

Chapter 2.

Propagation



Propagating plants is the creation of new plants, either from seed (**sexual propagation**) or from a part of a plant (**asexual propagation**). Any person working in the field of horticulture should have an understanding of the different methods of propagation, because without propagation there would be no plants to sell, buy or plant. Everything in this industry starts with propagation! It is a fascinating subject that can become a lifelong passion. The subject of propagation is an enormous one. This chapter will give a very basic overview of the different methods and techniques used to propagate plants.

Even after spending a lifetime propagating plants, most propagators and growers would say that they will never know all there is to learn about this vast subject. Luckily a wealth of information can be learned, both from hands on experience and by joining professional associations. **The International Plant Propagators Society** is a world- wide organization devoted to the subject of propagation. Its members share new information, new research and the latest propagation techniques, as well as visit nurseries and conduct

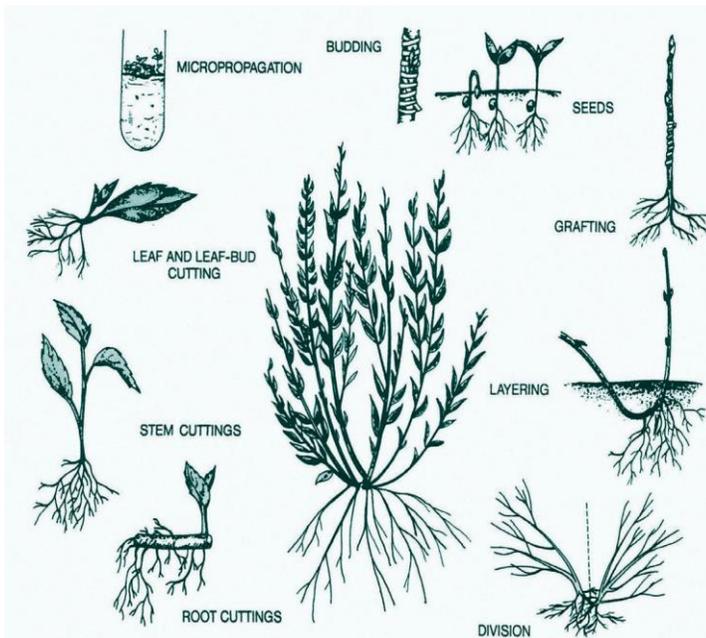
seminars. The Maryland Nursery and Landscape Association website, mnlonline.org, has a link to the IPPS website.

Some nurseries and greenhouse operations propagate all of their own plants. Others might propagate only certain plants and purchase young plants of other species from a nursery that specializes in propagating. These young plants are called liners. A **liner** is any young, propagated plant, such as a seedling, a rooted cutting or a bare root plant. Liners are grown on for one or more seasons, either in a container or in the ground. If planted in the ground then the task is referred to as “lining out”.

Sexual Propagation – Seed

Seed is produced as a result of the pollination and fertilization of the female reproductive parts of a flower with male pollen. This union results in the formation of a seed. Because sexual reproduction is a mix of genetic material from the two parents, the resulting plants might have slightly different characteristics from those of the parents. Some plants typically grown from seed may not be perfectly uniform in growth habit and have slight differences in flower color, leaf color or growth habit from their parents. However, by carefully controlling cross-pollination, plant breeders can produce **genetically identical seeds**. The resulting seedlings are called **F1 Hybrids**. They are important to growers because the seeds of F1 Hybrids will produce a uniform crop of genetically identical plants from seed. Plant breeders also cross pollinate certain plants to increase disease resistance, vigor or other desirable traits in their offspring.

Growing plants from seed is a relatively easy and inexpensive way to propagate a large number of plants in a short amount of time. Seeds can be purchased from a reputable seed company or collected. You can collect your own seeds but you must know that many plants do not “**come true from seed**”. This phrase is used to describe the fact that the seeds of many plants do not produce seedlings that have the same characteristics as their parents. If the flowers of the plant were pollinated by a different variety of plant, the seed will “not come true”. Most plants are “open-pollinated”, either by insects or by the wind. **Plant hybrids** almost never come true

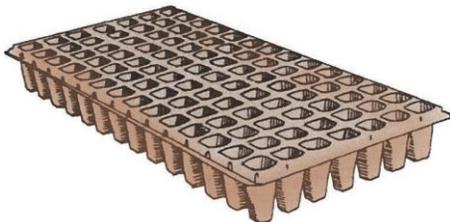


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from seed, if they germinate at all, and must always be propagated vegetatively. Collect seed only from straight species, never from plant hybrids.

Timing is very important when collecting seed. Seed must be collected when it is fully ripe but before it drops to the ground, is eaten by animals or is blown away in the wind. **Careful labeling** is also very important. Storage and cleaning methods of seeds vary greatly, depending upon the species. As a rule of thumb, seeds must be kept dry to prevent the seed from rotting, so store it in a cool, dry place. However, some seeds must be kept moist to keep the seed viable. Most seed needs to be cleaned to remove debris, such as pieces of stems or leaves, before sowing. Sieves of various sizes or a screen can help in the cleaning process. If the seed is a pulpy fruit, such as the seed of *Magnolia*, dogwood and crabapple, the pulp surrounding the seed needs to be removed by soaking in water for several days.

Until it germinates, a seed is in a **state of dormancy**. For a seed to break dormancy and germinate, the propagator must provide the correct conditions. The proper amount of moisture, proper temperature, amount of light and a suitable growing media must be present for the seed to germinate. Some seeds do not germinate easily and require pre-germination treatments such as stratification or scarification, to break dormancy. **Stratification** is done by placing the seeds in a cool, moist environment, such as a plastic bag filled with moist sphagnum moss or sand, and placed in a refrigerator for at least 8 weeks. This process mimics conditions found in nature and fulfills the seeds requirement for a cold period. The seeds will then break dormancy when sown in a warm greenhouse. Some seeds have multiple dormancy



This cell flat contains 98 separate cells for seedlings or cuttings.



Some seeds require stratification or scarification to germinate.

requirements and must be subjected to a warm period, followed by a cold period. This is done by placing the seeds in a plastic bag filled with moist sand and kept at 65-75° F for up to 12 weeks, before placing the bag in a refrigerator for a cold period of 8 weeks or more. Yet another method of stratification is to sow seeds in pots or flats and simply place them outdoors for the winter. They will then germinate in the spring. Take care to protect the flats from rodents that might eat all of your carefully collected seed!

Scarification is done to seeds that have a hard seed coat. Scratching a hard seed coat with a metal file is one method of scarification. The scratching weakens enough of the seed coat to allow water to more easily penetrate the seed and initiate germination. Seeds can also be cut or chipped with a sharp knife or razor blade to remove just a tiny portion of the seed coat. Soaking seeds in hot water breaks the dormancy of some seeds, while more stubborn species must be soaked in an acid solution to weaken the hard seed coat. Seeds that might require scarification or stratification are almost exclusively seeds of trees and shrubs, although a few herbaceous perennials may require the treatment.

Germination Media

Special media must be used for germinating seed. It must be fine-textured and uniform. It must drain well yet retain enough moisture that the seeds or seedlings won't dry out quickly. It must be weed and disease free. Most nurseries use commercially prepared media, such as Jiffy Mix or ProMix. These all contain peat, vermiculite and a low concentration of fertilizer to nourish the seedling after germination. Once the seedlings have developed their first set of true leaves, additional fertilizer is usually needed to keep them growing at optimum rates. Fertilizer requirements vary, depending on the plant species.

There are many different types of containers available for sowing seed. Some growers sow seeds in pots or in open plastic flats. Others sow seed into **cell flats**, also called **plug flats**. These are molded plastic flats that have individual cells, like small pots, lined up in rows in the same flat. There are many different sizes of cell flats and the size is chosen by the type of plant that is being propagated. An advantage to cell flats is that each seedling germinates and grows in its own individual cell, making transplanting much easier. Seedlings that are grown in open flats can often crowd each other and grow together, making transplanting more difficult. Always sow seeds in a container or flat that is clean and free of weed seeds and disease pathogens.

It is important that the media be watered thoroughly in the flat or cells before sowing the seed. This will eliminate air pockets and ensure there are no areas of dry media. However, it is equally important not to overwater the flats initially because oxygen needed for the roots of the new seedlings will be squeezed out by the water. Roots need oxygen to survive.

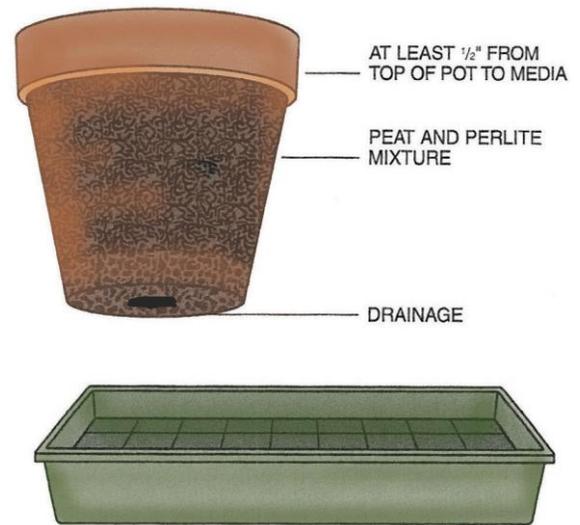
The **timing of sowing seed** is very important, in order to have the seeds germinate, grow, be transplanted and eventually be ready for sale by a certain date. Sowing seeds of petunias two weeks later than recommended, for example, can mean that the spring sales season will be over before those petunias are big enough to sell. Luckily there are many sowing scheduling charts available from seed companies and suppliers to help guide the grower.

Seed sowing can be done by hand or by machines. Seed sowing machines can be expensive. However, the speed in which they operate, versus the speed of the slower method of hand sowing, can translate into large cost and labor savings. Seeds sown by machines also use less seed because precise amounts are dispensed onto the flat or into the cell, resulting in a very uniform crop.

Covering the seed with fine sand or perlite is the usual practice for most species of plants. A rule of thumb is to never cover a seed more than twice the thickness of the seed. Very small seed, such as *Campanula*, would only be covered with a thin layer of sand or perlite, while a large seed, such as a horse chestnut, would be covered more heavily. The covering of seed helps keep it from being washed away and help retain precious moisture. However, some seeds germinate best if left uncovered because they need light to germinate. Examples of such seed are snapdragon, *Lobelia* and petunias.

Proper labeling is an important step in the seed sowing process. Recording with a waterproof marker the genus and species and the sowing date onto a plastic label will keep seedlings from being mixed up or mislabeled when they are ready for transplanting. Further information, such as seed source, date seed was collected or purchased, media used, method of seed covering, and temperature is just some of the information that should be recorded in a logbook for later reference. Good record keeping is one of the best ways to track your successes and failures in propagation.

Proper watering of the seed flat is crucial to the success of good seed germination. Very small seeds can easily be washed away if the incorrect nozzle is used or if the water pressure is too high. Mist nozzles emit a fine, gentle mist that is excellent for keeping the surface of the media moist. An automatic mist system is a good investment for any nursery that propagates plants. Nozzles that emit a fine mist are arranged along the length of a greenhouse bench or bed and a timer turns the water on automatically throughout the day. Timers need to be adjusted according to the weather and the time of year, to ensure that the mist does not turn on too frequently, causing seeds or seedlings to rot. Conversely, a mist system that does not turn on often enough could cause the seeds to dry out and die before or just after germination. Therefore some growers install a mist system that uses sensors that monitor the amount of moisture and will turn on or off based on when they sense it is too dry or too wet. Mist systems are never kept running at night



Any container at least 4 inches deep, such as a plant pot or flat, may be used to hold cuttings.

because doing so would keep the flats too wet and disease problems will occur.

Temperature requirements for optimal germination are species specific. But most seed (if they don't require stratification prior to sowing) will germinate if the flats are kept at temperatures between 65 and 75 degrees F. To help keep the flats at a uniform temperature, many greenhouses heat the propagation benches using a method called **bottom heat**. There are many different methods of providing bottom heat, including running rubber tubes filled with hot water under the flats, blowing hot air under the bench or using electric heating cables. Installing bottom heat is expensive but the resulting faster, more uniformly germinated seeds can speed up production of some plants significantly.

Fertilizing seedlings, after the first set of true leaves appear, is usually done weekly using a very low concentration of water soluble fertilizer. Different rates are used depending on the species of plants. For example tree seedlings require much less fertilizer than fast growing annuals, such as marigolds.

Poor seed germination can be the result of many factors. Poor cultural practices such as over watering or improper temperatures can prevent seeds from germinating. Sometimes the seed was not viable due to improper storage. Perhaps the seed needed special treatment, such as scarification or stratification. Disease causing pathogens might have killed the emerging seedlings or maybe mice or birds ate the seeds soon after sowing. Constant monitoring of the seed flats is important so that a grower can make changes to the greenhouse environment quickly before a problem gets out of hand. Excellent record keeping will help prevent problems from reoccurring. Propagating plants from seed is a learning process that never ends.

Asexual Propagation

Asexual propagation uses a plant's ability to create new plant parts from pieces of the parent plant. All plants have the potential to be reproduced asexually, a process which is more commonly called **vegetative propagation**. Some plants do not produce seeds and other plants produce seed that is very difficult to germinate. Vegetative propagation is used to produce such plants in large numbers. Unlike sexual propagation, the resulting plants are an exact genetic replica of the parent plant. These genetically identical plants are called **clones**.

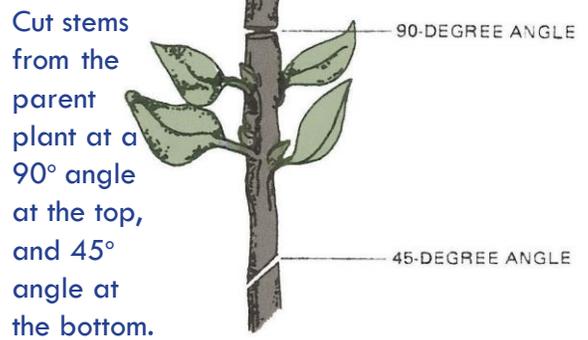
With vegetative propagation, new plant parts can be formed on a piece of a plant in places that they don't normally grow. An example of this would be when roots form on the cut end of a stem. A stem growing on a tree or shrub does not normally produce roots while it is attached to its parent plant. However, if the stem is removed at a certain stage of growth and proper conditions are provided, such as water, rooting hormones, proper media, temperature, humidity and light, roots will grow from that stem. The resulting plant would be called a **rooted cutting**. Another example of vegetative propagation is when buds begin to grow on pieces of roots that have been cut from the roots of a plant. If the pieces of root are placed in media and given proper moisture and other requirements, buds will grow and a new plant is formed. In that case it would be called a **root cutting**. These are just two examples of vegetative propagation.

In the nursery industry the term for the parent plant is the **stock plant**. Plants are selected to be used as stock plants if they are healthy, vigorous and have desirable characteristics, such as variegated leaves, large flowers, attractive bark or a compact habit. Propagators use plant material from the stock plant to vegetatively propagate exact replicas of that desired plant. Some stock plants might also be used for seed collecting because of the superior seedlings which they produce.

Some varieties of some plants are so unusual or distinctive that they have been given a **plant patent**. If a plant breeder develops a cultivar that is worthy of naming and introducing to the nursery trade, that breeder may choose to patent that cultivar. The breeder then has the right to control who can and cannot propagate that cultivar, as well as collect royalties on the sale of the resulting plants. Before propagating a plant it is important to find out if it is patented.

Cuttings –Woody Plants

As previously stated, a cutting is a vegetative plant part that is severed from the parent plant and rooted to form a new plant. One of the most common methods of propagating woody plants is by **stem cuttings**. A stem cutting is taken from the current season's growth, either from the actively growing softwood stems of a woody plant, the semi-hardwood stems that are found later in the growing season or hardwood cuttings that are taken soon after a woody plant has gone dormant.



When cutting plant stems to use for cuttings, always use sharp knives, scissors or pruners that have been cleaned with a solution of 1 part Clorox to 9 parts water. Early morning is the best time to cut plant material because the stock plant will be **turgid** (full of moisture). Always take more material than ultimately needed, to allow for mortality, especially for more difficult to root species. However, never take so much material that the stock plant will be weakened. Place the plant material into buckets of water or plastic bags containing water. Carefully label each bag or bucket. Always keep cut plant material away from sun and heat.

Make and prepare the cuttings for sticking as soon as possible. The length of the cuttings will depend upon the species being propagated and the method being used. Generally, cuttings are 4-6" in length. The diameter of the cutting is also species specific and can range from 1/8" to 1/4" in diameter. Most cuttings are cut just below the leaf nodes. Plant growth hormones are concentrated at the nodes and cutting a stem there will optimize the chances for root formation. The base of the cutting is cut on a slant to expose more of the surface area to the rooting medium. When taking hardwood cuttings it is important to be able to distinguish between the top and the bottom of the stem. Cuttings that are stuck upside down will not root.

Leaves are trimmed from the **basal** or lower end of the cutting. Generally 3 or 4 leaves are left at the top of the cutting. If the leaves are very large, as on *Rhododendron*, the leaves need to be cut in half or even more, to reduce the surface area. Reducing the surface area of the leaves helps to prevent moisture being lost through transpiration and evaporation. Also, too many leaves will crowd and smother the cuttings, reducing air circulation. If leaves come in contact with the medium they will rot and cause disease problems.

Cuttings of many woody plants will root more readily if the base of the stem is slightly wounded. **Wounding** is done by carefully cutting away a thin