SEED PROPAGATION (SEXUAL) PROPAGATION

Prepared by Thelma Glover
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The increase of plants can be done either by seeds, sexual propagation, or by vegetative methods, asexual propagation. The method to use is usually determined by circumstances and the results expected by the propagator. There are advantages and disadvantages to both methods, depending on how many plants are needed, as well as the purpose or purposes for increasing certain plants.

For obtaining numerous plants which will not have the exact appearance of the parent or its brothers or sisters, seed sowing, sexual, is the easiest and least expensive method. The seedlings can be very diverse in appearance, providing a chance to select certain seedlings which may be more desirable than the parent, either being more attractive or having certain other traits which would make the plant more interesting than the parent. This is the way selective cultivars are obtained.

On the other hand, vegetative propagation, asexual, is the method for obtaining an exact clone of the parent. It can be the only method available for those plants that do not set seeds or seeds aren't available for whatever reason. This is accomplished by selecting a vegetative part of the parent and growing a new plant from that part. This can be done by cuttings from the root, stem or leaf, by divisions, layering, grafting or tissue culture.

Only propagation by seed and propagation by stem cuttings will be discussed herein.

SEED PROVENANCE

Provenance refers to the geographic location from which seed is collected. Provenance may influence traits such as hardiness, growth rate and adaptability to climatic conditions. This should be kept in mind when purchasing or collecting seeds.

SEED COLLECTION

The most difficult challenge of seed collecting is knowing when the seed is ripe and ready to be harvested. Seeds of some spring bloomers are ready for collection in April,
while the seeds of the fall blooming plants may not be ready until after the first frost.

Because some of the early spring plants flower and disperse their seeds quickly, probably the most reliable method of knowing when to collect seeds of specific plants is to keep a collecting calendar over several seasons. Such plants as foam flower, fire pink, boodroot and wild geranium must be watched carefully as they can spill their seeds in a short time after maturity.

On the other hand, plants such as butterfly weed and Thermopsis bloom in June, but they do not produce mature seeds until August. Many of the flowers of the composite family (Asteraceae) bloom late in the summer or fall. The seeds of these flowers are best left on the stalks until after the first frost.

In general, the fruiting structures that hold the seeds will give indications that the seed is mature. Most capsules, pods and berries will expand in size and turn from a light to a darker color. Likewise, the seeds themselves usually turn a darker color when ripe.

Capsules and pods are best collected a short time before the seed is fully mature and placed in paper bags in a dry place in order to catch the seeds when the fruiting structures open or split. Many seeds collected this way will continue to mature after collection. Do not leave seeds in a plastic bag for any length of time because they will begin to rot from humidity.

SEED CLEANING

After collecting seeds, they should be spread on paper (newspaper works well) to air dry for several days in a well ventilated room with low humidity. Seeds left in the collection bag too long begin to heat up and decay. This period of air drying often allows the fruits to split open making removal of the seeds easier.

Field collected seeds often are infected with tiny insects that are not visible to the naked eye. Fumigation is necessary to eliminate the insects before the seeds are stored. This can be done by placing a piece of No-Pest Strip in a bag with the seeds, closing it tightly, and storing it in a cool, dry place for a few days.

Seeds enclosed in capsules or pods can usually be extracted after the fruiting structure has begun to split by placing them in a bag and shaking it vigorously. Another method for removing dry seeds is to beat the seed heads into containers, such as a bag or bucket, or use a rolling pin or mallet.

With the coneflowers, Stokes aster and Rudbeckias, extracting the seed is easier if the seed heads are left on the flowering stalks a month or two after flowering, allowing the seed heads to expand and soften.

Fleshy or moist fruiting structures, such as the berries of Jack-in-the Pulpit, are best removed by soaking the berries in water overnight to soften and then pealing the pulp off the seeds with a finger or gently mashing them with a wooden spoon.

Storing and planting seeds with a little chaff or litter does not present a problem; however, sieves can be used to clean away the larger particles of litter.

SEED STORAGE

A seed's potential for germination is greatly reduced with improper storage. Dry seeds can be safely stored at room temperature temporarily, but for a longer storage period, germination is usually higher and more uniform with seeds stored in the refrigerator immediately after cleaning. Cool temperatures slow down seed metabolism extending the life of the seed. The seeds of most eastern natives lose viability in direct response to increased moisture or temperature, or both. Refrigerator storage with temperatures of 34-41 degrees F. will keep seeds fresh. The seeds can be stored in sealed envelopes, canisters or jars marked with the name and storage date.

Moisture level in the storage containers of plants of the Aster family and those plants produced in dry pods needs to be as low as possible to prevent fungal growth and to prevent the seeds from germinating. It is best to make sure these seeds are totally dry before storing and then a small amount of silica gel in a porous wrapper can be placed in the bottom of the container to draw moisture from the air and away from the seeds.

Seeds produced in moist, fleshy fruits must be stored in a moist environment immediately after cleaning to keep them viable and prevent them from entering an extended period of dormancy. These moist seeds should be layered in a damp medium in airtight containers and refrigerated. Moistened sphagnum moss, which inhibits fungal growth is an excellent choice for stratifying moist seeds. Sterile potting soil may also be used, but care must be taken to make sure the medium is damp enough, but not so damp to encourage fungal growth.

SEED DORMANCY AND TREATMENTS TO OVERCOME DORMANCY

The express purpose of seed dormancy is for the survival of the plant.
The seeds of our native wildflowers contain different chemical and mechanical mechanisms to promote dormancy and delay seed germination. The seeds of most of our natives mature by fall but do not germinate until spring. If these seeds germinated in the fall, it is not likely that the young seedlings could survive our winter.

Seed Coats

Seed coats may cause dormancy and prevent germination. An extremely hard seed coat prevents the penetration of water. Secondly, some seed coats may contain inhibitors which prevent germination.

Many species of the Fabaceae family (Bean) have seeds with very hard seed coats. In order to break dormancy of a hard seed coat, scarification can be used. This process involves making a small cut in the seed to allow water to be absorbed.

Seeds with hard seed coats may also be treated with hot water. Immersing a seed in hot water and allowing it to remain over night will soften the seed coat while also breaking down the chemical inhibitors.

Stratification

Some seed embryos contain inhibitors which prevent germination. Seeds placed in moist (not soggy) soil and stored in the refrigerator (40 degrees) for a period of four to eight (twelve) weeks may deactivate their germination inhibitors.

Exposure To Light

Some seeds contain a light sensitive pigment called phytochrome. Many small seeds such as wild columbine will germinate after being stratified for four weeks. Germination will often take place within one week if they are sown on top of the planting medium, exposing them to light. The exposure to light activates the phytochrome which speeds up germination.

Double Dormancy

Some seeds, particularly those of woody plants, have impermeable seed coats and embryo dormancy. Periods of warm, moist (70-80 degrees F.) stratification followed by cold, moist (31-41 degrees F.) stratification usually satisfy the double dormancy and allow for germination. In nature**,** double dormancy requires two years to germinate fully. The root is produced during the first dormancy period and the shoot the second.

SOWING SEEDS

When sowing seeds in pots, flats or other containers, use containers that are at least three inches deep filled to the top with potting medium. The containers of soil should be moistened, but not soaked, before the seeds are sown. Spread the seeds uniformly throughout, allowing ample room for root development. As a general rule, the larger the seed the deeper it should be planted. Seeds of some species, such as columbine, require light to germinate. These should not be covered at all. A good rule to follow is plant the seed to a depth four times as deep as its length. Therefore, small seeds should barely be covered with soil.

If you are growing the plants inside, it is important to use sterile medium to discourage fungus and disease. Sterile seed starter mixes can be purchased at garden centers.

After germination, seedlings generally remain in the seed flat for three or four weeks and then in four inch pots for five or six more weeks. Then seedlings can be planted outside at the beginning of the frost free period in spring.

For seeds planted in February or March indoors, the seed containers can be placed in a sunny, south facing window in order to get six to eight hours of direct light per day. A constant soil temperature of 70-78 degrees F. is best for rapid, uniform germination.

Seeds can be planted outside in the protection of a cold frame. The soil in the cold frame should

be pulverized to a depth of six inches and mixed with a three/four inch layer of peat moss or ground pine bark. No fertilizer is needed. When sowing is completed, water the soil in the frame with a soft, fine spray. Cover the frame but tilt the cover to allow fresh air to enter. Keep the soil constantly moist, neither too wet nor too dry. When the seeds have germinated, fertilize the seedlings with a liquid soluble fertilizer at one third the normal rate. The seedlings are ready for transplant when the first set of true leaves is enlarging. The transplanted seedlings should be allowed to "harden off" before being placed in the garden. Hardening off can be accomplished by placing the plants in a shady protected place out of direct sun for several days.

Seed Germination

Seeds will break their dormancy only if certain physical and chemical requirements are met. Many seeds will germinate under a wide range of conditions; others are quite specific in their demands.

1. **Time**
   Proper timing, which allows a period of dormancy, is an important factor to most seeds. Wild indigo, (Baptisia spp.), for example, will germinate immediately upon being shed. If that is prevented and the seed is stored in a refrigerator, more than likely scarification would be needed for germination to take place.
2. **Temperature**
   Many seeds require a cold stratification between 35 and 50 degrees F. in order to germinate. At temperatures above 55 degrees the stratification process will take longer to complete. After the stratification process is completed, seed germination proceeds best between 70 and 80 degrees F.
3. **Water**
   Water must be available to any germinating seed. It softens the seed coat, making it possible for the seed to emerge. Water is also needed to leach out the inhibitors which are found in the seed. It is also needed in all chemical processes, including cellular respiration.
4. **Carbon Dioxide and Oxygen**
   Seed germination cannot proceed in water saturated soils. Oxygen in soil air is required for the respiration of food reserves in the seed. Although water is needed to facilitate the diffusion of oxygen into the seed and carbon dioxide outward, if the water is over abundant there will be too little oxygen for the germination activities and perhaps too much carbon dioxide. Under these circumstances, carbon dioxide can be toxic to the cells of a seed.
5. **Light and Darkness**
   Many seeds contain the light sensitive pigment phytochrome. Energy obtained by absorbing different wave lengths of light renders the phytochrome molecule active or inactive in promoting growth.
6. **Seed Coat**
   The seed coat must be penetrated by the emerging seedling if the seed is to

germinate successfully. Some seed coats offer little or no resistance and fall away easily after absorbing water needed to swell the tissues and soften the seed coat. Other seed coats may require scarification or acids from acid fruits to break down the surface of the seed coat.

7. **Germination Inhibited By Soil Conditions**
   Germination may occasionally be chemically inhibited by toxic by-products from other vegetation growing in the area. Tannins, phenolic compounds or alkaloids from roots or leaf and stem litter are released into soil where they can prevent seed germination and other plant growth.
8. **Hormones**
   For many seeds to break dormancy, they must overcome the affects of inhibitors. Hormones needed to break down these inhibitors are the hormones known as the gibberellins and the cytokinins.

VEGETATIVE PROPAGATION (ASEXUAL)

Divisions

One of the easiest and quickest ways to propagate plants is by division. This method assures the new plant will end up exactly like the parent. When should divisions be made? The rule of thumb is that spring blooming plants should be divided in the fall, and fall blooming plants should be divided in the spring. This method avoids disturbing the plant when it is in bloom and when the weather is extremely hot.

Propagation by division can be done using a sharp knife or one's hands to separate or divide plants. In a few cases a large shovel or axe may be needed to divide large clumps such as Baptisia or day lily. After a division is made, be sure to dust the wound with a fungicide or sulfur.

Plants that are easy to divide are those that have rhizomes, bulblets or crowns (eyes). *Iris fulva* (Louisiana Iris) is an example of a rhizomatous plant. To divide this plant, simple pull the rhizomes apart, making sure that each division has one or more eyes. Bleeding heart has several small crowns which may be pulled apart and planted. Each crown is a potential plant. Turk cap lily is an example of a plant with bulblets or offsets. Each bulblet may be broken off and planted.

Dividing native plants not only increases the number of plants but also rejuvenates older plants. An older bleeding heart becomes overcrowded and stunted by having too many older crowns. Dividing the crowns will alleviate the problem and yield several healthy individual plants.

Stem Cuttings

Collecting Stems

The best time of the year for making stem cuttings of perennials is late spring or early summer when the plant is in a full flush of growth. Cuttings should be made early in the day when the temperature is cool and the mother plant most turgid.

The plant providing the cuttings should be vigorous, healthy and disease free. Using a sharp knife or pruners, remove a 3-6 inch terminal segment of a shoot just below a node. The cutting should have at least 3 nodes. Place the cuttings in a plastic bag with a few ice cubes or in an ice chest with several ice cubes in the bottom. Alternately, cuttings can be wrapped in damp newspaper or cloth to keep them cool. Dampened sphagnum moss can also be used to wrap them until they are ready to be stuck. Keep the cuttings out of direct sunlight and do not place them in water.

Sanitation

The pruners or knife used to make stem cuttings should be disinfected in a mixture of 9 parts water to 1 part bleach before each use. The work area should be as clean as possible. The flats, pots, etc. that the cuttings are to be stuck in should be dipped in bleach solution also.

Wounding

A sharp, sterilized knife can be used to make a vertical wound of about 1/2inch on one or both sides along the bottom of the stem that will be covered in the rooting medium. Wounding is not really necessary for herbaceous plants but with woody plants, wounding is thought to induce internal hormonal changes that may improve rooting. It also exposes active cells to hormone preparation.

Hormones

The first hormone to be used to propagate plants was indol acetic acid (IAA), which is naturally found in plants. Eventually, two synthetic auxins, indole butyric acid, (IBA), and naphthalene acetic acid, (NAA), were found to be more affective than IAA. The favorite commercial root formulations are Hormodin, HormoRoot, Hormex, Rootone, Dip and Grow and Woods.

Propagation Medium

The most important consideration is that the medium must have excellent drainage in order to prevent the cuttings from rotting. A one to one mixture of course building sand and perlite makes a good medium for rooting cuttings. Some people have just as much success using the building sand alone.
Sand and seed starter mix can also be combined to use as a medium.
The medium should be course enough to support the stem upright under misting or light spraying.

Inserting Cuttings

Before sticking the cuttings in rooting medium, remove all fruit and flowers and strip the stem of its lower leaves. Any leaves inserted under the soil will rot. If the cutting has very large leaves, such as hydrangea and witch hazel, the leaves left on the top of the stem can be trimmed in half to reduce their size.
If wounding is to be used on the cutting, make the l/2" vertical cut, apply the rooting hormone on the bottom portion of the stem along the wound, dusting any excess hormone powder off the cutting. Moisten the medium and with a finger, pencil or wooden dibber make a hole in the medium large enough to accommodate the stem. Insert the stem into the hole and firm the medium. Using a gently spray, water the cuttings immediately. Label the container with

the name and date of the cutting. Place the container in a location so that it gets bright light but not direct sun. The best success comes with keeping the root zone warm and the exposed stem cool.

Check for roots after 2 or 3 weeks by gently tugging on the top of the cutting. If resistance is felt, rooting has begun.

Care of Newly Rooted Cuttings

After cuttings have developed roots, the new plant needs special care to survive its first year. If it is to be planted outside for the winter, it must have sufficient root system to support itself. It must first be hardened off in a shady location to acclimate. Leave it in the pot and harden it off for several weeks, gradually moving it to a more exposed location each week. Ideally, the new plant should be left undisturbed in the pot it was rooted in and placed in a shade house or other protected place through its first winter. By spring, the plant will be hardy enough to support itself and be planted out.