

# Propagating Woody Plants Without Grafting

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## Why propagate asexually?

The primary reason for propagating asexually or vegetatively (as opposed to growing from seed) is that woody plants tend to be heterozygous, this means they don't "come true" to seed, in other words they are unlikely to closely resemble their parents.

If you were to plant 10 seeds from one McIntosh apple pollinated by a Granny Smith apple you wouldn't get 10 apple trees with hybrid McIntosh/Granny Smith fruit. Instead, you would get 10 totally unique trees, and most likely none of them would be as good for fresh eating as their parents.

I have heard that as few as 1 in 1,000 apple seedlings produce fruit as good as their named parent. An apple tree can take several years to even begin producing fruit, so using asexual propagation can ensure that you end up with delicious fruit after all of your invested time, space and effort. Additionally, asexually propagated plants produce fruit sooner than seedlings.

There are certainly situations where growing heterozygous plants from seed is indicated, but when your goal is to replicate a known quality fruit, asexual propagation is the way.

## Why grow a plant on its own roots rather than graft it?

Grafting is the process of cutting a piece of one genetic individual and inserting it into another. This process has 2 main advantages: 1.) Some plants are very difficult to propagate in other ways (such as Paw Paw.) 2.) Sometimes a benefit or control that can be gained from the rootstock- for instance a dwarfed apple that bears early and stays small, or a peach resistant to nematodes.

Other benefits include having multiple cultivars or species on a single tree and being able to create many new plants from a very small amount of material. Often only a single bud is needed to grow a new tree.

Grafting has its drawbacks as well. It can be tricky, requiring special skills, tools and materials. You need to have access to the right rootstock at the right time, which requires you to source it, purchase it, or grow it separately. Grafted plants generally take more time and labor to grow than plants grown from cuttings or divisions. Young grafted plants of some species are prone to dying at the graft over a hard winter, especially when they are being grown in a zone which is near the limit of their hardiness, leaving you with a rootstock that will likely bear lesser quality fruit unless re-grafted.

Plants that tend to sucker a lot (such as Elderberries) are less suited to grafting as the suckers tend to overtake the grafted stems unless careful pruning is maintained. Like growing from seed grafting certainly has its place, but it is not always the best option.

## Techniques

### Dividing clumps and suckers

Lets start with the most basic method, dividing a clumping plant.

A clumping plant, such as an Elderberry or Blueberry, has many stems growing from one root system. Clumps can be divided at any time, but it is best done when the plant is dormant. Unearth the clump carefully, looking for a section of stems and attached roots which can be separated from the mother plant, leaving a good amount of roots attached to both the mother and daughter plants. When you find your suitable section, sever it from the mother plant with a sharp shovel (or even an axe or saw, potentially) and move it to its new placement.

If your unearthed division reveals a lot of stem, but not many roots, it is recommended to cut the top back dramatically. Reducing the top of the plant can help your division recover, because without enough roots to supply water to the abundant stems and leaves, the plant may wilt or even die. In a situation where roots are scarce, it is good to pot up the division and place it in the shade for a couple of weeks to recover. Once you see healthy new growth it can be planted out.

Suckers are similar to clumps, in that they are stems growing from the same root system. However, their distinct difference is that they can shoot up many feet away from their mother. I have seen sumac suckers growing as far as 50' away from the parent!

Suckers are attached to their mother by one large root, and often have very few feeder roots of their own. It is a big disappointment to dig up a beautiful sucker with a big long thick root attached to it, replant it, water it in... and just have it die.

You can avoid this by root pruning the sucker. Cut a wide circle all the way around it with a sharp shovel, but don't pry it up. Leave it in peace in its undisturbed soil for a while to establish new roots. Later, you can come back and dig it up. The tiny, delicate feeder roots take this opportunity to bulk up, and with its new roots it will be more ready to move. The ideal time to root-prune a sucker is just after the plant drops its leaves in the fall, allowing it to rest for the winter, and transplant it in the early spring before it puts out new leaves. If the sucker is large it is best to cut back the top by 25%-75% when root pruning. Marking root pruned suckers is a good idea, surveyors tape works well, you can even write on the tape the approx diameter of the root pruning with a fade resistant marker so you are sure to get as many roots as possible.

Watch out for grafted plants, though- if you dig a sucker from a grafted tree you won't get a plant that is like the tree, you will get a plant that grows like its rootstock.

These species are good candidates for dividing and digging suckers:

Corylus spp. – Hazelnuts and hybrids

Sambucus spp. - Elderberries

Vaccinium spp. - Blueberries, Cranberries, Lingonberries and others

Rubus spp. - Raspberries, Blackberries and others. (Raspberries need no root pruning when digging suckers.)

Chaenomeles spp. - Flowering Quince

Hippophae rhamnoides - Seaberry/Seabuckthorn

Rosa spp. - Roses

Ribes spp. - Currants, Gooseberries and Jostaberries.

Schisandra spp. - Magnolia Vine

### **Layering and Stooling**

Layering and Stooling are two ways of encouraging a mother plant to grow an offshoot of itself. These methods require patience, but plant species which are particularly slow to root are good candidates for these methods, because the mother plant nourishes and maintains the offshoot while it develops. When the young plant has a developed root system of its own, it can be safely removed from the mother plant.

Layering is accomplished by taking a low branch or vine of new growth and placing it in soil, still attached to the parent plant. You may need to use a small rock or a hoop of wire to prevent it from springing back up. And then- you wait. Depending on the species, it may be a couple of weeks or a couple of months before roots develop. You can check if the stem has rooted by carefully digging around it. When the layering has grown enough roots it is severed from the mother plant. For slow to root or particularly delicate plants you may want to gradually sever the new plant from the parent plant, this is easily accomplished by binding the parent stem just before it enters the soil at the layering site, as the stem grows it will be collared by the wire.

It is often advantageous to layer your offshoot directly into a pot, so that when you sever it from the mother plant the roots remain undisturbed by digging. The new plant can then be moved to the shade for a week or two to strengthen its root system.

If you are layering directly into the ground, it will be beneficial to the new plant to leave it in place for a week or two after severing it from the mother plant. Either way make sure the soil stays damp.

Vining plants with long, flexible new growth are good candidates for compound or serpentine layering where the stem goes in and out of the soil / pots several times, and each place there the stem is buried will create a new plant.

Some plants that don't readily set roots can be encouraged to do so by damaging the bark and coating with rooting hormone in the place where the stem will be buried.

If the growth you want to layer isn't long enough to reach the soil, you can try the method of air-layering. This involves damaging the bark, coating with rooting hormone, and wrapping the area in a handful of damp sphagnum moss or coco coir. Use a wrapping of black plastic to hold the substrate in place, and carefully secure the edges of the plastic with tape. Check it once in a while by carefully unwrapping the plastic, and then replacing the plastic so it stays damp. When you have decent roots you can sever your layering and treat it as you would any other fresh layering.

Stooling is similar, though better suited to growing a larger number of plants than layering. Where layering does not disturb the mother plant from going about its usual business of growing fruit, stooling uses all of the plant's energy.

To stool a plant you cut it way back, near to the ground, inducing a spurt of new growth in the form of several vertical shoots. When the new shoots are about 6" tall, begin to mound them in soil or compost. Keep adding more material until you have a small mound with shoots coming out of it. After awhile the shoots will grow roots and you can carefully remove the mound of material and sever the rooted shoots, treating them as you would layerings. Be sure to leave 1-3 shoots attached to continue growing. Rather than building a mound you can cut the bottom off a bucket or large pot, put that around the stump to be stooled and fill with compost or soil.

These species are good candidates for layering and stooling:

Malus spp. - Apples (air layering for grafted trees, stooling for growing clonal rootstocks or own root cultivars)

Ribes spp. - Currants and Gooseberries

Corylus spp. - Hazelnuts and hybrids

Rubus spp. - Raspberries, Blackberries and others. (Blackberries, Black Raspberries and their hybrids are usually propagated by tip layering, the only difference is the tip of the stem is buried rather than the mid section of the stem.)

Actinidia spp. - Kiwis (Serpentine layering)

Schisandra spp. - Magnolia Vine

Vitis spp. - Grapes

Chaenomeles spp. - Flowering Quince

Amelanchier spp. - Shadbush / Juneberries

## Cuttings

Cuttings are sections of stems, cut away from the mother plant and given the opportunity to develop roots of their own. The cutting needs to grow roots before it dies of lack of water, and this time limit makes this method a bit trickier than layers or divisions. The biggest killer of cuttings is dehydration, so whatever style of cuttings you are growing, be sure that you are keeping to well hydrated.

Cuttings are a great way to root in large quantities. It is easy and cheap to buy, trade or ask a friend for a cutting, whereas it could be a challenge to layer or stool a mother plant that you do not already have growing in your garden or orchard.

### Leafy Cuttings (Softwood and Semi-Ripe)

These cuttings are taken in late-spring or summer, they are generally this year's growth with leaves attached. You want cuttings 4"-6" long, having 2 or more nodes is good but not necessary. Once you have your cuttings trimmed down into short lengths you need to remove most the leaf area, because leafy cuttings are constantly losing moisture by transpiration through the leaf surface. If too much water is lost, the cuttings will wilt and die. I aim for 1-2 square inches of leaf surface per cutting. If the plant has small leaves, prune away all but a few leaves. If they are large, prune away all but 1/4-1/2 a leaf per cutting, snipping the leaves laterally with sharp pruners.

The next step is dipping the cuttings in rooting hormone. Most species benefit from this step, but some plants can actually have their growth inhibited by a high concentration of hormone. Rooting hormone is typically IBA (Indole-3-butyric) in a concentration of 0.1%-0.8%. Powder forms are easiest to use and most available. Liquid forms are less common for home use but are better for large amounts of cuttings.

If using a powder, be sure to poke a hole into the growing medium before planting the cutting to avoid wiping off the powder when pushing the cutting into the growing medium. Alternatives to artificial rooting hormones are honey and willow twig tea, I have no experience to offer on these options, but other people speak highly of them.

Leafy cuttings need protection from drying out, so place them in a shady spot. A close covering of plastic can be very helpful to maintain moisture, but if you cover with plastic, you need to carefully harden off your cuttings before removing them from this humid microclimate.

Both shade and humidity can be provided by a covering of damp burlap, watered whenever it starts to get dry. Cuttings should be planted with about 3/4 of the length buried leaving only 1-2 buds/leaves above ground.

## Cuttings need something to grow in, here are some options for different mediums:

- Soil - Many easily rooted species can simply be stuck right into the soil and grow just fine, extra attention to watering is important and row cover to maintain high humidity may be helpful for some species. I have had best luck with this method when rooting water tolerant species in damp soils, such as Sambucus (Elder,) Salix (Willow,) Cornus Sericea (Red Twig Dogwood,) as well as Ribes nigrum (Black Currant.)
- Soiless solids – My favorites are 1:1 Perlite:Vermiculite and 1:3 Perlite : Peat / Coir, but commercial potting soil and plain sand are also options. The perlite / vermiculite mix is nice because it offers nothing for rot-causing bacteria or fungi to grow on. When using these mixes I use a plastic pot 3/4 full of medium, inside a clear plastic bag and placed in a shaded place outdoors. You can also use a milk jug, cut horizontally around the middle, with a section left un-cut, to serve as a hinge. Fill the jug 1/2 to 1/3 with medium and cuttings and tape it back together. Check on the cuttings weekly, and once they have some roots, leave the bag or jug open a little bit more every day until they are in open air, then pot them up or plant them in soil.
- Water- While water is not a great rooting medium for many plants, it has some great advantages for some. For one thing most people have plenty of water, so you don't have to buy anything, it is also clear so you can see when roots are developing. When they have developed, you can remove the delicate roots from the water without damaging them. Another advantage is that cuttings can absorb liquid water directly. If you remove most of the leaves you can skip the plastic covering, which means you save time and effort hardening off. A drawback of using water is a lack of oxygen, and without oxygen, cuttings tend to rot. The best way I have found is to use a small fishtank air-pump, allowing you to put many cuttings in one container without them rotting. For just a few cuttings, simply placing them in 1/2 full jar of water and changing the water daily is fine. Don't bother with IBA if rooting in water, it isn't water soluble, but other hormones (especially IBA-K) are worth experimenting with.
- Mist, I haven't had much success yet, but many types of cuttings can supposedly be grown in aeroponic systems, where the medium is very humid air and the cuttings are automatically misted frequently. This is sometimes referred to as aeroponic cloning.

A few tricks for difficult to root cuttings:

- Precallusing - Many species root most readily out of callus tissue (the plant equivalent of scar tissue), rather than cut the plants and wait for the to callus to develop before rooting, you can cut small strips of bark off the stems while still attached to the mother plant. These are left to heal for a week or two and then those stems are cut and rooted in using your preferred method.
- Etiolated shoot - Before growth starts in spring attach tube of light proof material to a shoot you wish to grow from, the tube should extend around 6" beyond the terminal bud. This will cause the shoot to grow long and thin while it "reaches" for the light at the end of the tube, this etiolated growth tends to root better than normal growth.
- Mist systems - Growing under automated mist systems has greatly increased the variety of species that can be grown from leafy cuttings in recent years. I have not explored this method myself, but there are some interesting videos on youtube about DIY mist systems.
- Extra light – Some species are stimulated to root by longer day lengths, so supplemental light can be useful (14-16 hrs of light a day).
- Timing makes a big difference – the precise stage of growth the cuttings were harvested at can determine success with many species, if you have access to the parent plant and want to figure out the best way to propagate by cuttings you can take a few cuttings every 2-4 weeks and keep good notes.
- Different cultivars of the same species root at different rates – try different cultivars or use different levels of hormones, temperature etc on different cultivars.

These species are good candidates for Leafy Cuttings:

Morus spp. - Mulberries (they grow well from very short ~2"-3"cuttings, 0.3%-0.8% IBA in soiless mediums.)

Actinidia spp. - Kiwis (0.3%-0.8% IBA in soiless mediums, does well in aerated water)

Cornus mas - Cornelian cherry (I have had limited success, 0.3%-0.8% IBA in sand, very slow to root)

Elaeagnus spp. - Goumi and Autumnberry

Vaccinium corymbosum – Highbush Blueberry (0.3% IBA in soiless mediums,)

Vaccinium macrocarpon – Cranberry (cuttings in damp soil, longer cuttings mostly buried)

Ribes nigrum – Black Currants (very easy)

Salix spp. - Willows (very easy)

## **Hardwood Cuttings**

Hardwood cuttings are taken from the newest growth in late fall or winter, when the plants are fully dormant. Make cuttings between 5"-12" long. Most hardwood cuttings are treated with 0.8% IBA.

Hardwood cuttings can be planted right away in the fall or stored carefully and planted out in very early spring.

Fall planted cuttings should be placed directly in the ground and heavily mulched. If not planted in the fall cuttings should be stored between 33 to 40° fahrenheit. Store them in the refrigerator, wrapped in damp paper and double bagged in plastic, or in the rootcellar, buried in a bucket of damp sawdust or perlite.

Outdoors, you may bury your cuttings in soil. Label bundles well and bury them upside-down. This way as the soil warms in the spring, the bottoms warm first. The cut ends will be stimulated to callus and root before the buds are warmed and leaf out. These buried cuttings should be dug up and planted out early in spring.

Like leafy cuttings, hardwood cuttings cannot support abundant leaves without adequate roots to support them. Providing conditions that will induce root growth before buds grow is important. Storing the cuttings in cold, but not freezing, conditions allows them to callus and start root formation while not stimulating leaf growth helps with this. Bottom heat can also be very helpful, especially with difficult to root species.

Hardwood cuttings should be planted deeply, with only a couple of buds above ground. Hardwood cuttings can be propagated in the same mediums as leafy cuttings, and benefit from the same humidity control techniques, except that hardwood cuttings often do not thrive in water.

These species are good candidates for Hardwood Cuttings:

Ribes spp. - Currants and Gooseberries

Sambucus spp. - Elderberries

Vitis spp. - Grapes

Actinidia spp. - Kiwis

Ficus spp – Figs

Salix spp. - Willows

## **Root Cuttings**

I have very little personal experience with root cuttings of woody plants, but I encourage experimentation and so I will provide the basics. Root cuttings should be harvested as soon as the ground thaws.

There are two methods for digging roots. You can unearth the entire plant, harvest your roots, and compensate for the lost roots by cutting back the top. Otherwise, you can carefully dig a small amount of roots while taking care to minimize the disturbance of the other roots.

As you dig your roots pay close attention to which end was "up" and replant accordingly, with "up" being the end closer to the stem of the parent plant. Root cuttings should be planted vertically in a pot or bed with 1"-1.5" of soil covering the top of the root. Keep them damp and wait patiently. Any plant that suckers is worth experimenting with root cuttings, but as always, be aware of grafted trees, because root cuttings will grow clones of the rootstock, not of the grafted cultivar. Root cuttings are not usually treated with hormones, but if you wanted to experiment, BAP (6-Benzylaminopurine) or GA3 (Gibberellic acid) would be worth trying.

These species are good candidates for Root Cuttings:

Malus spp. - Apples

Prunus spp. - Plums, Peaches, Cherries and others.

Rubus spp. - Blackberry, Raspberry and others.

Sambucus spp. - Elderberries

Sassafras spp - Sassafras

Amelanchier spp. – Shadbush / Juneberries

Diospyros spp – Persimmons

Hippophae rhamnoides - Seaberry

## **Micropropagation / Tissue Culture**

This method involves using tiny samples of plant material, and growing them on agar-based mediums under sterile conditions. Because of the specialized equipment and skills needed, it is most well suited to commercial production, but if it interests to you, I encourage you to pursue it at whatever scale is suited to you situation. While I have no experience with plant tissue culture, I do have experience propagating mushrooms, which are cultured in a very similar way. I built equipment and taught myself fungal tissue culture on a very small DIY scale, so with enough enthusiasm and ingenuity, I'm sure you could teach yourself plant tissue culture on a shoestring budget.

## **Resources**

### **Books:**

Lewis Hill

Secrets of Plant Propagation: Starting Your Own Flowers, Vegetables, Fruits, Berries, Shrubs, Trees, and Houseplants Paperback: Storey Publishing, LLC (January 2, 1985)

Michael A. Dirr, Charles W. Heuser Jr.

The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture, Second Edition: Timber Press; 2 edition (January 7, 2006)

Alan Toogood

American Horticultural Society Plant Propagation: The Fully Illustrated Plant-by-Plant Manual of Practical Techniques: DK ADULT; 1st American ed edition (April 26, 1999)

Miranda Smith

The Plant Propagator's Bible: Rodale Books; 1st edition (March 6, 2007)

### **Web/Social Media**

Web Resources:

<https://www.davesgarden.com> – A great resource for trading plant material.

<https://www.Youtube.com> has millions of videos on plant propagation, many of them excellent resources.

<http://www.pfaf.org> – A database of 7,000 useful plants with many useful types of data, including basic propagation.

Facebook Groups:

Edible Plant Propagation

<https://www.facebook.com/groups/115086485323076/>

North American Scion Exchange

<https://www.facebook.com/groups/684498728257243/>

North American Permaculture Nursery Exchange

<https://www.facebook.com/groups/1518976338351628/>

The North American Fruit Explorers

<https://www.facebook.com/groups/21070015101/> and consider joining the organization at <http://www.nafex.org/>