

One Into Many

Year-round gardening retailers offer tools for vegetative propagation, ranging from the simple humidity dome with heat mat to cloning pods and units that aim to produce the perfect environment for root formation

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A mixture of perlite and vermiculite is a good substrate for cuttings.

WHEN YOU TAKE a leaf cutting from a plant and grow it into a new plant, you are cloning. In this case, it's called vegetative propagation. The resulting new plants will be exact genetic copies of the parent plant. This is possible because every cell of the plant contains the genetic information necessary to generate an entire new clone. New plants can even be started from a single cell or clumps of cells.

Asexual reproduction—producing genetic copies of a single plant—has some major advantages when working with horticultural crops that have been extensively bred for certain desirable traits, such as fruit size, flavor, etc. Many of our best varieties of fruit trees and other cropping plants have been raised from a single source of vegetative material. This may have been as selection of a superior plant from a population of seedlings, or as a single variant from a mature tree, or a chance discovery of a genetic mutation. These plants were then multiplied up to large numbers.

Some crop species don't produce viable seed, for example, some kinds of bananas, figs, oranges and grapes, and growers may need to vegetatively propagate these.

Vegetative propagation also gives the new crop a head start, and it's a good way to speed up multiplication of plants. And cloning also allows more complex methods of plant improvement, such as grafting and budding.

Many hydroponic growers will often maintain small populations of stock plants from which they regularly take cuttings or other material to grow replacement plants. Many ornamental plants are produced in this way, including carnations, chrysanthemums, lilies and other bulbs. Growers of other crops such as fresh cut or potted herbs may also keep stock plants such as French tarragon, lemon thyme and variegated sage, which need to be raised from cuttings or divisions if their special characteristics are to be passed on.

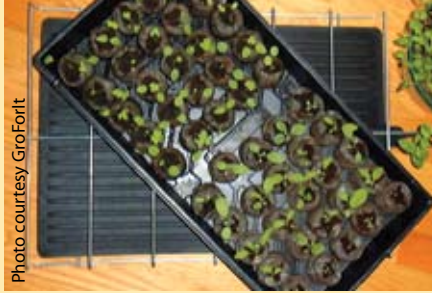
Equipment for Vegetative Propagation

Propagation of new plants is essential to small and large hydroponic growers alike. Even perennial plants need replacement with fresh planting stock at some stage, and having the facilities to produce your own healthy transplants is a good choice.

"In my circle of friends, we try to use clone machines as much as possible in order to save time and money," said Benjamin Wilson of Botanicare.

If the right equipment is selected and used to its full potential, cuttings or clones can form roots and be ready to plant out into a hydroponic system in as little as 10 days. Heated pads or mats used for raising plants from seed, such as the Gro-Mat from GrowForIt products, can also be used for cuttings as they provide just the right degree of bottom heat for most plant species.

Hydroponic retailers have an extensive range of equipment for vegetative propagation, ranging from the simple humidity dome with heat mat to unique cloning pods and units that aim to produce the perfect environment for root formation. Many work on a principle of misting the end of the cutting which provides a delicate balance of oxygen for callus and root formation and moisture to prevent desiccation during this process. If you combine this with the correct tempera-



Top: Propagation equipment can have a dual purpose. The GroForIT GroMat can be used for seedlings and to provide additional bottom heat for cuttings. *Directly above:* An indoor grow room makes an ideal propagation area where the plants are protected and growers can easily control temperature and light. *Directly below:* Many cloning treatment products come as a gel, which should be poured out into a shallow container for use. Any leftover gel should be discarded. *Bottom:* The Botanicare Power Cloner 70 unit from American Agritech allows rapid root growth on cuttings while the attached humidity cover maintains moisture levels around the plant material.



ture, state-of-the-art automatic controller and clean and hygienic conditions, then propagation becomes a simple matter of selecting the right material and watching it grow.

A good example of a custom made clone machine for rooting cuttings is the Botanicare Power Cloner, which comes in a number of different sizes for propagators large and small.

"Why wait for seeds to germinate when you can clone up to 165 cuttings of your favorite plants in as little time as one week," said Botanicare's Ben Wilson. "With a little help from my Power Cloner, I was able to restock my system one week after pests destroyed my plants."

This cloning system has further advantages for growers pressed for time, Wilson said. It comes with a humidity dome that's a great time-saver, since he no longer has to foliar spray morning, noon and night to retain humidity in the canopy.

Wilson recommends the Power Cloner to any one who is sick and tired of the daily watering and monitoring of cuttings. While it's not appropriate for all plant types, the Power Cloner can be used to propagate a wide range of plants, including succulent and soft-wood types. He's cloned plants as diverse as jalapenos, tomatoes, coleus, eggplant, basil and various houseplants, with most of these being rooted and transplanted within 10 days.

Care for Cuttings

Along with providing just the right amount of heat, moisture and oxygen in the rooting zone of the cutting material, the top of the new plant must also be cared for. Removing a piece of plant stem from a mature plant and cutting off its supply of water, nutrients and other compounds from the roots is extremely stressful, and the cutting faces desiccation or starvation if roots are not formed as quickly as possible. In deciduous plants, where cuttings are taken when the stem has no leaves, this is not so critical, but in softwood cuttings from evergreen and succulent plants, desiccation is a real risk. For that reason, humidity levels must be maintained to prevent excessive water loss from the leaves retained on the cutting. Humidity domes, misters

and plastic covers all assist, and there are many cloning units which provide these. Good examples of these for small systems are the Super Dome humidity cover and Germination Station from Hydrofarm, available from many year-round gardening retailers.

The cutting can also still carry out photosynthesis, despite being isolated from any root system in the early stages, thus just the right level of light needs to be supplied so that this can occur. While most seeds can be germinated in the dark as they have food and nutrient reserves inside the seed itself, a cutting needs light, otherwise the leaves attached will soon turn yellow, desiccate and fall. The small amount of photosynthesis carried out in the cutting helps support the new growth. For that reason, cuttings need a level of light that can promote some photosynthesis, but not so high as to create a heat overload or stress and desiccate the delicate foliage. Hydroponic retailers have some excellent solutions to this problem. Clone units with low-intensity, full-spectrum fluorescent light setups with low heat output are available, such as Hydrofarm's Jump Start Light System. It can be used for seedlings, cuttings, flowers and houseplants.

Root-Promotion Products

Using plant hormones or plant growth regulators to promote and speed up the rate of root formation on cut stems has been around in commercial production for decades. These days, even small growers can choose from a wide range of root-promotion products, in a number of different formulations for a range of purposes. Hydroponic retailers stock many brands of rooting gels, powders and liquids that are highly effective in promoting root development on cuttings of many plant species.

Cloning or root-promotion products contain synthetic root-promoting growth regulators similar to those plants produce for themselves.

Some products contain other compounds such as rooting co-factors, various nutrients, fungicides and sticking agents. The plant-growth regulators responsible for

stimulating root developing on cuttings are auxins, with IBA being the most commonly used. IBA is the most commonly used auxin in cloning products as it is relatively stable and insensitive to the auxin-degrading enzyme systems within the plant.

Rooting gel/powder or liquid products are available for different types of cuttings, such as succulent soft wood, semi-hardwood or hardwood. It's important to select the product or dosage rate for the type of cutting being taken. An overdose of auxin-rooting product can actually hinder the process and act more as a herbicide than a root-promotion compound. Growers should always carefully read the usage instructions on cloning products and follow the advice for dose rates, soak times for liquids, and application methods.

Two cloning products widely used by growers are Clonex rooting gel and Olivia's Cloning Gel/Solution.

Cloning Systems

The simplest cloning systems often just comprise a mixture of substrates designed to retain sufficient moisture between waterings, but also drain freely so that the cutting base has sufficient oxygen for root development. Media such as coarse sterilized sand, fine-grade perlite and vermiculite, coco fiber and similar mixtures work well for many propagation units, and are reasonably inexpensive if large numbers of new plants are being raised by cuttings.

Many of the custom-made clone machines, units or systems make this easy and provide some form of plant support. Foam inserts which gently hold the stem upright above a misting chamber, or plugs, cubes or cells of inert media or material such as Oasis, rockwool or similar are often used. Cell trays containing inserts of material that are placed on heated propagation mats, under humidity domes or misting units are also available.

New Root Formation

Rooting hormone products speed up the process of new root formation. They also greatly increase the number of root primordia, resulting in a larger number of

new roots forming at the same time. This is one of the major advantages of using root promotion products—new plants with an extensive and well-developed root system can be produced in less time. Studies with root promotion products show a large increase in the number of new roots formed on cuttings, giving a superior new root system that's better able to support new stem growth and produce faster establishment once potted or transplanted into a hydroponic system.

The rate at which new roots are regenerated depends on a number of factors—the use of rooting hormone products, the environment provided around the new cutting and the species of plant. Some commonly grown plants produce roots within a few days and this can be watched by simply placing the cut stem in a glass of water – tomato laterals, impatiens, coleus, mint, mung beans and willow are all good subjects for class room experiments to watch how the new roots develop and emerge. Other species take much longer to produce roots and need carefully controlled conditions to ensure the cuttings remain alive while the root formation occurs as in some species this can take several months. Some hydroponic crops such as chrysanthemum will usually have some visible root initials after around 7 days if given sufficient warmth and moisture. Carnations take longer, up to 20 days and roses, 24 days before visible root formation can be seen. When conditions are not optimal, root formation takes much longer and the greater the length of time the cutting remains without new roots the higher the chance of root rot pathogens taking hold or of the cutting drying out.

How to Take Cuttings

There are many different types of cuttings, depending on the plant which is being propagated. Some succulent houseplants such as begonias and African violets can be grown from leaf cuttings where roots and new plantlets form from the cut stem or leaf vein. Stem cuttings are perhaps the most common where a small piece of stem is cut from semi-mature growth, containing buds and a few expanded leaves. Stem cuttings are further divided into softwood, semi-

hardwood and hardwood categories. There are also leaf/bud cuttings and root cuttings as well. Success in propagating new plants for hydroponic production depends on the grower knowing the best type of cutting to use, treating it correctly and providing a suitable environment for root formation.

Not just any old piece of stem selected from a plant will form roots. The physiological condition of the stock plant, the age of stock plant and the type of tissue selected all play a role. In some plant species, such as deciduous fruit trees, time of year when taking a cutting also is important. All growers should be aware that taking cuttings from diseased stems such as those infected with viruses will result in that problem being carried over to the new plants.

Plant propagation books are the best reference source when determining all of these factors as they can differ for each species being propagated. However, in general, cuttings should not be taken from fresh new growth because it desiccates rapidly, has low carbohydrate reserves and is often not physiologically mature enough to form new roots. Semi-hardened growth usually gives the best result as these types of stems have good carbohydrate reserves.

Presence of flowers or flower buds can drain reserves from the cutting and are best removed at the time of taking the cutting. Stock plants must be healthy, free from pests, including diseases and viruses, which can delay or prevent root formation and carry over to the new plants.

Some perennial plants used for supplying cutting material can become exhausted over time and should be replaced on a regular basis with fresh young stock plants, as root formation can be affected by the overall condition of the mother plant. In hydroponics, stock plants for cutting material are best maintained in conditions that are not going to cause overly soft, succulent growth, as cuttings of such material may not root well. Growing stock plants slightly "hard" with a higher-than-normal EC, correct temperatures and not overwatered will

give foliage that's better able to retain moisture after being cut from the mother plant. Many herbs such as sage, thyme, oregano, rosemary and bay benefit from this type of treatment, as do many ornamental plants propagated from cuttings.

Taking Cuttings

Stem cuttings are relatively easy to select and prepare. A length of stem is selected and cut directly beneath a node. Nodes are slightly swollen areas on the stem, and by cutting here more cambium tissue is exposed, which is where root initials will form. The best time of day to take cuttings is in the early morning, when the stock plant is more turgid and the cutting material will contain good moisture levels. Cuttings shouldn't be taken from plants which are under temperature or other types of stress which limit the amount of moisture in the cutting tissue and can cause the cutting to rapidly dry out. Ideally, the cuttings should be prepared immediately and placed into a humid environment for root formation. But sometimes this isn't practical, and many propagators have to store cutting material, wrapped in plastic, often under refrigeration and sometimes treated with fungicide, until the preparation and planting can be carried out.

Leaf cuttings often require no more than using a sharp blade such as a razor to slice cleanly through the leaf stem or leaf vein, a rooting product applied and then carefully placed into the substrate or clone system. The sharper the blade when taking leaf cuttings the better, as it lessens the number of damaged cells. However, for some other types of cuttings, most notably the harder-to-root woody types, giving a greater wound will increase root formation, and deliberate and careful "stem wounding" is common practice for some plant species.

After cutting from the stock plant, the material can be further prepared. Some growers like to prepare the cutting by taking another cut directly under a node, just before applying a rooting gel or liquid product. Some of the older foliage can be removed to lessen the leaf area from which water will be lost via transpiration. In larger leaved plants, and with

some leaf cuttings, the leaves may be cut to reduce the surface area.

However, some foliage must be retained, unless dormant plant material is being used. The presence of leaves and buds helps the plant produce its own natural auxins, which are transported downwards to the area of root formation. Leaves also act as a supply of carbohydrate, which helps sustain the cutting until new roots form and, provided there is sufficient light, these leaves can carry out some photosynthesis. There is fine balance between reducing leaf area enough to limit water loss by transpiration but at the same time retaining sufficient foliage to supply reserves and auxin for root development. 🍃

This is the first part of a multi-part series on vegetative propagation.

Lynette Morgan, together with Simon Leonard, own and operate SUNTEC International Hydroponic Consultants, New Zealand. For more information, see website www.suntec.co.nz.

References and Resources

American Agritech
Botanicare Power Cloner
www.americanagritech.com
480.777.2000

D&K Enterprises LLC
GroClone
www.groclone.com
sales@groclone.com
916.391.9500

GroForIt
Gro-Mats for seedlings and cuttings
www.groforit.com/ged
sales@groforit.com
800.662.5021

Hydrodynamics International
Clonex
www.hydrodynamicsintl.com

Olivia's Cloning Gel/Solution
www.OliviasSolutions.com

Nickel City Wholesale Garden Supply
AeroGarden Garden Starter Tray
www.ncwgs.com
585.500.4404

HydroFarm
Jump Start Light System
Super Dome humidity cover
Germination Station
www.hydrofarm.com