

• Basic Plant Propagation Handbook •

This handbook is designed to provide basic information, a booklet you can take to your kitchen counter or potting bench to follow the simple steps. The GCA Horticulture Committee hopes that this will encourage you to try starting your own plants from seeds and cuttings. An expanded version of this handbook is also on the GCA website (under Horticulture Committee) with photos and more detailed information about seeds, cuttings, other methods of propagation, plus a list of reference books and useful websites.

• Why Propagate Plants? •

Variety—Anything Is Possible!

Growing your own expands your choices. You can choose flowers for cutting, heirloom varieties of flowers or vegetables, or native plants to provide habitat for butterflies and birds.

Preservation

With an old or rare plant, taking cuttings is a way to perpetuate the plant. A plant grown from a cutting will be a clone, a new plant with identical characteristics. Because most garden centers offer “popular plants” that sell in large quantities, propagating from seeds and cuttings provides a chance to grow uncommon plants, varieties that commercial growers and garden centers do not find profitable.

Club and Zone Plant Exchanges or Challenge Classes at a Flower Show

Learn these skills so you can participate in plant exchanges and the propagation classes for flower shows. This is a fun skill to acquire and share with other club members, your children or grandchildren.

You Control Chemical Usage

Most commercial growers use chemicals to control insects and disease and chemical growth regulators to keep the plants short. Plants grown commercially are often pushed into bloom quickly, without sufficient root growth. When growing your own plants, you control any use of chemicals and can grow a sturdy, “green” plant.

Fun

Growing from seed or cuttings is a great learning experience; you will have great success, and probably a few failures. You will have many plants to share with friends! Your gardening skills will improve as you work with seedlings and newly rooted cuttings, learning when to water and to recognize the signs of pests or disease.

General Rules of Propagating

Research

A little time spent researching the plant species before you start will result in much higher success rates and the Internet makes this easy. A quick on-line search, using Google or another search engine, will save time and anguish. Just type in: "propagating" followed by the name of the plant. Some seeds need a cold treatment, some plants are almost impossible to propagate from stem cuttings or from seed, but can easily be grown from a root cutting or a simple layer.*

Cleanliness

Disease organisms can survive in the bits of soil in used pots; plant viruses can be spread from an infected plant to a healthy plant on your hands or by a knife or scissors.

1. Be sure your hands, gloves, containers and tools are clean!
2. Wash with soap and water, then disinfect tools and containers with 1 TBSP Clorox/gallon of warm water.
3. Use new, sterile, soilless mix; this is not the time to re-use the soilless mix from last summer's container.

Use Healthy, Well-Watered Plants for Cuttings,

New or Well-Stored Seeds

Many seeds will remain viable for years if stored in a plastic container in a refrigerator; some seeds must be fresh. (Research your plant species, and for information on testing for viability.)

Water

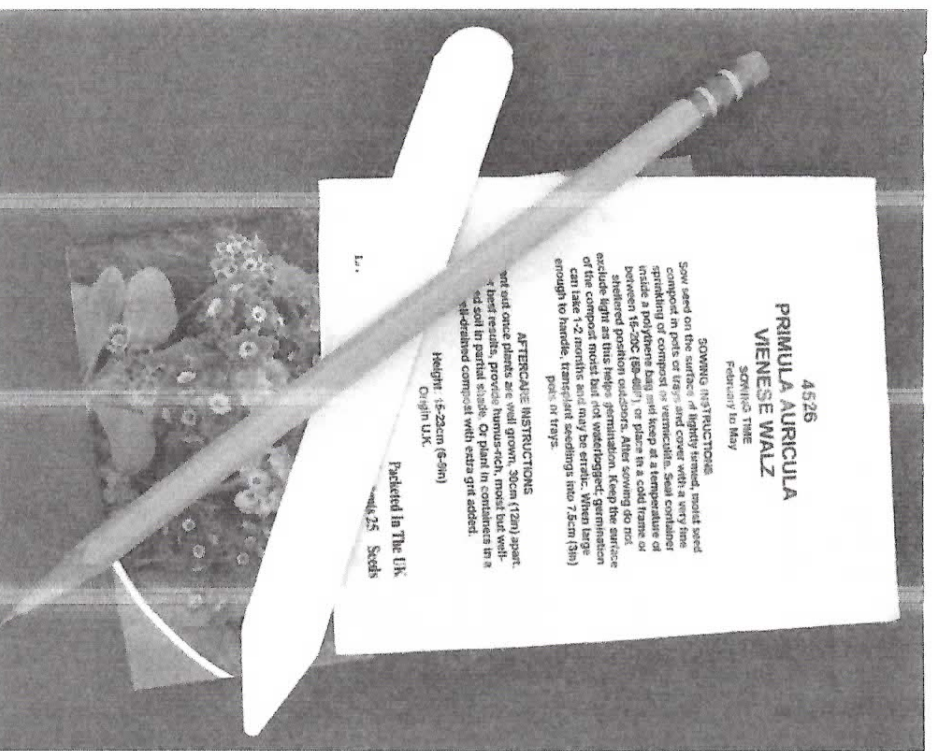
Warm water is best. Cold water will lower the soil temperature, slowing germination or root formation. Water processed through a water softener has toxic amounts of sodium, which will kill plants. In a home with softened water, use untreated water, water from a rain barrel or an outside tap (that does not connect to the water softener).

*The seeds of many perennials, trees and shrubs that evolved in cold climates need special treatment to break winter dormancy. The on-line Propagation Handbook has information on Scarification and Cold Stratification for seeds, and other propagation methods.

Timing

Seed packets (or on-line sites, reference books) will give number of days to germinate, and number of weeks before planting. Check the "last frost" date for your area, and then count backwards on a calendar. **Do not start too early!** Seedlings will grow quickly, especially during the longer, sunnier days of April and May. For most annuals, 6-8 weeks after germination will produce a healthy, well-rooted plant.

★ **Tip:** Plants will be much healthier in your garden if planted before they come into bloom. You may not get the instant satisfaction on the day you plant, but a stocky "green" plant will reward you with better garden performance all summer.



Supplies: Basic Tools and Equipment

1. **Sterile growing medium**—A commercial soilless mix (e.g. Pro-Mix, Fafard, Sunshine) works well for almost all seeds and cuttings; these are sterile, consistent, and available. (A local nursery growing their own plants often offers a quality soilless mix for sale, or Google a brand name to find a local source.) Avoid mixes with “continuous feeding.” Soilless mixes with up to 40% hardwood bark will help suppress disease organisms in the soil. By using the same mix, you will learn to judge when to water.
2. **Shallow containers 2”–3” deep with drainage holes:** Bedding plant flats and inserts are useful; shallow pots also work. Deeper containers remain too wet (no air spaces). New roots will rot.
3. **Use warm water:**
 - a. Spray bottle to spritz (mist).
 - b. Watering can with a “rain-nozzle,” or “water-dispersing nozzle,” so the water doesn’t create gullies but is gently spread across the surface.
 - c. Self-watering trays are a useful option.
 - d. Otherwise, large dishpan or aluminum turkey roasting pan for bottom watering.
4. **Light:** If you will be growing the young seedlings for more than two weeks before planting outdoors, supplemental lighting is useful. Fluorescent lights are ideal (do not need specialty “gro-bulbs”). Fluorescent lights 16 hours per day, (with an 8-hour dark period) are helpful for most plants.
5. **Temperature control:** You can go hi-tech, or improvise. There are specialty heat mats; or you may have a warm spot above a radiator, or on top of a refrigerator. A string of tiny Christmas lights under a Pyrex baking dish will create bottom heat. (LED lights will not work; use an old string of incandescent bulbs that give off heat.)
6. **Labels, #2 lead pencil, notebook to record.**

7. **Plastic for tenting:** Ziploc bag or a dry-cleaner bag, plus supports (almost anything works: wire hangers, popsicle sticks, bamboo stakes, plastic straws) to keep plastic about 4” above seeds or cuttings. Self-watering trays have a lid that serves this function.
8. **Tool for marking rows,** transplanting the rooted seedlings or cuttings—a butterknife, dibble, pencil.
9. **Plastic pill container:** for working with tiny seeds.
10. **Fertilizer:** use only when seedlings or cuttings are well established; liquid (chemical) fertilizers, timed-release, or organic forms—e.g. diluted sea weed emulsion.
11. **Small fan or cold frame:** useful options to help harden off seedlings or cuttings.

For Cuttings

1. **Clean cutting tool:** one-sided razor, sharp knife, clippers, scissors.
2. **Rooting compound:** Rootone, Hormodin, etc.
3. **Potato peeler:** for “wounding” the bark of a cutting.



● Sowing Seeds ●

This is a basic step-by-step recipe for germinating seeds; once you have mastered this method you may want to experiment with variations. (See on-line Propagation Handbook.)

Plants need both air and water in the growing medium, the soilless mix. A good soilless mix retains moisture but also has tiny air pockets. Over-watering fills the air pockets and the roots drown; too little water and the roots dry out and die. Because the roots on newly germinated seeds are so tiny, **maintaining the proper balance of water and air is critical.** (See article by Sara Mauritz, *The Real Dirt, Issue #16*, for more information on this.)

1. Get specific instructions from the seed packet or on-line. Seed-bearing plants evolved in jungles, deserts, prairies and tundras; germination requirements vary. (See on-line Propagation Handbook for more information.)
2. Pour or scoop soilless mix to fill a seed flat or shallow pot; do not tamp down (that removes air spaces).
3. Water thoroughly with warm water; (if the soilless mix is old and has dried out, it may need repeated watering). Sub-irrigate (placing your container into a larger dishpan) or water with a watering can with a water-dispersing nozzle.
4. Let the water drain—**mix must be thoroughly moist but not soggy.**

★ **Tip:** *Rushing to start seeds before the soilless mix is thoroughly moist and drained will lead to failure; water your containers early, or even the day before you sow seeds.*

5. **Lift your container!** Knowing how heavy it is when watered will help you judge when the mix is dry. One pound of mix will absorb 2 pounds (4 cups) of water. If your container is not significantly heavier after watering, the soil is probably not wet throughout.
6. **For larger seeds** (large enough to pick up individually):
 - a. Create shallow, parallel furrows in your container (about as deep as the seed)
 - b. Drop seeds into these furrows (furrows are used to prevent spread of damping off); sow seeds sparsely! Once

they germinate, crowded seedlings will compete for light, grow tall and spindly.

- c. Cover the seeds very **lightly** with sand, vermiculite or soilless mix. (Some seeds require light to germinate, and should not be covered. Most tiny seeds do not need to be covered; larger seeds usually do. The covering helps maintain critical moisture around the emerging root.) Read instructions on the seed packet, or check on-line.
- d. Water gently—a water-dispersing nozzle is ideal, or sub-irrigate (place tray in dishpan with water to soak up). This is needed to moisten the seed, and to make sure it is in contact with the mix. (If you sub-irrigate—don't forget to remove it from the water—you could drown the seeds!)
- e. Label—seed variety, date (Prepare the labels in advance, so they are ready to insert.)
- f. Tent with plastic to maintain humidity. This can be a dry cleaner bag or a Ziploc bag placed over the top (zip side at the bottom). Use tags, plastic straws, wire coat hanger, etc. to hold bag 4–6" above soil surface.

7. **For very tiny seeds**, save a small plastic pill container, fill half-way with sand, vermiculite, or talcum powder, add the tiny seeds, put the lid on and shake to mix. Then pour slowly in rows onto the surface of the soilless mix. (This helps prevent all the seeds from landing in one spot.) Tiny seeds do not need furrows, or to be covered with sand or soilless mix. Water gently but thoroughly (as above), label, and tent.
8. **For very large seeds (e.g. palms, conifers)**, soak for a few hours, place on a tray between layers of wet paper towels. Keep warm (75°) and check daily for the root (radicle) to emerge. Transplant into individual 3"–4" pots.

★ **Tip:** *Many tree and perennial species grow with a taproot, examples include conifers, oaks and buckeyes. These seeds should be planted in deeper pots from the start or germinated before planting. Most plants with taproots resent transplanting so it is very important to make sure the root has adequate room to grow from the start. Research your plant species on-line.*

9. Most seeds prefer soil temperatures between 70° and 75° for germination. The moisture in the soil makes it cooler than ambient air temperature. Providing bottom heat (heating mat, a string of Christmas lights under your tray, or a spot on top of a refrigerator or a high shelf) can provide the needed warmth.

★ **Tip:** Above 80° is too hot for most seeds—they cook! If the soil temperature is below 70°, germination is slower, and disease organisms grow quickly. Your seedlings will sprout and then be killed off. Check seed packet or reference for specific requirements.

10. High humidity (90+%) aids germination; the plastic tent holds moisture in. You may need to spritz 2–3 times a week to keep humidity high. You want to see drops of moisture on the inside of the plastic tent. If water is accumulating on the soil surface, open tent a little; you want very humid conditions, but not “raining.”

11. **Watering:** Since the soil was thoroughly moist before planting and the plastic tent holds in humidity, you should not need to water for at least a week. Lift the container (checking the weight) to know if the soilless mix needs water. If the container is still heavy, but the surface is dry—spritz the surface; if the container is light, the soilless mix has dried out, place it in a pan of water, allowing the container to absorb water from the bottom, to moisten thoroughly, then drain, re-tent.

12. **Light:** some seeds require light to germinate. Fluorescent bulbs 4”–6” above the tented container is the goal, but seeds will germinate even if lights are further away. For seeds that require darkness, place a trash bag or large pot over the plastic tent.

13. **Check daily:** germination will be staggered over days. Once seedlings begin to emerge, loosen the tent to allow more air, less humidity. (And remove the “darkness” cover, if used.) Maintaining bottom heat will encourage the slower germinating seeds to emerge. After a couple of days, remove the plastic tent.

Seedlings—Critical First Week(s)

Plants need water, light, moderate temperature and Carbon Dioxide for photosynthesis to take place (which is how they grow). There is plenty of Carbon Dioxide in the air. As the grower, your job is to provide the right amounts of water, light and warmth.

Water: Once the seeds have germinated, it is essential to allow the mix to dry a little between waterings. Not too wet, not too dry—proper watering is the key! Water is absorbed through tiny root hairs, and passes through the cell walls by osmosis. It moves by osmosis from these root hairs into the roots, and then stem, leaves and flowers. If the soilless mix is constantly wet, these root hairs will rot. Once the root hairs are damaged, water cannot transfer into the plant; there may be plenty of water in the soil, but the plant cannot use it.

1. For the first week after sowing, spritz heavily at soil level if the top 1/2" is dry. You want droplets of water to soak into that top level, to water the tiny roots.
2. As seeds sprout, open or remove plastic tent for an hour or two, then gradually longer periods over the first week. For germination the seeds needed 90% humidity, but now humidity levels of 50%–70% are ideal. Higher humidity levels encourage fungus and disease organisms.
3. As the seedlings grow and roots elongate, use bottom watering (or water with water-dispersing nozzle). If the soilless mix in the top inch of the container is always moist, the roots will stay in the top. Permit the soilless mix to dry out between waterings, forcing roots to grow down into the bottom of your container for moisture.

Light: Unless you have a greenhouse, it is difficult to grow sturdy, healthy seedlings indoors without providing supplemental light.

1. Fluorescent lights 16 hours per day (with an 8-hour dark period) work best, with the lights 4”–6” above the top leaves. Fluorescent light fixtures on chains make it easy to move the

lights up as the plants grow. Or improvise, using inverted pots to lift tiny plants closer to the lights.

2. Light filtered through a window is simply not strong enough or long enough (16 hours a day, every day is ideal). Plants will stretch for the light, and become weak and spindly.

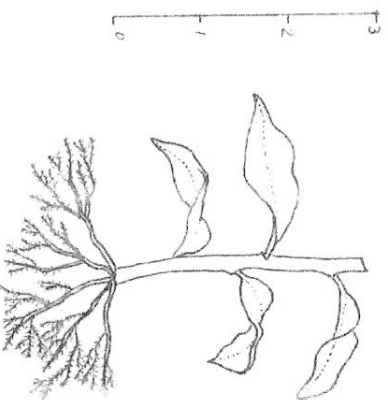
Temperature: Most young plants grow best if the soil temperature is maintained between 68–75°. The temperatures in a window sill vary too much for tiny seedlings—too hot on a sunny day and too cold at night.

● Pricking Out—Transplanting to Individual Container ●

When a seed germinates, the first set of leaves are the cotyledons, which were actually inside the seed. The next set of leaves are the first true leaves. Ideally, seedlings should be transplanted after these first true leaves develop. The longer multiple seedlings continue to grow in the same container, the more difficult transplanting will become as the roots intermingle, and crowded seedlings stretch for the light. If seeds are sown very sparsely, or in individual containers, then you can delay transplant until the plant has two or three sets of true leaves.

★ **Tip:** Calculate how much well-lit space you have under fluorescent lights or in bright windows. Depending on your plants, each seedling should have a minimum of 2" x 2", (6 plants per foot), with larger plants requiring 4" x 4". It is hard to throw away healthy seedlings, but transplanting too many and crowding them will yield

spindly, weak plants. If you have a cold frame, frost-resistant varieties (perennials, some annuals) can be moved into that, providing room in your sunny window or under lights for tender seedlings. (See The Real Dirt, Issue #4, "Cold Frames and Holding Beds.")



1. Fill container with soilless mix; water thoroughly (using water-dispersing nozzle) or sub-irrigate. Drain. Final soil level should be just below rim of container.

2. If seedlings are spaced closely, use a wooden label (or butter knife) to dig up a clump, drop on a table to break apart, or gently pry them apart. If seedlings are spaced, dig each one up individually.

3. These are fragile and need a delicate touch. Pick up seedling by its leaves, or under the root ball (not by stem!). If seedlings are hard to separate, some growers plant a small clump—and then snip off all but one.

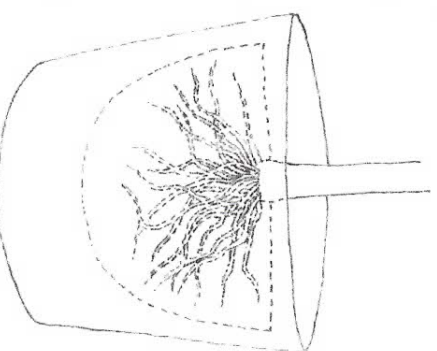
4. Make a shallow hole in the soilless mix, no deeper than the length of the roots. (Plant label, pencil, butter knife all work—or your finger.)

5. Tuck the seedling in carefully, and firm mix around it. Be aware of where the stem emerges from the roots. Do not plant too deeply! (There are a few exceptions: tomatoes, marigolds may be planted "deep" and will form roots along their stems.)

6. Water thoroughly, using a watering can with a dispersing nozzle, or bottom watering. This brings moist mix in contact with the roots.

7. The first few days after transplant are critical; inevitably roots were bruised or broken. Warm temperature in your soilless mix will help plant roots to grow, misting to add to humidity will help prevent desiccation. Keep out of direct sun for 2–3 days.

★ **Tip:** Use a container in proportion to your plant and the size of the root at transplant; for small plants, the inserts used for bedding plants work well; for larger plants, a 3"-4" pot. A tiny root ball in a 3" pot is inviting root rot. It is much better to transplant a second time to a larger pot after it has healthy roots in a 1" container.



● Growing On ●

Key factors remain water, air, light and temperature.

1. Once the seedlings perk up after transplanting (2–3 days), begin to ration watering. Water thoroughly, but only when the area around the roots has dried; the plant will have to send roots down into the soilless mix for water creating a strong root ball. Once the plant is well-rooted, allow it to wilt a little between waterings. Lift your container before watering. You can judge from the weight whether the soil is dry.

★ *Tip: Tough Love for your small plants! Your goal is to have a healthy root system, and sturdy, stocky plant. You have been nurturing these baby plants and it takes will power not to water frequently. Remember that if there is always plenty of water in the top inch of the soilless mix, roots will remain near the surface.*

2. Fluorescent lights, or bright windows provide the necessary light.

3. After 4 weeks if the seedlings are healthy and growing, water with a weak solution of either an organic or chemical fertilizer that offers approximately equal amounts of Nitrogen, Potassium and Phosphorus (the numbers on the package). Read the package instructions, and use at half strength; if it suggests 2 TBSP per gallon of water, use 1 TBSP per gallon. Then use fertilizer for alternate waterings. Or use a timed-release fertilizer, a few granules in each container.

★ *Tip: Commercial soilless mixes all have a “starter charge” of fertilizer that is plenty for the first month. When you fertilize a plant, the fertilizer dissolves in water, creating either an acid or base. This is absorbed through the roots. Excess fertilizer burns the roots. Think of putting your hands in Clorox! The roots on new seedlings are tiny—almost any quantity of fertilizer is too much. (See The Real Dirt, Issue #16, Fertilizing Indoor Plants.)*

4. Ideally, seedlings should be hardened off by placing the containers outside, out of direct sunlight and protected from high winds. This will acclimate them to the real world, but you may need to bring them back inside on chilly nights. A

cold frame is perfect for this, since you can open it in the daytime and close at night. If you cannot harden off the plants, wait to plant outside until predicted night

temperatures are mild. (Temperatures below 45° will set seedlings pampered with house temperatures back; ideally nighttime temperatures should be above 50°.)

★ *Tip: If hardening the plants outdoors is impossible, a small fan directed at the seedlings for several hours each day will simulate wind. You don't want a hurricane, but a steady breeze will produce shorter, sturdier plants. Brushing your hand gently across the tops of the plants a couple of times a day also helps.*

● Vegetative Propagation—Softwood Cuttings ●

Vegetative propagation requires cutting a small part of a parent plant and promoting root growth to create a new plant. The new plant will be genetically identical to the parent plant. It can be as simple as placing stems of ivy, pussy willow, or coleus in water and seeing roots form in a week or two, or a very slow meticulous process. Before you start, do a quick on-line search to learn what type of vegetative propagation works best for the plant you are working with.

This is a description of the basic steps for propagating with Softwood Cuttings; once you have had success with this, we hope you will want to try other methods. Check the on-line GCA Propagation Handbook to learn about other forms of vegetative propagation. (See The Real Dirt, Issue #7, “Neat Kits to Encourage Propagating.”)

★ *Tip: Make sure the “parent plant” is well watered in advance; once the cutting is removed from the parent it cannot absorb more water until roots grow. Success depends on keeping the stem and leaves from drying out before new roots form. Take cuttings in the morning, place in a plastic bag to retain moisture—do not allow to wilt!*

Softwood Cutting

These are cuttings taken from current season's growth (late spring or summer): use non-blooming or non-fruiting softwood when new growth is hardening or at the “snap stage.” Depending on the plant,

cuttings should be 4"–8", ideally with 2 leaf nodes. (Annuals and tender perennials are usually shorter, 3"–4", woody plants 6"–8").

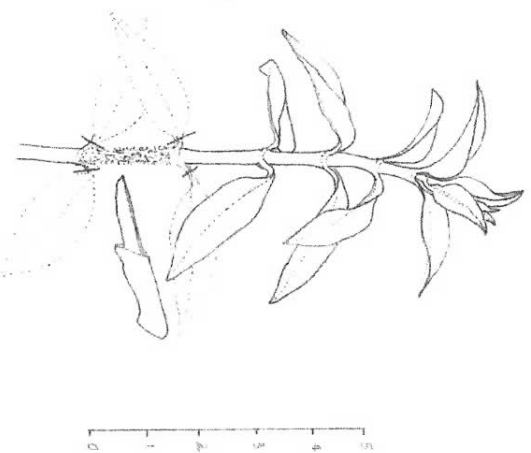
1. Fill container with commercial soilless mix; bedding plant inserts give each cutting its own pocket, preventing the spread of soil-born disease. Shallow pots also work. Water thoroughly; mix needs to be thoroughly moist.

★ **Tip:** *Even cuttings taken from the same plant will vary in the length of time to form roots. By using separate containers or cell-packs, it is easier to move the rooting plants from those still needing extra warmth and humidity.*

2. Cut a 4"–8" tip from the branch, below a node; remove any lower leaves that would be below ground, cut large leaves, such as rhododendron,

in half. Minimize evaporation by minimizing the

number and size of leaves. For woody plants, use a potato peeler or knife, very gently peeling a vertical strip at the bottom 1/4" of the stem in two spots, leaving part intact. This is called "wounding" and encourages root development.



★ **Tip:** *Cuttings longer than 4"–8" seldom take root; without roots to absorb water, the tip of a long cutting loses moisture (turgidity), and within a week, the entire cutting desiccates.*

3. Pour a small amount of Rootone or Hormodin (rooting hormones) into a cup. Dip cutting in—then tap gently to remove excess (which could clog pores). You do not need a lot—just a light dusting.

4. Poke 1/2" holes in soil-mix with a pencil or dibble—not too deep! Place the cutting in (being careful not to scrape off the rooting powder as you place it); firm soil around it. (Make sure no leaves are under the soil. They would begin to rot, and those disease organisms could spread to the cutting.)
5. Do not crowd cuttings in a single container—leaves should not touch.
6. Continue with your cuttings, insert labels with name and date, then spritz with water.
7. Tent with plastic, keeping it above the foliage, creating a warm, humid micro-climate.
8. Provide bottom heat to keep the soilless mix close to 75°, roots will form more quickly. This may be on top of a refrigerator, a radiator, or using a heat mat. (Disease pathogens thrive in cooler temperatures; providing bottom heat speeds up root formation and slows the growth of disease organisms.)
9. Spritz with warm water 2–3 times a week to keep humidity high. Lift containers to check weight, to know if it is drying out. Sub-irrigate (bottom water) if dry. Soilless mix needs to be moist, but not soggy.
10. After two weeks, begin to check for rooting. Some plants may root in two weeks, others may take months. Tug very gently. If there is resistance, roots are forming. To peek, carefully use a dibble or label and lift from below.
11. As roots begin to form, reduce the humidity—open the plastic tent, and then remove it after 3–4 days. You want these new roots to grow into the soilless mix, so water only when mix is drying out (lift container to know when it is dry).
12. Immediately remove any cuttings that have lost all leaves, look squishy or sick, and remove the soilless mix from the immediate area if you have several cuttings in one container. This will prevent disease organisms from the "sick" cutting from attacking the other cuttings. (Or move healthy cuttings to a new container with fresh soilless mix.)
13. Wait to transplant into a larger container until roots on cuttings are about 1" (ideally a nice ball, with multiple

roots). Transplant to a 3"-4" container, water well, label, and keep out of direct sun for a few days (to help plant recover from transplant shock). Choose a container in proportion to the root ball, providing 2"-3" inches of soilless mix around the roots.

14. Once plant is established, actively growing with healthy roots, use either organic or chemical liquid fertilizer at half-strength in alternate waterings.

★ **Tip:** *Fertilizing too early or with a full strength dose in the first weeks, before roots are reaching the bottom of the container may injure or even kill your rooted cutting; a plant can only absorb fertilizer when the roots are healthy. (See *The Real Dirt*, Issue #16, "Fertilizing Indoor Plants.")*

15. After 3-4 weeks, if the roots have reached the bottom of the pot, cuttings may need to be transplanted to a larger pot.
16. If the rooted cutting is now growing actively, fertilize at full strength in alternate waterings.

An expanded version of this handbook is on the GCA website (under Horticulture Committee). This has more detailed information about seeds, cuttings, other methods of propagation, photographs, plus a list of reference books and useful websites. On the GCA website, you can also find *The Real Dirt*, which has articles on special techniques for propagating Alpines, Ferns, and Hellebores, articles on growing vegetables from seed, sources for heirloom seeds, etc.

Watching a plant grow that you have started from a seed or cutting is great fun! The members of the Horticulture Committee hope that this handbook will bring you success with propagating plants.

Copies of the Basic Plant Propagation Handbook are available for \$3.00 each (includes postage).

Ordering information is on the GCA website, under Shop, or mail your request with your check, name and address to:

The Garden Club of America
14 East 60th Street
New York, New York 10022

Please include your name and shipping address.

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