

Plant Propagation for Home Gardeners

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Many home gardeners wish to reproduce special plants in their landscapes or start their own vegetable and bedding plants. Plant propagation is the controlled reproduction of plants using a variety of methods. These methods can be broadly grouped into sexual and asexual (vegetative) methods. Sexual propagation is focused primarily on propagating plants by seed. Seed propagation offers some advantages in that the technique is often economical and efficient and lends itself to long-term storage. The primary disadvantage of seed propagation is that many seeds do not come “true to type,” so the offspring are not exact copies of the parent. Asexual propagation techniques include cuttings (e.g., root, stem, leaf), budding or grafting, layering and division. Asexual propagation techniques, while often more labor intensive than seed propagation, do allow the gardener to get an exact copy of the parent plant.

Seed Propagation

Seed propagation is commonly used by a home gardener when starting plants for the vegetable garden or for some bedding plants. Most gardeners are well aware of how to prepare a seedbed in a vegetable garden and then follow the directions on the seed packet to sow the seeds.

Starting seeds indoors for the vegetable garden or for bedding plants is fairly simple. The two most critical factors are using a high-quality seed germination mix and then keeping the seeds moist but not overly wet. Media for seed germination should ideally be sterile, most likely consist of a significant percentage of peat moss and never contain garden soil. Garden soil is a poor choice because it is not

sterile and typically holds too much water. Manufacturers often sell a soil-less media designed specifically for propagation. The media should be moist before sowing the seed. For very small seeds, it may be easier to sprinkle the seeds on the media surface and then use a fine spray of water to settle them into the media. For larger seeds, you can sow the seeds and then cover them with an appropriate depth of moistened media. The general rule of thumb for covering seeds is to cover the seed with two times the diameter/width of the seed. Again, use water to settle the media in after topdressing the seed with media.



Figure 1. Germinating seed.

Keeping the media moist (i.e., not wet and not dry) during germination of the seed is critical. Once the media is at the correct moisture level, simple techniques can be used to maintain that level for the entire germination period. One simple method involves placing a glass plate or sheet of plastic or Saran™ above the lip of the seed tray or container. If the plate or sheet is elevated just slightly above the media surface, it will need to be raised or removed once the seeds begin to germinate and grow. The other common option is to place a

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clear plastic bag over the container, again with the goal of simply trapping existing moisture contained in the media. If the bag is not rigid, it is common to use an appropriate length of bamboo stake or chopstick to keep the bag from collapsing in on the fragile seedlings. Some seedlings are very sensitive to salts in water; therefore, for small seed germination projects, you may wish to use deionized bottled water until seedlings are up and actively growing. If seed has been sown with a high density, you will most likely have to transplant the fragile seedlings to a different container (e.g., cell pack) to allow the seedlings to reach a size that can be transplanted into the garden or landscape.



Figure 2. Seed germination trays.

Especially with woody plants, you will need to become familiar with two terms: *stratification* and *scarification*. In a simple sense, *stratification* involves different methods imposed by man to cause seeds to germinate after simulating environmental conditions that seeds would normally experience in nature. For example, think about a red oak acorn that falls to the ground in the fall. In nature it is exposed to winter temperatures and then begins germinating the following spring. The internal signals keep the acorn from germinating in the fall before harsh weather sets in. Knowing this, if you harvest red oak acorns in the fall and then want to germinate the seed indoors, you need to replicate what would have gone on in nature. Therefore, the red oak acorns are placed in a container with moistened media and then placed in a refrigerator (32 to 45 degrees F) for three months. These “stratified” seeds can then be removed from the refrigerator and sown, and germination should begin soon if the temperatures are suitable. Reference books will clearly mention what kind of stratification regime is required for each species.

Scarification is any physical process that softens or damages the seed coat making it more permeable to water and air. Again, propagation books clearly indicate which species require scarification to improve germination. Plants in the Legume family are one group often mentioned. For small seeds, you can simply place the seeds between two layers of medium sand paper and then rub the sheets back and forth. For larger seeds (e.g., Kentucky coffee tree), you can use a metal or nail file to abrade the seed

surface. Seeds can also be scarified using hot water (170 to 212 degrees F). With this method, simply drop the seeds into four to five times their volume of hot water, remove water from the heat source and let the seeds soak for 12 to 24 hours unless the literature states otherwise.

Vegetative Propagation

Vegetative (asexual) propagation techniques include cuttings (e.g., root, stem, leaf), budding or grafting, layering and division. Propagation techniques such as cuttings, layering and division can be easily performed by home gardeners; however, budding and grafting typically require more skill.

Cuttings

An understanding of terminology is required before going further. A number of terms are used when discussing cutting propagation. Simple terms are used to describe where the cutting originated

from (e.g., root, stem, leaf), or with stem cuttings, the relative age of the wood/tissue (e.g., softwood, semi-hardwood, hardwood). With stem cuttings, we may also refer to the number of nodes. Nodes are simply the locations on the stem where the leaves originate from (i.e., more precisely, where the buds are located). It is also common to refer to the overall position on the stem that the cutting was taken from (e.g., terminal, sub-terminal). For example, it is common for a gardening book to instruct you to collect “terminal cuttings with three to four nodes.” With most cuttings, you also need to pay attention to the original “up and down” ends of your cuttings (polarity). If you think you will have trouble keeping track once you have removed a cutting from a stem, you can simply use a lateral or cross-cut to reference the top/“up” and an angle cut to reference the bottom/“down” of the cutting.

The **media** you use to root cuttings can have a significant impact on your rooting results, not only the number of new roots but the growth of these roots. An ideal rooting media needs to be sterile, well drained and provide adequate oxygen. Individual components that are most commonly used include coarse perlite, coarse vermiculite, peat moss and sand/pumice. These individual components can be combined in a variety of ways and percentages. Examples include 50% peat moss: 50% perlite (volume basis); 50% perlite: 50% vermiculite; 100% perlite; 100% sand/pumice; and 100% peat moss. Rooting cubes (e.g., Oasis Rootcubes®) made out of foam are also used.



Figure 3. Typical three-node semi-hardwood cutting with basal leaves removed.



Figure 4. Effect of media on rooting performance.
Left: vermiculite, peat moss, perlite, peat:perlite

The **rooting environment** has a major influence on the rooting results. Remember that with cuttings we have separated a portion of the plant from the parent plant, thus removing its source of water and nutrients until a new root system has reestablished. Environmental conditions that add stress or hasten water loss diminish the rooting success. Therefore, conditions such as high light, high temperature or breezy conditions often have a negative impact on the rooting results. Even with cuttings that have leaves, it is hard for people to imagine that making “food” is not a priority but forming roots is. Cuttings will rely on stored “food” until new roots are regenerated. With this in mind, ideal temperature conditions for most cuttings are to have the air temperature 10 to 15 degrees cooler than the rooting media. Ideal temperatures for many types of cuttings would be an ambient temperature of 55 to 65 and a media temperature of 65 to 75 degrees F. In most home situations, having a dual temperature is difficult; however, garden suppliers do sell waterproof heating mats designed specifically to place propagation trays on to elevate the media temperature. As for light levels, it is critical to keep cuttings out of direct sunlight until they have rooted. Appropriate light levels can be found in north-facing windows or by using grow lights in dark rooms or basements.

The critical factor with cuttings that contain leaves is to maintain the highest level of relative humidity possible around leaves until roots form. Commercial propagators use intermittent mist systems or fog systems to achieve this goal. While these options are possible for a homeowner, there are easier solutions. No matter what option you chose, the goal is the same: you are trying to trap moisture already present in your rooting media. For very few cuttings, using an inverted Ziploc™ bag or one-half of a clear plastic soda bottle works very well over a single pot. If you use the threaded end of a plastic bottle, you can easily remove the bottle cap to vent moisture if it builds up too high in the bottle. For large numbers of cuttings, it is easier to use a seed tray or flat. To trap moisture when using a tray, use a clear tray lid or pieces of bent strap metal (Fig. 7) to keep a plastic bag from touching the cuttings. With most leafy cuttings, we need to transition or “harden off” cuttings before planting them outside. Once cuttings

have formed roots, you can start this transition by periodically venting your cover with increasing frequency to reduce the relative humidity slowly over time.

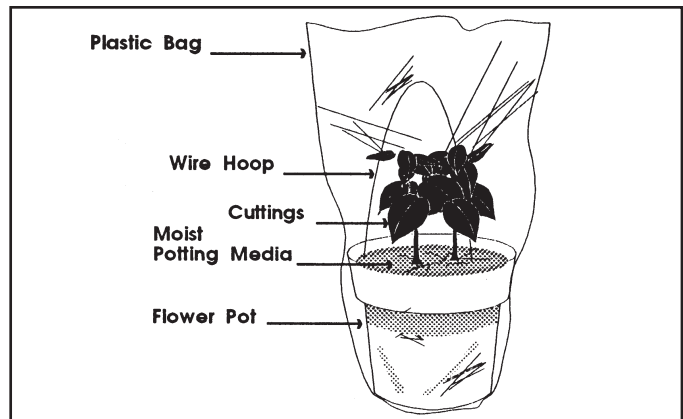


Figure 5. Simple propagation option using plastic bag.



Figure 6. High dome for rooting cuttings.



Figure 7. Simple propagation tray.



Figure 8. Plastic bottles (top or bottom) for rooting cuttings.

Houseplants

Many different kinds of common houseplants can be easily propagated by stem, cane or leaf cuttings and by division or layering.

Stem Cuttings

There are a number of common houseplants that can be easily propagated by stem cuttings. These include coleus, begonia, Christmas cactus, fuchsia, geranium, poinsettia, rubber plant, shrimp plant and wandering jew. Take cuttings from shoots that are vigorous, pest free and, ideally, not flowering. Cuttings will typically be 4 to 6 inches long depending on the plant. Cut the stem just below a node with a sharp knife or razor blade. Remove leaves from the lower half of the cutting and dip the basal 1 to 1.5 inches in a rooting hormone. Rooting hormone is probably not necessary for easy-to-root plants such as coleus and fuchsia, but it will not hinder the rooting process either. Carefully stick the dipped end of the stem cutting into the rooting media. Some people like to pre-drill the hole using the eraser end of a pencil. The rooting media would then be firmed around the cutting after inserting into this preformed hole.

A modification of this works well for foliage plants that have a larger stem such as dumb cane, corn plant and Chinese evergreen. In this case you will remove a leafless section of the stem, now referred to as a cane, and lay this cane horizontally on the media surface. If the cane is thick, you will push the cane slightly into the media surface so you get good media contact.

Leaf Cuttings

Leaf cuttings are used to propagate many houseplants including begonia, African violet, *Episcia*, gloxinia, jade plant, kalanchoe, mother-in-law's tongue and peperomia. There are several variations of leaf cutting types depending on what parts of the leaf are used and whether a leaf petiole is attached or not.

Leaf-Petiole Cuttings – Just as it sounds, a leaf-petiole cutting includes both the wide part of the leaf



Figure 9. Begonia leaf cuttings.

(lamina) and the petiole that attaches it to the original stem. This method is commonly used for African violet, peperomia and some begonias. Roots and a new plantlet typically originate at the base of the petiole.

Leaf-Blade Cuttings – Leaf-blade cuttings consist of the leaf blade only and are commonly used to propagate many succulent plants such as jade plant and sedums. In this case the leaf is most commonly inserted vertically into the media with a majority of the leaf visible above the media surface. Roots and new plantlets typically originate from the base of the leaf. One exception would be kalanchoe. In this case you lay the leaf horizontally on the media surface and plantlets will develop at many of the serrations or notches in the margin of the leaf.

Leaf-Vein Cuttings – The classic example of this cutting method is the begonia. You simply lay the leaf on the media surface and cut several slices perpendicular to the major leaf veins. Some people also flip the leaf over and lightly dust those cuts before laying the leaf back on the media surface. Roots and plantlets will develop at the cuts in the veins.

Leaf-Section Cuttings – The most common example of this technique is used to propagate mother-in-law's tongue (*Sansevieria*). In this case you cut the long "tongue-like" leaf into 2-inch segments and insert the bottom ½ inch into the rooting media. Remember to keep the original orientation of the leaf intact (polarity). Some of the baby plantlets that will form at the bottom of the leaf piece from a variegated selection may develop as green only (i.e., no variegation).



Figure 10. Mother-in-law's tongue leaf-section cuttings.

Preformed Plantlets – A small number of houseplants produce preformed plantlets along aerial shoots. Examples include spider plant, wax plant (*Hoya*) and strawberry begonia (*Saxifraga stolonifera*). Propagation is simple involving the removal of these plantlets (with or without aerial rootlets) and then inserting the base of the plantlets in a high-quality potting soil and treating the plantlet as if it were a stem cutting.

Outdoor Plants

Many of your favorite outdoor shrubs, vines and ground covers can be easily propagated by cuttings.

Softwood Cuttings

Softwood cuttings are prepared from the soft, succulent, new flush of growth. Many ornamental plants can be propagated by softwood cuttings including lilacs, forsythia, magnolia, weigela, oleander, pyracantha, spirea, apple, peach, pear and plum. While softwood cuttings tend to root easily and faster, they may require more care since the soft tissue is more susceptible to drying. In general, with softwood cuttings, we are talking about cuttings that are typically 3 to 4 inches long, with two to three nodes and the basal leaves removed before inserting the cutting into the media.

Semi-Hardwood Cuttings

Realistically, terms such as softwood and semi-hardwood are not absolutes. Once the very soft flush of new growth starts to stiffen up and form “wood,” we have likely passed into the semi-hardwood stage. A majority of our common ornamental shrubs are propagated from semi-hardwood cuttings. Plants such as viburnum, camellia, azalea, holly, crape myrtle, hydrangea and euonymus use this type of cutting. In Arkansas this peak time is often between May 15 and June 15.



Figure 11. Dipping prepared holly cutting in rooting hormone.

Hardwood Cuttings

Hardwood cuttings are made from woody, dormant wood on deciduous plants (e.g., grape, poplar, rose, willow, peach, wisteria, elderberry, blackberry, forsythia) or some needle evergreens (e.g., junipers, arborvitae). Hardwood cuttings are easy to prepare and less perishable. For deciduous plants the cuttings are leafless and tend to be longer than softwood cuttings. Hardwood cuttings are typically 6 to 12 inches long. As a general rule for the needle evergreens, rooting percentages tend to be increased when cuttings are harvested in mid- to late winter. As a general rule, higher rooting percentages occur on junipers when a small “heal” of wood is included at the base of the cutting.



Figure 12. Hardwood cutting.

Root Cuttings

Root cuttings are used very rarely and only on a few species that typically do not root well from stem cuttings. These include *Aesculus*, *Aralia*, *Koeleruteria*, sumac (*Rhus*) and sassafras. The most challenging aspect of root cuttings is uncovering from soil the roots of your desired plant and not some other plant. While root cuttings may be made at any time of the year, it is probably more common to do this in the dormant season. Root pieces can be held in moist media in a cooler (>38 degrees), placed nearly horizontal in rooting media like you would treat other cuttings or direct planted in well-prepared garden soil with the top of the root-piece just barely emerging from the soil.

Grafting/Budding

Realistically, grafting or budding is not an easy technique for home gardeners to master. Most people would be amazed at how many ornamental plants in their landscape originated from budded or grafted plants. Many shade trees, all Japanese maples, many weeping plants and all hybrid tea roses use these techniques. Budding or grafting is also the mainstay of the tree fruit industry. Budding and grafting are essentially the same technique; however, with budding you are simply attaching the bud from your desired plant to the rootstock/understock, and with grafting you are using a piece of stem that contains many buds on it. The obvious advantage of budding is you can potentially get many more plants from your desired scion/stockplant. The major



Figure 13. Chip budding.

disadvantage of budding is that you are typically working with a very small bud versus a larger piece of stem that is easier to handle. A good propagation text can go into the specific details related to budding and grafting.

Layering

Layering is a method of rooting a new plant while the stem is still attached to the parent plant. It is simple to perform and can be done in the home without special equipment or structures.

Air Layering – In the case of air layering, we are forming roots on stems well above the soil. This method can be used successfully on a number of common tropical houseplants including croton, dumb cane (*Dieffenbachia*), dracaena, rubber plant and schefflera.

The process is quite simple. First, pick a point in the stem at least 10 to 12 inches from the tip. Remove all leaves several inches on either side of the region where you will make your air layer. The area will typically be about 6 inches in length. Two types of stem cuts are typically used. One involves making an upward-angled cut into the stem that stops about halfway through the stem. The other method involves removing a ring of the outer bark. The ring of bark tissue will be 1 to 1.5 inches long. Apply a rooting hormone to the cut surfaces. If an angled or vertical cut has been made into the stem, you will want to prevent that from closing by inserting a small piece of toothpick in the wounded area. Next, take a handful of moist *sphagnum* moss and pack the moss in and around the cut surfaces. To retain the moisture around the wounded area for weeks/months, wrap a layer of plastic sheet around the entire work area and seal both ends with electrical tape. Many people also cover the plastic with aluminum foil to prevent any light from penetrating the rooting zone and to reflect any heat from sunlight. You can simply keep your foliage plant in the same place (i.e., indoors or outdoors) where it was originally growing. Once roots do form, simply make a single cross-cut in the stem below the rooting zone. You should end up with roots on the bottom and leaves at the top: a new plant.

Ground Layering – Ground layering can be used to easily propagate a number of ornamental shrubs and vines. This simple technique works well



Figure 14. Air layering Mahonia.

for plants such as wisteria, brambles, forsythia, weigela and spirea. Ground layering simply involves bending an intact shoot over and burying the middle portion (i.e., shoot tip comes back up above ground and is exposed) under the existing soil. You may wish to wound the lower portion of the bent stem. With easy-to-root plants, roots will often form along the buried stem. Once roots have formed, you simply cut the stem below the rooted zone, excising the plant from the mother plant.

Division

Many home gardeners did not realize that they were actually plant propagators when they divided common perennials such as cannas, hosta, daylilies, iris, peonies, bleeding heart, many ornamental grasses, ferns and lily-of-the-valley. As a general rule, the best time to divide plants is during the dormant season.

Resources

- Bubel, Nancy. 1988. *The New Seed Starter's Handbook*. ISBN-10:0878577521.
- Dirr, M.A., and C.W. Heuser Jr. 2006. *The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture: A Practical Working Guide to the Propagation of Over 1,100 Species*. Varsity Press. ISBN-10:1604690046. *Basically an A to Z recipe book for propagating woody ornamental plants.*
- Druse, Ken. 2000. *Making More Plants: The Science, Art and Joy of Propagation*. ISBN-10:051770787X.
- Gowdy, Mary Ann. 2002. *Home Propagation of Houseplants*. University of Missouri - Columbia. G6560. <http://extension.missouri.edu/p/g6560.pdf>.
- Hartmann, H.T., D.E. Kester, F.T. Davies, Jr., and R.L. Geneve. 2010. *Plant Propagation Principles and Practices*. Prentice-Hall. 8th edition. ISBN-10:0135014492. *This is considered the bible of plant propagation. It is used in every college and university. Expensive, but thorough.*
- Heffernan, Maureen. 1997. *Burpee Seed Starter: A Guide to Growing Flower, Vegetable, and Herb Seeds Indoors and Outdoors*. John Wiley & Sons. ISBN-10:0028610024.

Supplies

- Your local garden supply store can often provide trays, media and rooting hormone.
- A.M. Leonard, Piqua, OH, <http://amleo.com/>
- Hummert International, Earth City, MO, <http://www.hummert.com/>

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