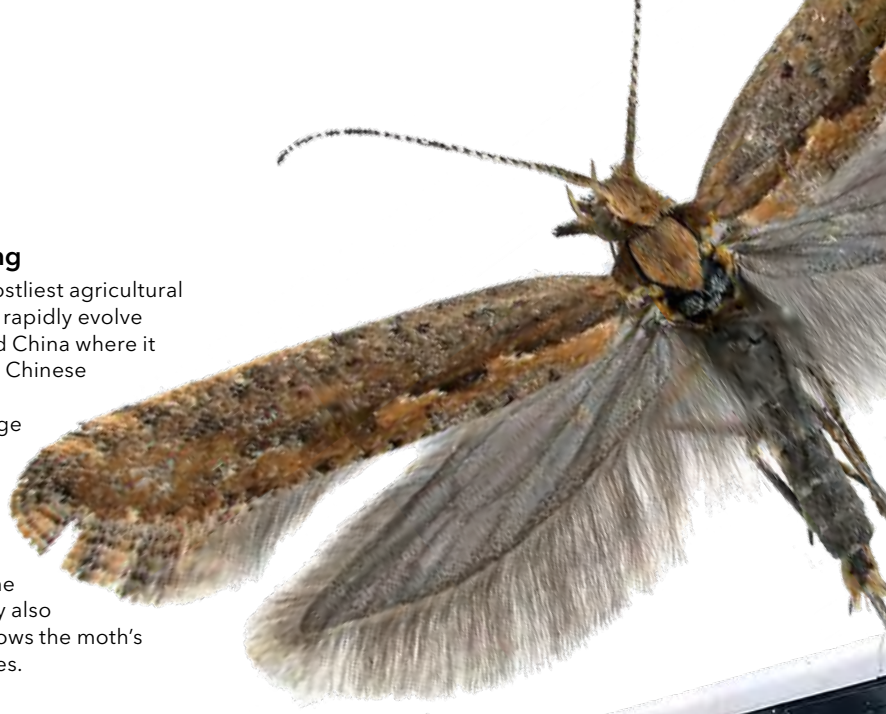

Crop-Eating Moth will Thrive with Global Warming

Climate change in this century will allow one of the world's costliest agricultural pests, the diamondback moth, to both thrive year-round and rapidly evolve resistance to pesticides in large parts of the U.S., Europe, and China where it previously died each winter, according to a study by U.S. and Chinese researchers. The moth, *Plutella xylostella* (also known as the cabbage moth), already causes more than $4 billion in damage worldwide each year to broccoli, cauliflower, cabbage, kale, mustard, radishes, turnips, watercress, Brussels sprouts, and other crops. It is also one the world's most pesticide-resistant species, with a documented resistance to at least 97 insecticides. Researchers found climate change over the past 50 years has increased the overwintering range of the diamondback moth by more than 925,000 square miles. They also showed each increase in mean global temperature of 1°C allows the moth's overwintering range to expand by about 850,000 square miles.

– *phys.org*

Mobile Aquaponics Lab Fosters Learning

If you're in Pennsylvania, keep an eye out for the AquaJack, a fully functional aquaponics operation on wheels that is being used as an educational tool in the state. It was created by The AquaJack Mobile Lab includes fish, water, LED lights, plants, and hands-on lessons. Students perform water tests and label the different parts of the aquaponic system. The lab is capable of connecting to the sensor system at the main Capital Campus, so students and community members can compare what is occurring at the main facility to what is occurring on the mobile lab. The mobile lab is scheduled across the state at school districts, fairs, agriculture conferences, and other events to spread awareness on controlled environment agriculture. The AquaJack is 19 metres long, three metres wide, and four metres high. The Mobile Lab is free for local Pennsylvania school districts.

– *hortidaily.com*

photo courtesy of Commonweath Charter Academy
twitter.com/commcharteracad

Hydroponics Industry Seeing Sustained Growth

The global hydroponics market is projected to reach a market size of S30.07 billion by 2028 at a rapid and steady compound annual growth rate of 14.3 percent over the forecast period, according to the most recent analysis by Emergen Research. The hydroponics market is witnessing increased demand due to the growing pressure on the agriculture industry for high-yielding farming techniques. The surge in global population is creating a high demand for food across the globe. The world population in 2019 was approximately 7.7 billion and is expected to grow to 8.5 billion in 2030. This will create a demand for alternative farming technologies to increase the yield of the crops. There is a growing demand for exotic fruits and vegetables due to increasing buying power of consumers. Several research institutions and universities are focused on development of hydroponics systems to fuel the production of these exotic products to meet the rising demand.

– *cbj.ca*

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2 | O_2 Grow Oxygen Bubblers

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3 | Reiziger Bloom Food A & B

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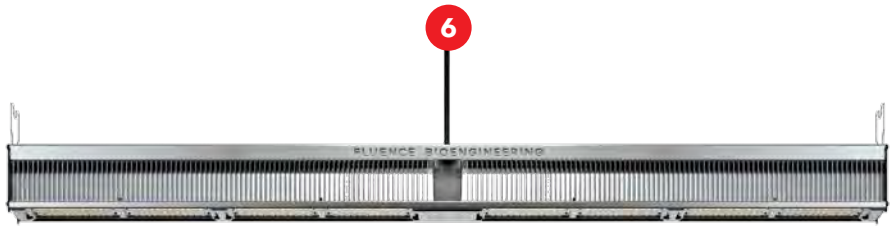

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5 | CANNA CALMAG AGENT

CANNA CALMAG AGENT is a calcium and magnesium mineral nutrient designed to increase the level of calcium and magnesium in the system without disrupting the balance of these ions in the plant. It also establishes a correct hard water condition in soft/RO water systems for calcium sensitive mediums such as coco. The pH is stabilised, and the minimal level of nitrogen helps replace what a CalMag product will remove from the plant.

6 | Fluence VYPR 3p Top Light

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7 | 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.

8 | Hygrozyme

Hygrozyme is a best-selling horticultural enzyme formula. Hygrozyme is a powerful blend of concentrated, beneficial enzymes that work synergistically to ensure plants achieve their full genetic potential. Its unique proprietary formula contains the highest units/mL of cellulase, which rapidly breaks down dead root matter and converts it into simple sugars which feed your beneficial bacteria. Hygrozyme is effective in all growing media and growth stages, and is compatible with all nutrient and supplement programs. Look for it through Growhard Australia.

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HYDROPONIC ELECTRICAL CONDUCTIVITY:

EC and EC Meters Explained

by Grubbycup

Mother Nature doesn't make mistakes, but people do, so monitoring EC is essential for any hydroponic grower.

Electrical conductivity (EC) meters are used to estimate the amount of nutrient ions in a nutrient solution. They rely on the principle that solutions with more ions conduct electricity better than those with fewer. Although the exact specifics of how each meter performs the test may differ, the basic concept is the same. All EC meters test how well a given solution conducts electricity.

Pure water is not a particularly good conductor of electricity. To reflect this, EC meters will show a reading of zero (or at least ideally zero, some meters have trouble when there isn't enough conduction) when placed in pure water. Water with conductive contaminates in it (for example, the ions from salts) do conduct electricity, and that difference is where EC meters come in.

Nutrient solutions are created by dissolving measured amount of nutrients (often salts of nitrogen, phosphorus, and potassium) into water (the solvent). Hydrophilic (water-loving) materials like salts tend to dissolve easily in water because water molecules have a positive charge on the side with the two hydrogen atoms, and a negative charge on the oxygen side. These are attracted and attach easily to many other molecules. Salts are often used as nutrient sources because they also have a positive and negative side but are generally held together with a weaker ionic bond. Water molecules attach themselves to either side of the salt molecule and literally split them apart. That's why many chemical hydroponic solutions make use of nutrient salts dissolved in water.

When salts such as potassium nitrate are dissolved in water, they break into their ionic forms. In the case of potassium nitrate this breaks into ions forming the cation $K+$ (potassium) and anion NO_3- (nitrate). Not only is this handy as a source of both potassium and nitrogen for the plants, but it allows the solution to better conduct electricity. There are many salts that can be used as fertilisers, such as urea, ammonium nitrate, mono ammonium phosphate, diammonium phosphate, and potassium chloride to name a few. The more salts that are added to the solution (to a point), the better the solution conducts electricity, and the higher the EC will read on the meter.

Raising the temperature of the solution increases the movement of its molecules, including its ions, and raises its conductivity. As one of the factors of conductivity is temperature, some EC meters include a thermometer to adjust their readings automatically, or one without can be used if care is taken to measure samples at the same particular temperature each reading or with the use of a temperature-conductivity adjustment chart.

One place where EC can be immediately useful is in determining if a solution is within expected tolerances. If the EC numbers unexpectedly double in a fresh batch of nutrient solution, it may be an indication that nutrient concentrates were added twice. Paying attention to EC levels can not only help identify issues but can be used to track changes in a nutrient schedule which can then be compared with similar historical data recorded from previous seasons. In general, nutrient schedules start light, then build in intensity to a plateau, and then taper off as harvest approaches.

Careful recording of readings during one season can set a baseline to compare subsequent seasons against, possibly alerting an attentive gardener to potential issues or unexpected changes. Note what nutrient schedule was used for the week, and the EC of the nutrient solution. This way changes in the nutrient schedule (or other factor) can be compared to prior performance. Changes that can be linked to improvements can be kept, and detrimental changes can be reversed. This allows for a continuous fine tuning of the nutrient regimen.

While EC meters do a fair job at displaying how many ions are in the solution, they don't indicate which ions are in the solution and it will not show results for any particular nutrient. A solution high in nitrogen salts but low in phosphorus may give an EC reading of 2, but so can one low in nitrogen but high in phosphorus. A solution made with table salt may show an EC of 2 but still not have enough nutrients in it for plant growth because plants don't need much chlorine and need even less sodium. A different solution with an EC 2 value might be well suited to growing plants if the ions are part of a balanced mixture of macronutrients and micronutrients.

"While EC meters do a fair job at displaying **how many ions** are in the solution, they don't indicate which ions are in the solution and it will not show results for any particular nutrient."

"Being able to monitor the overall levels can be not only **helpful** but can alert a grower to possible mistakes in solution mixing."

The easiest way to ensure the solution is a mixture of the desired elements is to add them in the correct proportions, such as by following a manufacturer's recommended feeding chart. To correct imbalances in a recirculating system, the nutrient solution can be replaced periodically to rebalance the mix of available nutrients in the solution.

Parts per million (PPM) and total dissolved solids (TDS) meters use the same principle. In fact, they are fundamentally the same EC meter with the results displayed slightly differently. There is currently an issue with the lack of a standard conversion between EC and PPM which often leads to confusion. Depending on which of the three most popular PPM standards are used, the conversion factor is 0.5, 0.64, or 0.7. Less commonly used is total soluble salt (TSS) which is x10 the EC reading.

Hydroponic gardeners can use EC meters to check the quality of the starting water, ensure freshly mixed nutrients are within expectations, and check recirculating nutrient solutions to determine if more nutrient solution or just more water should be added. It is an important tool in a hydroponic gardener's toolbox. On the other hand, those who rely on more traditional organic nutrients tend to rely on sources other than salts to deliver their nutrients, and as a result EC metering of organic-based nutrient solutions is less useful and often not done. Adding more kelp to a nutrient solution doesn't make the EC change as much as a similar amount of salt would.

An EC meter is an essential tool to hydroponic gardening. Since the only nutrients available are those administered by the gardener, being able to monitor the overall levels can be not only helpful but can alert a grower to possible mistakes in solution mixing.

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PLANT VIRUSES
POTENTIAL SUPER SPREADERS

When a virus arrives in a garden, be it commercial or home grown, it can swiftly cause a lot of damage. Follow Lynette Morgan's advice on how to identify symptoms and mitigate damage should a virus appear in your garden. | **by Dr. Lynette Morgan**

Viruses can cause us a great deal of fear and disruption and plants are, unfortunately, not immune to this curse. While we may be quite familiar with the common scourges of mildew, botrytis, and pythium, viruses are another problem that can continually plague some crops and growers are not always aware of the culprit. Vague and numerous symptoms can be characteristic of viruses, of which there are potentially many hundreds that can infect cultivated plants with hydroponic crops being no exception. Unlike fungal, bacterial, and physiological diseases, viruses have no control or cure and destruction of the infected plants to protect those which are not diseased is the only option. This makes prevention of infection the first line of defence and understanding how viruses are spread is important for any grower.

WHAT IS A PLANT VIRUS?

Plant viruses are extremely small, too small to be seen under a normal microscope, and consist of nucleic acid surrounded by a protein coat. These only infect and multiply within a living host plant where they hijack cells and disrupt growth and functioning. As this is occurring, symptoms may start to show, however, this is not always the case. Viruses have the ability to remain latent inside the plant and only cause symptom expression under certain growing conditions. Some common viruses can be temperature sensitive and only cause symptoms under high or low temperatures, others may be suppressed or masked when the plants are growing vigorously, or displayed when the plants are stressed.

VIRUS TRANSMISSION

Virus-infected plants can randomly show up in the most unexpected places — the middle of an otherwise healthy and thriving crop, in indoor growrooms, and even in fully enclosed cultivation areas. The secret to the success of virus transmission is the multiple methods by which these infectious particles can move from plant to plant. In hydroponic crops, which are usually grown in relatively clean environments, the main vectors are insect pests, new and infected planting material, or human activity. Some viruses are seed borne, however, by only using high-quality seed sources from reputable companies this is less common under protected cultivation. In greenhouses, chewing and sucking insect pests such as aphids, whitefly, leaf hoppers, and thrips can cause a huge amount of damage by simply transmitting viruses, both by carrying in virus from outside the crop and then by spreading it from plant to plant. Prevention of such pests is one of the main methods of virus prevention and control.

In a greenhouse or growroom setting, sap-to-sap transmission can rapidly occur during training, pruning and other plant-maintenance procedures carried on with equipment, knives, and grower's hands. Further spread can occur when cuttings or clones are taken from virus-infected plants, particularly where material is harvested from multiple plants without disinfecting propagation knives and tools during the process. Most viruses only survive long term in living plant tissue of certain hosts or briefly within the insects that spread them. However, some viruses such as tobacco mosaic virus can survive for many months or even years in soil, plant debris, dried plant material such as tobacco on tools, in growing substrates, or as seed contaminates. Tobacco mosaic virus can be spread from dried tobacco on the hands of growers and tomato crops, which require regular pruning and training, are particularly susceptible to this.

"MOST VIRUSES only survive long term in living plant tissue of certain hosts or briefly within the insects that spread them."

Viruses can look similar to many other plant issues and can be difficult to diagnose.

Mild symptoms of some viruses can make the early signs easy to miss.

Viruses can cause a wide range of symptoms, unusual petal colour streaking can be one.

Aphids and other insect pests such as thrips and whitefly are major vectors of crop viruses.

Colour disorders are common signs of some viruses.

TYPES OF VIRUS DISEASES AND SYMPTOMS

While there is a large number of viruses that may infect greenhouse crops, the most widely occurring in hydroponic crops and greenhouses are tomato mosaic, cucumber mosaic, tobacco mosaic, lettuce mosaic, tomato spotted wilt virus, double streak virus, tobacco etch, curly top, tomato yellow leaf curl, and pepino mosaic. Each virus is often not specific to one species of plant — tobacco mosaic and tomato spotted wilt virus can each infect many species including many weeds, vegetable, ornamentals, and flowering plants — they are not just limited to tobacco and tomato. The name of these types of viruses only indicates the crop it was first identified in, not the species it can infect.

Viruses may produce a range of symptoms from barely distinguishable to severely deforming and may including leaf mottling, chlorosis, and other colour disorders, twisting, curling, and deformities such as shoestring-like growth, stunting of growth, dwarfism, fruit disorders, death of the growing point, and numerous deformities or colour disorders of flowers, foliage, and fruit. Some symptoms may be immediate and striking while others may be quite subtle and require a great deal of experience to recognise the early signs. Virus damage can range from a few mildly infected plants to serious plant and yield losses. Often the main issue with a virus outbreak is a lack of correct identification and many mild virus symptoms are often mistaken for other diseases, nutrient deficiency or toxicity, or physiological disorders. One good indication that a virus may be present is if one or only a few random plants start to show unusual symptoms. Issues caused by nutrient disorders, spray/chemical damage, or the growing environment typically display on many plants or larger groups of plants at the same time, virus outbreaks typically start on one or a few plants and gradually spread more widely. To complicate matters further, virus-infected plants may not show a great deal of outward symptoms — some may have slightly stunted growth or low yields, others may only develop diagnostic symptoms under certain conditions or as plants reach a certain stage of growth and development. While the development of characteristic symptoms is the main method of diagnosis of common viruses, there have been some test kits developed for use in certain crops. Most of these, however, only test for one specific virus, so may not be that useful if a different virus is present.

> "SOME SYMPTOMS may be immediate and striking while others may be quite subtle and require a great deal of experience to recognize the early signs."

VIRUS PREVENTION

Many modern hybrids of crops such as tomatoes, capsicum, and cucumbers have inbred resistance to a range of common viruses, and this is the most effective form of prevention from virus infection. Use of commercial, high-quality seed supplied by a reputable company is also recommended for virus prevention as some viruses can be seed borne and easily transferred to a new crop during propagation. Crops should be regularly scouted for signs of unusual growth such as leaf twisting or crinkling, mosaic, or other strange colour disorders or stunting and culled rapidly to prevent further spread. Infected plants should not be composted, and plant debris can still act as a source of infection via insect pests and some viruses can be carried within organic mater such as composts and mulches. Bagging up and disposing of virus-infected plants, away from the growing area, is the safest option.

Where virus-infected plants and the substrate they were growing in has been removed, sterilisation of floors, surfaces tools, and pruning equipment should be carried out to prevent any carry over infection. Insect prevention, screening, particularly the use of thrips screens, and insect control programs are essential where virus has been found to be transmitted from outdoors. With indoor growing areas, one common source of virus infection can be new planting stock — the early stages of virus infection are often not detectable, so any new planting material, stock plants or cuttings/clones should be carefully inspected and isolated in a quarantine area if virus is suspected. This is a good practice for all indoor hydroponic systems as viruses are the only problem which can be introduced with new planting stock.

Viruses can cause a wide range of symptoms, unusual petal colour streaking can be one.

Viruses can certainly cause some considerable damage and there is potential for infection to rapidly spread in some circumstances, however, these can be largely managed by immediate removal of plants with suspicious symptoms. Control of general hygiene, sanitation, and keeping in mind that sap-to-sap infection can occur tends to prevent many virus problems from becoming widespread.

The Best Ways to Harvest Hydroponic Lettuce

by Chris Bond

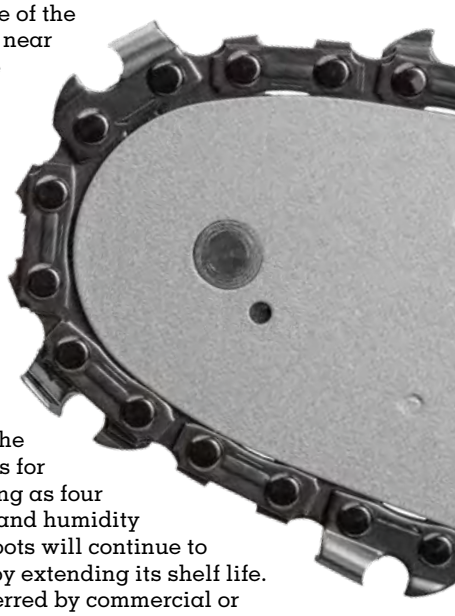
Lettuce grows very well via hydroponic production. When it comes to harvesting those tasty greens, growers have a couple of options based on the type of lettuce, as Chris Bond explains.

Lettuces are one of the crops most suitable for hydroponic production. Its quick turnaround and popularity make it a great plant and easy choice for both new hobbyists as well as seasoned commercial growers. Hydroponic lettuce can start to be harvested just a few weeks after seeding, depending on variety. There are several ways to harvest hydroponic lettuce which makes it a very versatile crop. It can fit a variety of applications, whether growing for your own salads or for market production.

While there are hundreds of species of leafy greens, most fall under one of two categories: head lettuce or leaf lettuce. As their designation implies, one type is harvested as a whole plant, and the other is harvested leaf by leaf. Each has its own unique methods of harvest.

Whole-Head Lettuce Harvesting

With whole-head lettuce harvesting, the plant is harvested fully and a new one will need to be seeded. Depending on the end user, this can be the whole plant including roots, which is how they are often harvested commercially or for market. If intended for quicker consumption, it may be the whole head cut just above the roots, and then the roots will need to be disposed of separately. When this is done, it is common to have to cut or remove some of the bottom leaves near the base of the plant that may not be suitable for eating either because of appearance (for commercial growers) or it they are too limp or damaged for use.



Harvesting the whole head with the roots is referred to as a living harvest. There are many benefits to this harvest method if the lettuce is not intended for immediate consumption. The harvests are cleaner because there is no soil. If the roots are too long, they can be trimmed or wrapped around the stem of the head. Leaving the roots intact allows for a much longer storage period. This can be as long as four weeks when stored in appropriate temperature and humidity conditions. The reason is likely self-evident; the roots will continue to feed the lettuce plant for an extended period, thereby extending its shelf life.

The whole-head lettuce harvesting method is preferred by commercial or market growers because it is more efficient than leaf-by-leaf harvests and the heads stay fresher for longer. Less time and labour are needed when harvesting lettuce by the head too. In some cases, though, leaf lettuce can be more profitable to harvest, even though it takes more resources to harvest.

Harvesting Leaf Lettuce

Most hydroponic lettuce growers raise some type of loose-leaf variety and leave whole-head production for the field. The benefits of growing leaf lettuce are many. You can harvest the same plant repeatedly until it has spent all its stored energy. Leaf-type lettuces are harvestable sooner than head-types and can be harvested over longer periods of time. They also typically take up less room in a hydroponic system than head-type lettuces, so more volume or more variety can be grown at one time.

This method of harvesting keeps the plant alive and encourages continued production of harvestable leaves. The how-to of harvesting hydroponic leaf lettuce is very easy. It can be started as soon as there are mature leaves that are large enough to harvest. It is generally considered best practice to harvest the older (bottom) leaves first. Shears are better for harvesting the plant versus pinching off with fingers. This will reduce the amount of surface area on the plant that needs to heal and the amount of energy the plant needs to devote to it instead of towards pushing out new growth. It is a wise idea to sterilise your pruning shears between harvests and, if there is any evidence of plant disease, to do so between crops or even plants. Never harvest more than half to three-quarters of any one plant in a single harvest, so that there are still leaves left to photosynthesise. This can be done every few days until the plant sends up a flower stem and begins to form a flower.

This is called bolting. It is a sign your plant is done with being harvested and is devoting its remaining energies to setting seed to carry its genetics onto the next generation. In most species of lettuces, leaves develop a bitter taste once the plant begins to bolt. It is best to remove these plants from the hydro system and start anew. Lettuce is a cool-weather crop and as such will bolt when the temperature gets too high or the hours of daylight are too long. It does best in temperatures below 21°C. To slow down the onset of bolting, a shade cloth should be put up if grown in sunny areas or the grow lights should be adjusted if grown using artificial lighting. Eventually, all lettuce plants that are not harvested using the whole-head method will bolt, but by reducing the amount of light shining on your crop, it will slow it down to prolong harvests.

"So long as the root system is **healthy**, and the hydro system is circulating enough nutrients, the plant will regenerate."

For continual loose-leaf harvests, several plants should be seeded at regular intervals. The amount and frequency will be dictated by space constraints as well as how much lettuce is wanted. However, it is possible to harvest fresh lettuce leaves every week by seeding new plants every two to four weeks and alternate the harvest on the mature plants.

Another method of harvesting leaf lettuce is similar to head lettuce in that the entire plant is harvested, but unlike head lettuce, the roots remain in the hydro system. Not all types of lettuce are suitable for this type of harvest, but many are. Butterhead and romaine types do typically grow back well after the initial harvest, but many other varieties also do well. Those that do are sometimes referred to as cut-and-come again lettuces. With this method, the lettuce is cut down to about one inch above the roots. So long as the root system is healthy, and the hydro system is circulating enough nutrients, the plant will regenerate.

Cut-and-come again types will have a second full flush of leaves, though not always quite as full as before the first harvest. Once they have achieved harvestable size, they can be cut again, down to about 2.5 centimetres. A third flush of growth should follow. It should be expected to not be as full as the first or even the second but should produce enough leaves of sufficient size for a third harvest. Not many types will generate enough for a fourth or even fifth harvest, and it does not always make fiscal sense to keep nurturing them along past their prime when younger plants will provide greater harvests.

"There are dozens of other types of salad green plants that can be grown hydroponically with varying degrees of **success** and varying skill levels."

To successfully employ this method of harvesting and to have a continual supply of lettuce, it is necessary for staggered seeding and harvests, just like with the loose-leaf harvests. Unlike the leaf-by-leaf harvest which can be done every couple of days, the cut-and-come again method requires at least a week or two in between harvests depending on variety.

Regardless of harvesting method for leaf lettuce, it will need to be consumed within a few days of harvest before it wilts and is unusable. Because so much of the makeup of lettuce is water, it is not possible to freeze it successfully and long-term storage is not an option either. Freshly harvested leaf lettuce can be stored in a refrigerator for one to two weeks on average. If it starts to get limp soon after harvest or while being stored, it can be rinsed with ice water or submerged in cold water. Then, the excess water should be shaken off and the lettuce leaves can be placed in a resealable bag until they are ready to be taken to market or consumed.

Best Varieties for Hydroponic Harvests

Varieties to choose for hydroponic growing are overwhelmingly loose-leaf types. There are dozens of different species with ruffled leaves, smooth leaves, round leaves, lobed leaves (oakleaf types), and many other shapes. Colours vary widely as well, spanning almost the full spectrum of the rainbow.

Lettuces are not the only greens that can be grown hydroponically. There are dozens of other types of salad green plants that can be grown hydroponically with varying degrees of success and varying skill levels. Consider greens like kale, collards, arugula, spinach, mizuna, or Swiss chard for variety. Microgreens can also be grown and harvested hydroponically. They can be harvested by cutting stems, or taken out in clumps, or roots and all like head lettuce.

Several herb varieties are appropriate for hydroponic production as well. Some growers will seed a variety of greens and herbs in the same block or cluster and harvest these bunches as one clump, providing great variety for consumers as well as for home-consumption. Whatever type you choose, lettuces are an easy crop to grow and harvest in a hydroponic system.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5 Decorative Plants
TO GROW HYDROPONICALLY

by Rich Hamilton

Growing decorative plants in your hydro system is a great way to keep your place bright, fresh, and fragrant. It can also keep you busy growing during the off-season.

Hydroponics is a great way to grow many edible plants, from tomatoes and lettuce to strawberries, blueberries, and micro herbs. Have you ever thought, however, about growing decorative plants hydroponically?

There are many beautiful decorative plant varieties you can propagate from a cutting and grow in a simple hydroponic system such as a DWC (bubbler) system. These plants can go on to thrive in your home as attractive houseplants or even in your outdoor garden.

Houseplants can be very rewarding to grow due to their positive effects on physical and mental health. These benefits include boosting mood, productivity, creativity and concentration, and reducing stress. Houseplants can also improve your indoor environment by cleaning the air, removing toxins, producing oxygen, and increasing humidity.

But what if you do not have a hydroponic system? Well, in that case, you can still root your cuttings very simply by placing the cut stem in a glass of water until you see the roots begin to form. You can then transplant your cutting into a pot if you so wish. Alternatively, you can keep growing it in water. The key is to pick the right plant.

So, here are five plants that you can grow hydroponically to brighten your home and garden environment.

Peace Lily

The peace lily is an easy-care houseplant. Not a true lily, its white flowers bear a close resemblance to the calla lily and is where the plant gets its name. A tropical perennial plant, peace lilies are recognisable also by their rich, dark-green leaves. Like many houseplants, peace lilies can survive just fine in low to medium light conditions but bloom more when in a sunnier position. Indoor peace lilies grow up to around 40 centimetres, much smaller than outdoor types that can reach up to 1.8 metres.

Peace lilies that can be grown in a hydroponic system are adapted varieties that have smaller roots.

In a hydroponic system, the ideal temperature range for your peace lilies to achieve optimal growth is 20-26°C, and the perfect pH is 5.6-6.5. Keep them in a warm, draft-free environment and clean leaves regularly to avoid pests such as aphids.

"Houseplants can also improve your indoor environment by cleaning the air, removing toxins, producing oxygen, and increasing humidity."

Orchids

Widely considered one of the most beautiful species of flowers in existence, orchids are a favourite with many gardeners due to their beautiful colours, thick-woody roots, and sheer variety. There are about 30,000 species of orchid in existence, making them the world's most extensive family of plants.

Orchids are ideal for raising in hydroponic systems, as many of them grow hydroponically in their natural environments. Native to tropical climates, orchids latch on between rocks or onto tree bark. They receive adequate watering from the rain, oxygen from the air, and get nutrition from any rotting organic matter in their immediate surroundings.

When growing in a hydroponic system at home, use media such as clay pebbles that allow maximum aeration of the root zone. Orchids need high humidity levels, good air circulation, temperatures between 15-26°C, and a pH range of 5.5-6.5. Orchids take in more water when under strong grow lamps, so use a 400W HPS lamp or equivalent LED.

Coleus

Coleus is an annual or perennial native to Indonesia. It is part of the mint family and is grown as an ornamental plant.

There are many types of coleus plants with velvety foliage and beautiful hues of purply-pinks, golds, burgundy, and bronzes. Coleus grows low to the ground and thrives best in lower light conditions making it an ideal houseplant for rooms with little natural light. The leaves' colours are brighter when kept out of the sun with exposure to direct sunlight, causing the leaves to become dull over time.

To get your coleus to thrive in a hydroponic environment, you need to think about light. Perfect conditions are bright but not intense morning sunlight and indirect light in the afternoons. The perfect temperature range for coleus is 15-24°C. Blooms on a coleus should be removed as they appear since they draw energy from the foliage and cause the plant to go to seed and die.

Snapdragons

Antirrhinum, or, as they are better known, snapdragons, are an attractive flower that comes in various colours from yellows to pinks, reds and purples. The name snapdragon comes from the flower's resemblance to a dragon whose mouth opens and closes when the flower is squeezed. Due to this attribute, they are an interesting plant for children and make an excellent choice for introducing the younger generation to gardening and plant care.

Native in origin to rocky landscapes of Europe, the U.S., and North Africa, snapdragons are short-lived perennials and vary in size from15 cm to 1.2 metres. They are classified into three ranges — dwarf, medium, and tall. Make sure you pick a variety that will fit in your system. If you have chosen a taller variety, you can transfer it to a pot or the garden once the roots are well established to allow the plant to reach its full potential. Snapdragons love the warmth and need full sun and occasional shade. They thrive in slightly higher pH conditions of 6.2-7.0.

Lucky Bamboo

The lucky bamboo plant originates from Southeast Asia and is a very popular houseplant choice. Distinguished by its signature thick, green-rounded stalks, lucky bamboo is very low maintenance and easy to care for. While it may resemble bamboo, lucky bamboo is not bamboo at all. Lucky bamboo is, in fact, a water lily that looks very similar to bamboo. The plant is well known for its use in the art of feng shui, a traditional Chinese practice going back 5,000 years that aims to create balance and harmony between a person and their living space.

Lucky bamboo represents good luck and happiness, making it a popular gift for house warmings and new beginnings. Most lucky bamboo plants you see for sale have had their stalks twisted, curled, or braided into all manner of shapes by professional growers.

Lucky bamboo is a good choice for a hydroponic growing system as its thick stems are perfect for growing in water. They can survive in many lighting conditions. Clay pebbles will provide the plant with good anchorage as it grows. Lucky bamboo grown in water will live for one to two years, so transfer to a pot and medium to extend its lifespan. Your lucky bamboo may lose leaves, but as long as you continue to care for it, it will replenish itself and flourish.

There are many advantages to growing plants hydroponically, including fast plant growth, low maintenance, fewer pests, better control, and saving space and water. With the added health benefits and the variety of decorative plant options available to you, these facts beg the question: why are you not doing it already?

> "They are an interesting plant for children and make an excellent choice for introducing the younger generation to gardening and plant care."

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THE DUTCH BUCKET HYDRO SYSTEM

and how it works

While there are many hydroponic setups growers can choose from, the Dutch bucket hydro system is one that's cheap, environmentally friendly, and perfect for growers cultivating large plants.

by Kent Gruetzmacher

When deciding on their equipment needs, hydroponic growers have more options than ever. Lucky for us today, hobbyist growers and professional engineers alike have toiled to create new and convenient ways to grow hydroponic crops. While all hydro systems are designed with the overall goals of efficiency and productivity, the methods for accomplishing such ends can diverge greatly.

Dutch bucket hydro systems have grown increasingly popular in the horticulture space due to their simplicity and versatility, as well as their environmental safeguards. Also known as "bato buckets," Dutch bucket hydroponic systems are a great option for both home growers and commercial producers. These innovative designs borrow methods from drip irrigation systems as well as hydroponic setups. If you are wondering if a Dutch bucket hydro setup is right for you, please check out the following criteria.

DUTCH BUCKET HYDRO SYSTEM BASICS

Dutch bucket hydro systems get their basic design principles from the ethos of recirculating hydroponics. However, Dutch bucket layouts are unique in the fact that irrigation water is pumped through individual large buckets, as opposed to a hydro table or deep water culture (DWC) reservoir. As can be surmised, the foundation of a Dutch bucket hydro system are the buckets themselves.

"DUTCH BUCKET LAYOUTS ARE UNIQUE IN THE FACT THAT IRRIGATION WATER IS PUMPED THROUGH INDIVIDUAL LARGE BUCKETS, AS OPPOSED TO A HYDRO TABLE OR DEEP WATER CULTURE (DWC) RESERVOIR."

In the most basic Dutch bucket setups, the buckets are situated on a shelving system that is placed over a nutrient reservoir. These buckets, in turn, house a cultivation medium that supports the plants' root zones.

The Dutch bucket hydro system functions as water is pumped through hoses from the reservoir and finally into the buckets. There are many variations that can be used to disperse water within the buckets. Many of these choices resemble equipment you would use in simple irrigation systems — such as drip rings. Once the buckets are thoroughly soaked and plants get nutrients to their roots, the excess water drains from the bottoms of the buckets. This water is then gravity fed through PVC pipe back into the nutrient reservoir.

RECIRCULATING HYDROPONICS

As mentioned earlier, Dutch bucket hydro systems are excellent examples of recirculating hydroponics. Also known as closed-loop hydroponics, these setups are celebrated for being environmentally friendly.

The hydroponics space is often viewed through two diverse schools of thought: recirculating and drain-to-waste. Eco-conscious cultivators favour recirculating hydro systems because they continuously recycle precious water and nutrients. This practice greatly reduces environmental impacts. Conversely, in drain-to-waste systems, irrigation water is only run through the garden one time before it is disposed of.

The water conservation practices of recirculating hydroponics systems are particularly attractive in dry climates like California. Especially for commercial producers in dry climates, such conservation methods could very well be the future of controlled environment agriculture (CEA).

The fact Dutch bucket hydro systems conserve water and nutrients also makes them financially attractive: the less water and nutrients you use to grow your crops, the less money you need to spend on garden inputs.

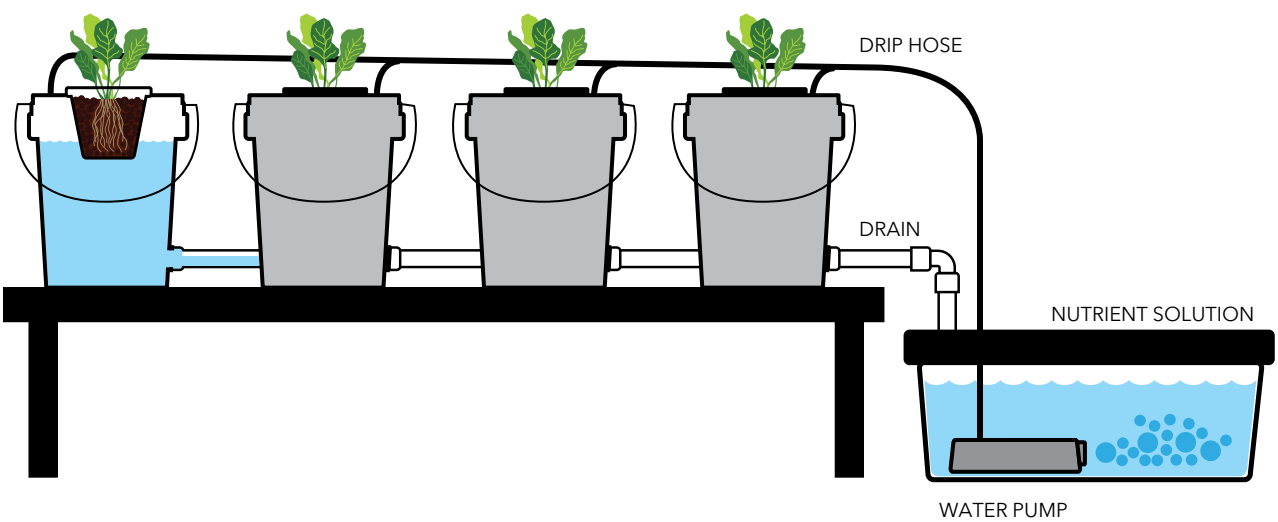
PERKS OF DUTCH BUCKET HYDRO SYSTEMS

There are several perks to using Dutch bucket hydro systems. These advantages are related to versatility in crop choices as well as the overall simplicity in using Dutch buckets.

Large Plants

One reason why Dutch bucket hydro systems are popular is because they are compatible with larger plants. Hydroponic setups generally require small plants. In these systems, crops are grown in small containers and cubes that are situated on tables and shelves.

The fact Dutch bucket systems feature individual buckets gives them more versatility in growing bigger plants. In fact, most Dutch bucket cultivators only place a single plant per container. By giving plants ample space in their own containers, the garden canopy does not become crowded and plants can grow large.



Scalable Setups

Cultivators also appreciate Dutch bucket hydro systems because they are easily expandable. That being said, if you are interested in scaling your Dutch bucket system, all you need to do is add another bucket. This simplistic approach makes incremental scalability possible and it gives you the opportunity to work your way up into a larger garden.

"THE FACT DUTCH BUCKET SYSTEMS FEATURE INDIVIDUAL BUCKETS GIVES THEM MORE VERSATILITY IN GROWING BIGGER PLANTS."

GREAT DIY OPTION

A final consideration about Dutch bucket hydro systems is they are great do-it-yourself (DIY) projects. You can find a majority of the components needed to build a Dutch bucket system at your house as well as the local hardware store.

The most basic Dutch bucket setups can be built with buckets, garden hoses, PVC pipes, irrigation tubing, plastic bins, and a simple pump. By building a Dutch bucket hydro system yourself, you can save lots of money on overhead garden costs. This is particularly attractive for novice gardeners who are just learning about hydroponics.

SUMMARY

Whether you are an experienced horticulturist or a novice home gardener, it's a good idea to have a basic understanding of different hydroponic setups. In studying the various hydro systems on the market today, you can better match your methods with your overall goals.

Dutch bucket hydro systems are popular in CEA cultivation because of their simplicity and versatility. Not only can you grow larger plants with Dutch buckets, you can also easily manipulate the size of your garden with these setups. What's more, they allow you to produce large plants while maintaining careful control over garden inputs.

While the practical side of Dutch bucket systems are noteworthy, the environmental protections they afford are their real selling point. As the CEA space continues to grow and evolve, recirculating hydro systems like these are likely the way of the future. As such, if conservation efforts are at the forefront of your thinking, Dutch bucket hydro systems just might be the choice for you.

Pioneering References

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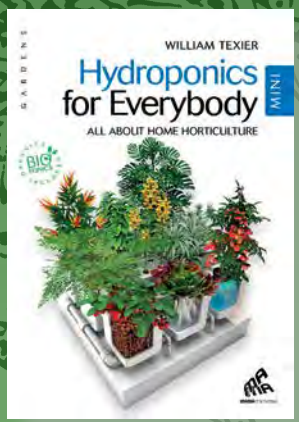

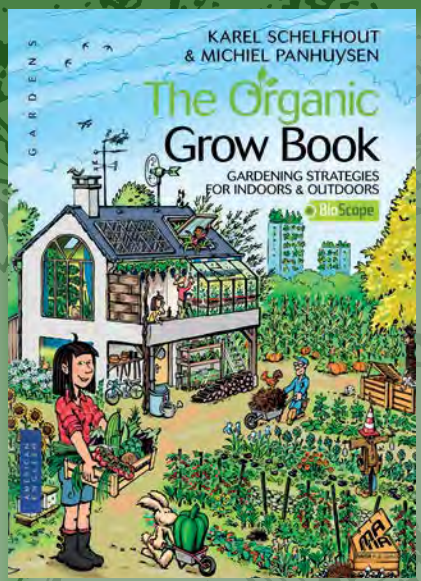

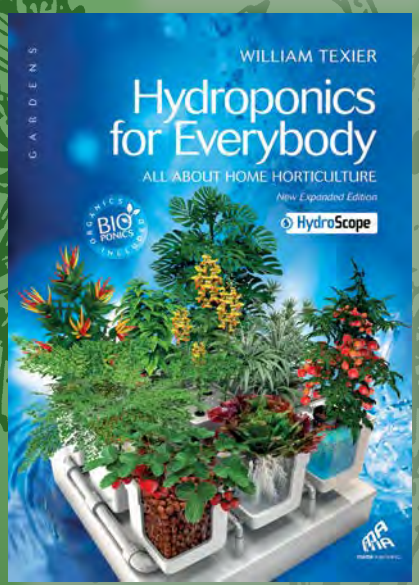

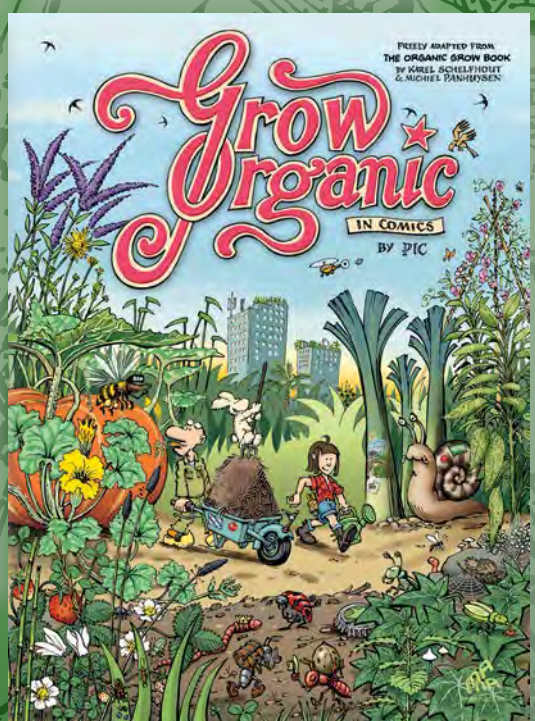

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Towering Spiders

by Philip McIntosh

The pandemic has been a challenge for teacher Phil McIntosh's classroom hydroponic lessons, but observations show that if you want to grow a reliable and forgiving plant, spider plants are the way to go.

When one thinks about what kind of plant to grow in a hydroponic tower, *Chlorophytum comosum* (Thunb.) Jacques, the spider plant, may not be the first species that comes to mind. Maybe it should be. Since my school began operating three garden towers seven years ago, we have grown lettuce, vit mâche (kind of like lettuce), morning glories, Coleus, and, most recently, spider plants. We've had good success with all those species, but nothing has been as reliable, productive, and forgiving as the spider plants (Fig. 1).

We have had all three towers stocked with spider plants at various times, but the tower shown in Fig. 1 has been operating with little maintenance for more than a year under moderate light conditions in a basement near a window.

Fig 1. Tower Garden with a full load of spider plants.

"To top off this impressive resilience, no fertiliser was added to the reservoir for more than eight months and the plants survived, thrived even."

Usually, students are responsible for everything to do with the horticulture program at the school which consists of three garden towers and a lab where seedlings and cuttings are propagated and studied. The lab technicians are trained to start plants in stonewool, load the net baskets with plants, mix nutrient solutions, monitor and adjust the reservoir level, pH, and electrical conductivity, and to perform basic repair and maintenance that has kept the towers running for the past seven years. The only problems we have had with the units are occasional kinked hoses and failed pumps which we replaced with upgraded ones. Students don't generally do the thorough cleaning required between runs. Guess who gets to do that?

I say *usually* the students are responsible for everything, but the 2020-21 school year was anything but usual. Due to the pandemic and precautions taken, only one tower was operational this year and it ran unattended for extended periods. The reservoir ran dry on at least one occasion, but the upgraded pump survived no problem. Other times the plants were reported to be severely wilted, though the addition of water brought them right back. To top off this impressive resilience, no fertiliser was added to the reservoir for more than eight months and the plants survived, thrived even, on just water and whatever nutrients were introduced by decay of roots and microbial action.

In an example of how we use spider plants in STEM (science, technology, engineering, and mathematics) education, a couple of students performed a series of experiments testing how the number of root initials on a spider plant cutting affected the later successful growth and development of the plant (Fig. 2) shows a graph of one result of this work. It shows that, on average, you can expect about one more root to develop than is visible as a primordia on a cutting. Note that the most primordia typically visible on a plantlet (also known as a spiderling) was nine because we collected plantlets as often as we could from about 20 stock plants in hanging baskets. However, after the recent extended growth period without harvesting, many of the tower-grown plantlets had more than 20 well-developed root initials (Fig. 3). Other experiments have shown that the more root initials there are on a cutting, the better the chance of survival after transplant. Each net basket started out with one plantlet rooted in stonewool, but now the baskets have three or four plants producing many plantlets each. When the tower was recently brought home for the summer, 241 plantlets with well-developed arial root initials were harvested and transplanted into soil (Fig. 4 and 5). We hope to sell them at a fundraiser next school year to support more hydroponics research.

There is much to recommend the spider plant as a candidate for hydroponic/aeroponic propagation: they handle neglect well, reproduce quickly, really fill out a tower, and people like them. One disadvantage is the mother plants are so tightly jammed into the tower openings that they are impossible to remove without disassembling the tower one level at a time. Oh well, I guess we'll have to leave them there and let them make more spiderlings.

Philip McIntosh is a science and technology writer with a bachelor's degree in botany and chemistry and a master's degree in biological science. During his graduate research, he used hydroponic techniques to grow axenic plants. He lives in Colorado Springs, Colorado, where he teaches mathematics.

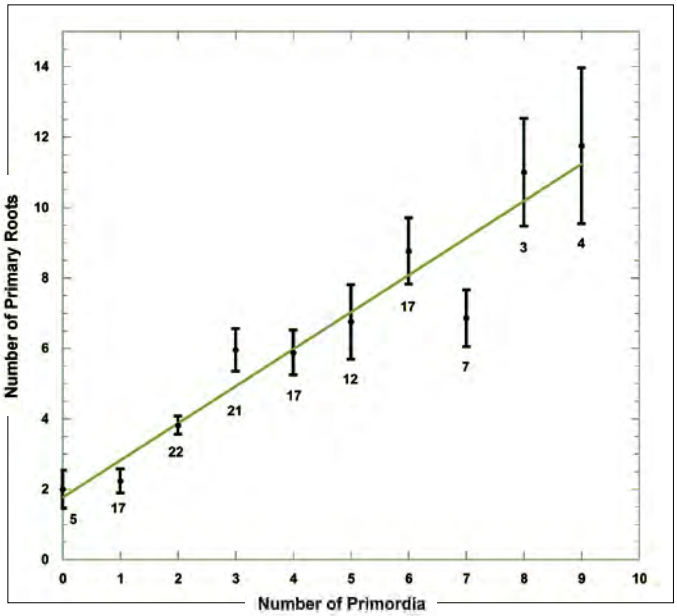

Fig. 2. Number of primary roots vs. number of primordia of *C. comosum* after 20 days in a growth chamber (mean ±SEM). Number below each point is the number of samples for that number of primordia. The equation for the line of best fit is y = 1.05x =1.77, R2 = 0.92.

Fig. 3. Spiderling with many well developed root initials.

Fig. 4. 241 spider plant cuttings ready for transplant.

Fig. 5. Transplanted spider plant cuttings.

a brief
HISTORY OF

PINEAPPLE

by Philip McIntosh

Much loved worldwide, pineapples have gone from a status fruit for the well-to-do, to one with a wide variety of uses across the globe. Piña coladas, anyone?

Hundreds of years ago, any newly encountered fruit tended to be referred to as an "apple." Some examples: peach = Persian Apple, tomato = love apple, potato (not a fruit) = earth apple, etc. The original "pineapple" was what we now know as the "pinecone." So it seems that whenever the pineapple was seen for the first time by European explorers, it got the apple moniker by botanical default (and because it kind of looked like a pinecone).

If the seed-bearing structures of some pine trees were not so conical in shape, perhaps we'd still be calling them pineapples and we'd know today's pineapple as something else.

The pineapple plant, *Anasus comosus*, is a perennial monocot, thus making it a distant relative of corn, wheat, barley, and the grass in your front lawn (assuming you haven't xeriscaped it). Pineapples are members of Bromeliaceae, the bromeliad family, which becomes obvious if you compare the appearance of the pineapple plant to that of a horticultural bromeliad such as an earth star or — interestingly enough — one of the "pineapple" bromeliads, also of the genus Anasus. The thick leathery leaves emanate in a rosette from a base, with occasional side shoots. The stem grows a flower spike that produces many small flowers that each form a fruit, which then fuses to form a collective or multiple fruit. The little fruitlets grow in a spiral pattern that follows the famed Fibonacci sequence, with eight going in one direction and thirteen going in the opposite direction. A similar pattern can also be seen in the whorled arrangement of florets and seeds in a sunflower head.

Pineapples originated in the area bordering current day Brazil and Paraguay. From there it was spread by humans throughout the rest of South America and up into Central America. Evidence suggests the pineapple has been cultivated for at least 3,200 years. Explorers introduced pineapples to Europe in the 1400s where it became a symbol of affluence since the only way to get one then was by import from the New World. It is now grown in many tropical countries and has proven to be well-adapted to greenhouse cultivation. Even after greenhouse production was developed it remained a status symbol since it took wealth to construct and operate a greenhouse.

Although the pineapple is associated with Hawaii, where both Dole and Del Monte established plantations starting in around 1900, large-scale production there diminished due to competition and improved shipping methods from other locales. Pineapples are now only produced for local consumption in the island state. Even so, people still assume a Hawaiian pizza will have pineapple slices on top.

As far as world-wide fruit production goes, pineapples come in at around tenth place (tomatoes are number one) but they fare a little better when the category is narrowed to "tropical" fruit, coming in third. About 30 million tons of pineapples are grown yearly with Brazil, Costa Rica, and the Philippines being the biggest producers. About half of the world's production is shipped to Europe.

So, what can you do with a pineapple besides slice it up and put it on a pizza? Juice is an important product, either alone or mixed with other fruit juices such as orange or mango. In Mexico you'll find sliced pineapple sold at small stands where is it put on a stick and covered with lime and chili powder. Canned or fresh pineapples find use in smoothies, fruit cocktails, embedded in jello, or for snacking as is. Did I mention piña coladas? The taste is sweet but citrusy with a bit of a sour kick at times. Interestingly, unlike many other fruit, pineapples do not ripen much after they are picked, so the harvest must be pretty well-timed.

From a nutritional standpoint, fresh pineapple is relatively low in calories so you can eat a lot without fear of overdoing it. It's a good source of vitamin C and the B vitamins, copper, and manganese, but pretty low in everything else. So next time you need a fruity snack, slice up a spiny pineapple for a tropical treat.

distribution **LIST**

retail stores are listed alphabetically in each state

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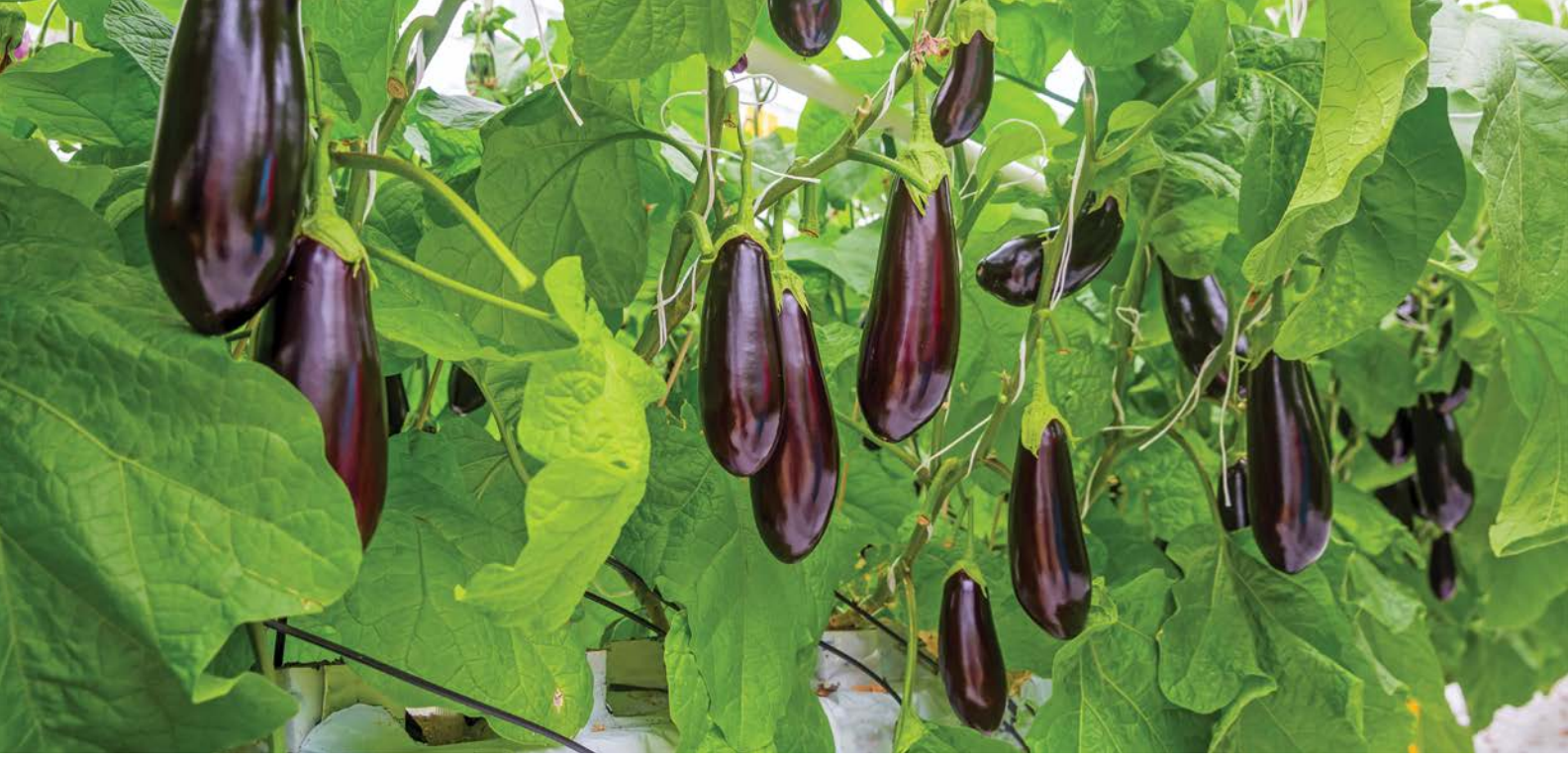

10 facts on EGGPLANT

by Philip McIntosh

It *kind of* looks like an egg and it's technically a berry.

1. **Why is it called eggplant?** Many years ago (in the 1700s) eggplant fruit were much smaller and white or yellow in colour, looking sort of like a goose egg. In English-speaking countries, people called it eggplant and the name stuck.
2. **The eggplant's native home** is India and surrounding regions, where it and close relatives can still be found growing wild.
3. **The eggplant,** *Solanum melongena*, is a member of the Solanaceae (the nightshades), which includes tomatoes, peppers, potatoes, tobacco, the highly poisonous belladonna, and Datura (jimsonweed).
4. **Don't eat the leaves.** As you can tell from the list of relatives above, the Solanaceae contains plants with toxic alkaloids in the green parts, even though the fruit (or tubers in the case of potato) are often edible.
5. **The fruit** has a leathery outer skin that encloses a fleshy interior with many seeds. Each fruit is derived from a single ovary making the eggplant technically a berry.
6. **Depending on** the variety, eggplant fruit vary in size from that of, well, an egg, to larger melon-sized specimens, and some are highly elongated, or club shaped.
7. **Most eggplants** seen in grocery stores are dark purple, almost black, but some varieties are white, yellow, green, or striped.
8. **Given that** they contain alkaloids such as nicotine and solanine, raw eggplant fruits are bitter and generally not pleasant to the taste.
9. **When cooked,** eggplant absorbs surrounding flavours well, making it good for combining with sauces and other flavourings.
10. **When it comes** to nutritional value, the eggplant is no super food. It is low in calories, protein, carbohydrates, and fat, but is a decent source of potassium, magnesium, and fibre.

GrowLush Lamps

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