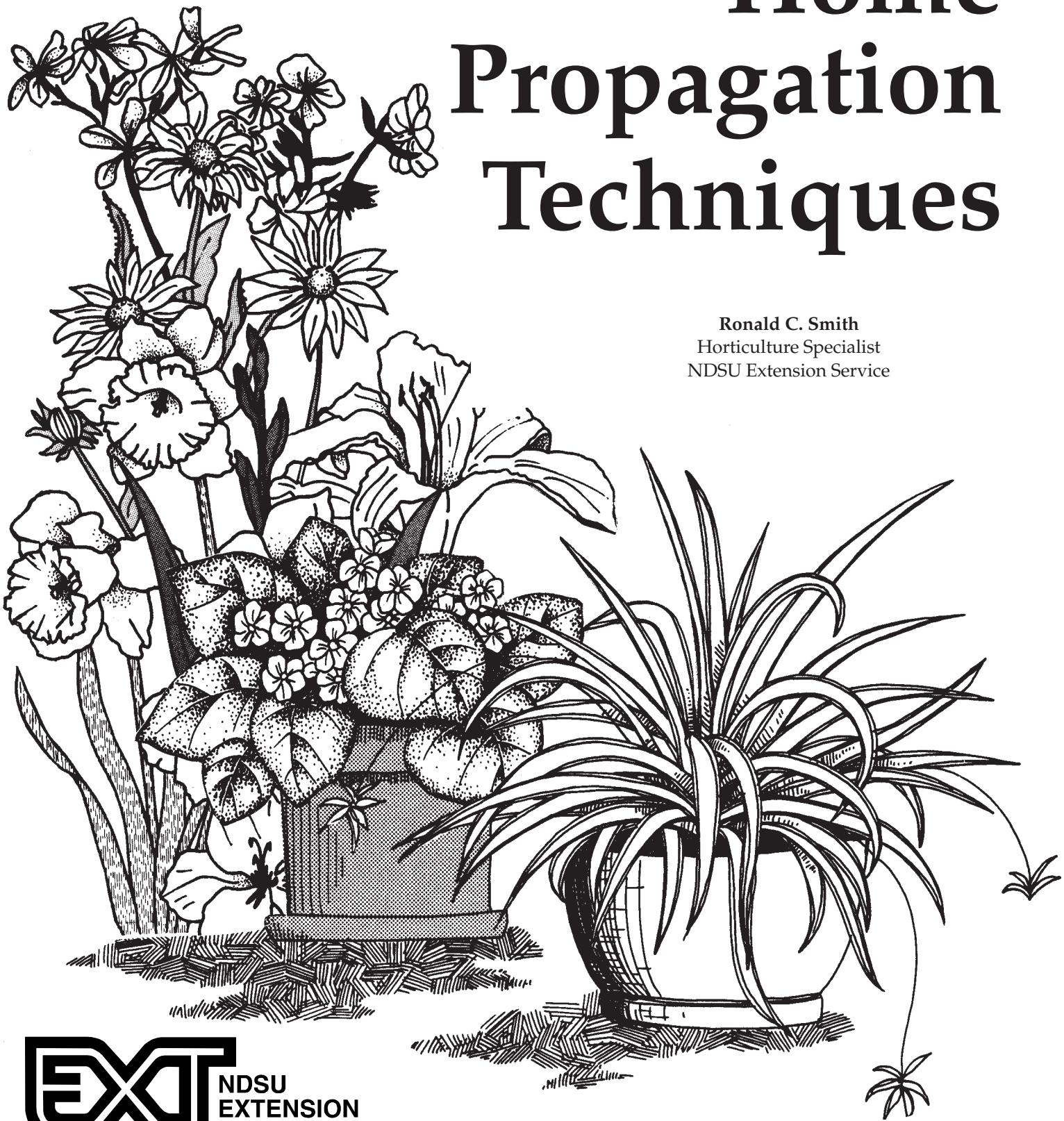
H-1257 (Revised)

Home Propagation Techniques



Ronald C. Smith
Horticulture Specialist
NDSU Extension Service

NDSU EXTENSION SERVICE
North Dakota State University, Fargo, North Dakota 58105
FEBRUARY 2004

Anyone with money can purchase plants, but part of the fun of horticulture is to start your own. The fun, fascination and fulfillment derived from starting your own plants are easily documented by attending a horticulture club meeting anywhere around the country. Here, new propagules and seedlings are freely exchanged among members and discussions are carried on concerning previous plant exchanges.

This circular will outline some of the propagation techniques which may be carried out by those interested in perpetuating their favorite plants.

Seed Propagation

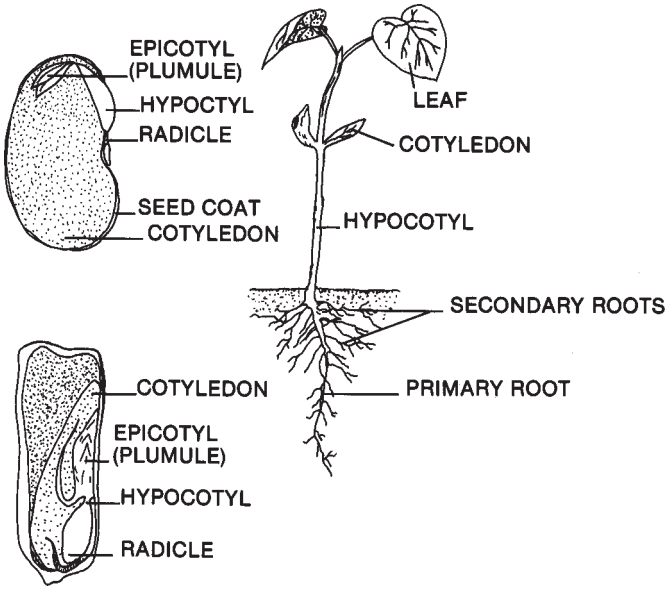
Seed or sexual propagation is the most frequently used means of producing new plants. Seed propagation offers several advantages over other methods: It is economical, fewer diseases are transmitted, the seeds can be easily and inexpensively stored for long periods and usually very little personal effort is needed.

Seeds are not always used for propagation because of some disadvantages. Many seeds require too long to germinate or require special pretreatment to overcome internal dormancy. Some seed require physical abrasion before germination can take place.

Genetic variation is another problem which may arise from seed propagation. Commercial seed companies go to great effort to develop plant cultivars uniform in flower color. When hybridizing, they go to even greater costs to be sure the crosses will breed true each time. When you purchase hybrid seed, you are planting the first generation of the parental cross. Should you save the seed from the hybrid plants and sow them next year, the results will be a genetic scrambling, producing an array of flower colors and sizes.

While seeds range in size from the large coconut to the very small petunia seed, they all have the same basic structure: seed coat, embryo and endosperm, which contains stored food. The embryo is the result of fertilization, and is made up of a radicle (embryonic root), hypocotyl (stem region below cotyledons), cotyledons (embryonic leaves) and epicotyl (stem region above cotyledons) *(see Sketch 1)*.

Seed germination begins with water being absorbed. Enzymes convert starch to sugar and combine with oxygen to carry on the building of new cells and expansion of others. Eventually, the radicle emerges from the seed coat and penetrates into the soil, forming the primary root. Next, the hypocotyl emerges and pushes the cotyledons above the ground. This point is witnessed as germination.



Sketch 1. Seed and seeding anatomy.

To Be Successful with Seed Propagation

Start with good, clean, fresh seed. Next, be particular about the medium in which the seeds will be germinated: This should be something which will allow sufficient air and water to reach the seeds. Typical garden soil is a poor choice. Milled sphagnum moss, which may be difficult for homeowners in some areas to obtain, is an excellent material for seed germination because it is highly acidic. Weed seeds, insects, or disease microorganisms are essentially eliminated.

Other materials to consider for starting seeds are perlite, vermiculite, peat moss and commercial mixes such as Jiffy-Mix.

Containers for starting seeds should be clean, inexpensive and readily available. Homeowners use a wide array of containers — old milk cartons cut in half, wooden flats, old butter tubs, or recycled salad trays from some fast food establishments. The choice is really yours. Just make sure it is clean and can be freely drained.

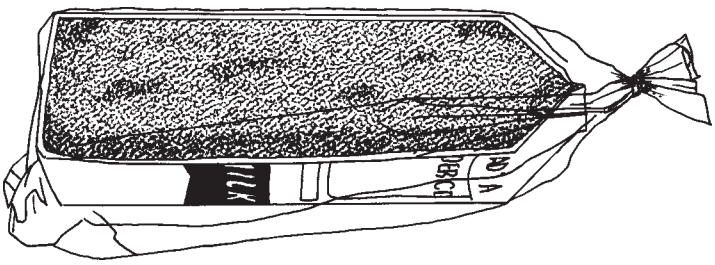
Fill the container to the top with the growing medium of your choice. Firm to about one-half inch from the top and score off some shallow rows for planting seeds.

At this point, a mistake is commonly made; the seeds are planted too deeply. When in doubt, plant shallower than you think necessary. As a rule of thumb, try to space the seeds about one-fourth to one-half inch apart in the rows and make the rows about 2 inches apart in the absence of any packet instructions. All of this fussiness is to cut

down on the incidence of disease, especially the fungus causing damping-off. This disease will girdle and kill seedlings. If everything is clean the disease will not be present, so spacing is less important. If the disease is present, spacing as suggested may only slow the spread.

To avoid the spread of this disease, be careful watering. Subirrigation is the best approach for the homeowner, allowing the water to enter in through the drainage holes. When the media surface glistens (appearance may vary with mix used) with moisture, remove the container and allow it to drain freely. Then cover with either a clear plastic bag or a piece of glass *(see Sketch 2)*.

After most of the seeds have germinated, promptly remove the cover to allow air circulation. The first leaves to appear are the seed leaves or the cotyledons. When the next leaves or first true leaves have opened, most seedlings are large enough for transplanting.



Sketch 2. Seed propagation: cover container with plastic bag.

Light and Temperature Considerations

Light quality and intensity are important for proper seedling development. The indirect light from a window may often be sufficient for seedling development. If the indirect light is too low, the seedlings may become leggy. In that case, the seedlings would benefit from exposure to direct sunlight. Drafts from windows in the cold winter months and the unilateral direction of the window light often create problems, first with germination and then with the straightness of seedling growth. In this situation, the homeowner is not in complete control: It may not be sunny, or it may be very cold. The result is lowered success.

Fluorescent lighting and heating cables put more control of seedling development into the hands of the grower. Generally, bottom heat from thermostatically controlled cables set to about 72 F and standard fluorescent light positioned directly overhead about 6 to 9 inches from the surface will result in swift germination and strong, healthy development of most garden plants.

Transplanting and Post, Transplanting Care

To transplant, gently lift beneath the seedling with your finger or a wooden label and lightly pull by holding onto one of the leaves. Grasping the stem and pulling up provide a greater chance of injuring the seedling. If the delicate seedling stem is crushed, the plant dies. If one of the leaves is damaged from rough handling, then usually only that leaf is lost and the plant has a chance to recover.

Make a hole in the new pot deep enough to contain the roots. Gently but firmly pack soil around them and water in to eliminate air spaces (drying out) of roots.

Once transplanting is complete (either into individual pots or flats) light is very important. Direct sunlight is best, but if this is not possible, then use the fluorescent lamps suggested for germination.

Houseplants can be maintained at relatively low light intensities once they become established. Garden plants which are intended for flower or vegetable production will need an excess of 1,000 footcandles to grow satisfactorily without stretching or discoloring. This intensity can be maintained by keeping the fluorescent light source 6 to 9 inches from the surface of the growing plants.

Most flowering plants will benefit from a pinching, which is the removal of the tip of the stem above a leaf axis after at least three sets of leaves have developed. This will cause the plants to branch and become compact in their growth habit. If you desire to have the plants tall and single-stemmed, then do not pinch.

Plants intended for the outdoors should generally be started four to six weeks before moving outside. The transition should not be sudden. Going from an interior where the temperature and light conditions are consistent to the shifting conditions in the garden could destroy the plants.

Begin the move by gradually acclimatizing the plants: An initial 30 minutes in the sun, building up to a full day in a protected area; a night in an unheated porch, watering less frequently. All or any of these steps should begin 10 to 14 days before the actual move-out date. Be aware that some plants are considered “tender;” a mere brush with near-freezing temperatures could set them back or kill them. Others, being more hardy, can tolerate occasional brief exposures to cold with no visible harm.

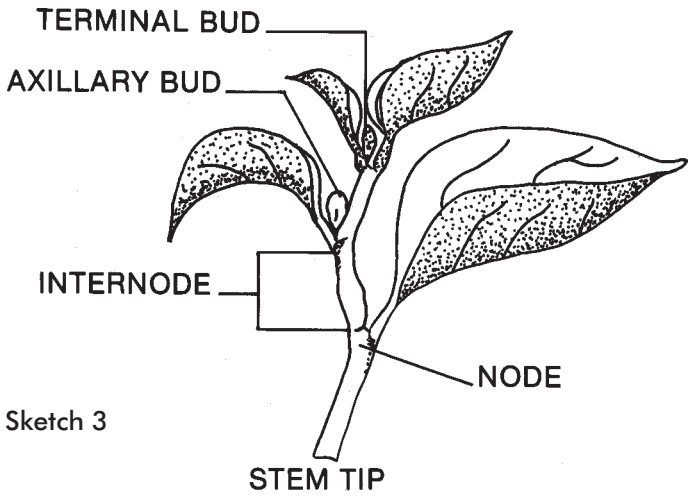
Keep a wary eye on the weather. If it appears that we are in a cycle of frosts when the set-out date is near, delay for a few more days when the weather appears to be more amenable to plant establishment.

Asexual Propagation Techniques

Many members of the plant world are capable of reproducing themselves from small pieces of root, stem or leaf. This characteristic allows the home propagator another resource for increasing plant numbers when reproduction from seed is not practical. Asexual propagation gives the home propagator another advantage that seeds do not; exact genetic replication of the parent.

Many methods of asexual propagation exist for the homeowner: cuttings, bulbs, divisions, offsets, runners, layering, grafting and micropropagation.

Perhaps the easiest and most common method of asexual propagation is the cutting. Plants like coleus, African violets and Swedish ivy are examples of plants commonly reproduced in this manner *(Sketch 3)*.



Sketch 3

Coleus propagation is usually accomplished via stem cutting 4 to 6 inches long just below a node and bearing at least two nodes. The basal end of the cutting is inserted in some rooting medium, and with care, roots will develop suffficiently in three weeks to support a new plant.

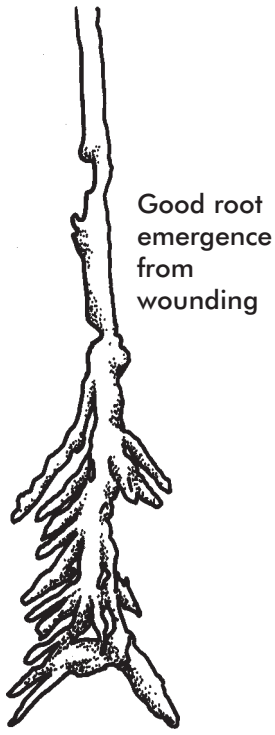
Sufficient root system development is the key to success in propagating with cuttings. Buds or areas where leaves arise on stem cuttings are the likeliest areas for good root development. Make the cuts about one-quarter inch below the last bud.

In some cases, a proliferation of parenchyma cells (living cells arising from the cambium, forming callus tissue) may form prior to root emergence; in other cases, no callus formation preceeds root emergence.

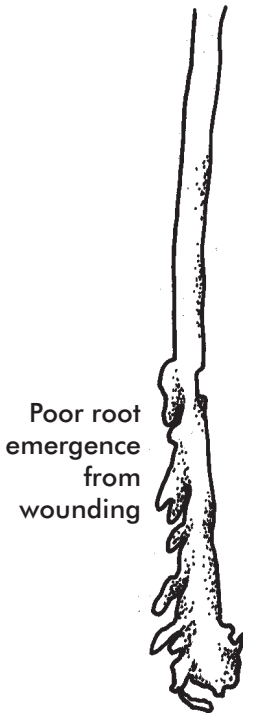
In contrast to roots arising in response to wounding are a classification of root cells known as preformed or latent root initials. They are found in such species as the easily rooted poplars *(Populus),* willow *(Salix)* and currant *(Ribes).* These root initials elongate into an established root system when a plant part (stem) is removed from the parent plant.

With some plant species, further wounding is beneficial to rooting. This involves making an additional light cut on either side of the cut stem at the base to expose more cambial area (the single layer of meristematic tissue which gives rise to the functional tissues — bark and xylem) and, in some cases, to break a physical barrier which may be impeding the formation of root initials and thus the emergence of such roots. This is evident in carnation cuttings where no further wounding results in the emergence of roots from only the base of the cutting *(see Sketches 4 and 5)*.

Another type of cutting infrequently used by home plant propagators is the root cutting. Where adventitious roots develop on stem cuttings, adventitious shoots develop on root cuttings. Plants which are propagated in this manner are: apple *(Malus* spp.), poplar *(Populus* spp.), and raspberries *(Rubus* spp.). It is important that propagation be made from disease-free plants in all situations, but especially with raspberries. Red raspberries sometimes carry a virus which they can tolerate, but will be fatal to the black raspberries. Propagating from virus-free stock is the best way to avoid this trouble. Taking sections from actively growing roots of these plants usually results in success.



Sketch 4



Sketch 5

It is important when working with stem and root cuttings that the sections be properly oriented. Make sure that the tops of all pieces are cut differently than the base, to keep from inverting them in the rooting media. Failure to keep track of this detail could result in failure of the cutting to become properly established.

Media for Cutting Propagation

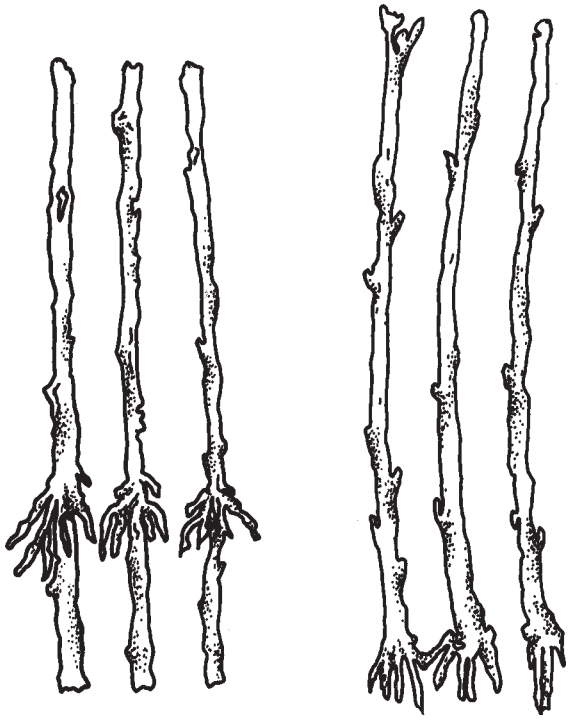
Any medium which will lend physical support, provide moisture and oxygen in the right balance, and is free of pathogens can be used for propagating stem or root cuttings.

Sand, perlite, sphagnum moss (unmilled), vermiculite and various combinations of these materials have been used to successfully establish cuttings. Obtain whatever is available and relatively inexpensive.

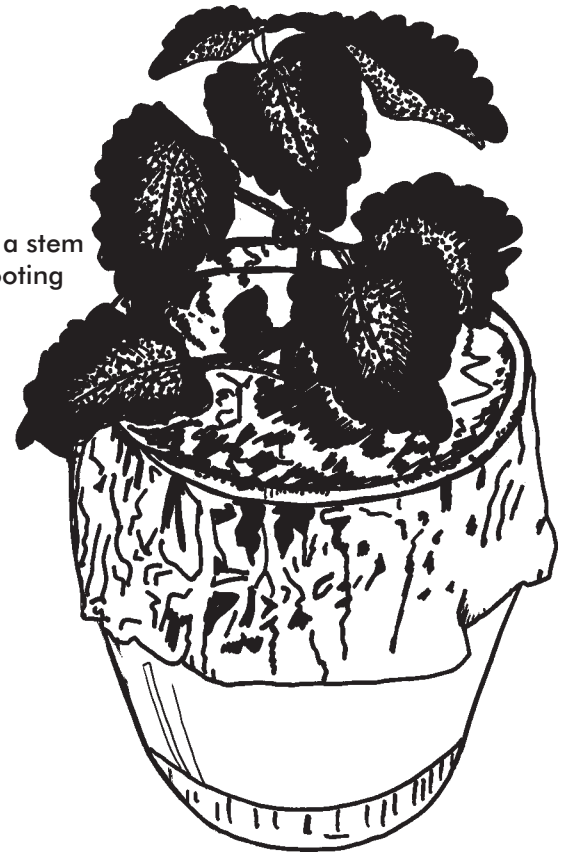
As with seed propagation, the container the medium is placed in should be well drained to allow good aeration for rapid root development.

Push the cuttings into the medium just far enough to be self-supporting. Cuttings pushed too deeply into the medium may develop roots similar to those shown in sketch 6 because there is insuffficient oxygen at the lower level for rooting to take place.

There are at least as many variations in the rooting pro-cedure as the imagination can provide. Simply use whatever is convenient and effective for you *(Sketches 7, 8 and 9)*.

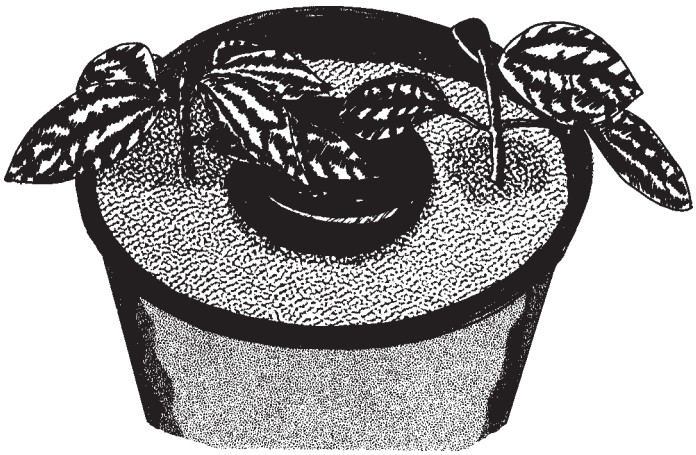


Sketch 6. Influence of oxygen concentration affecting root formation.



Sketch 7. Cuttings: a stem cutting rooting in water.

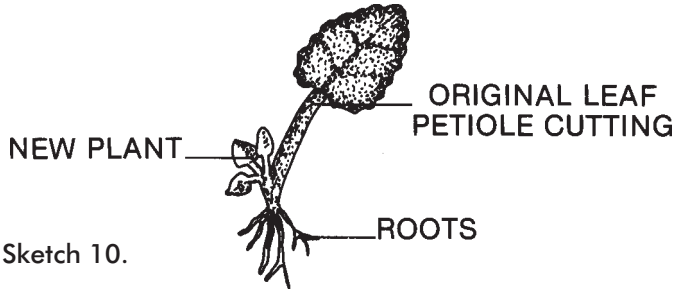
Sketch 8. Cuttings: plastic bag closed.



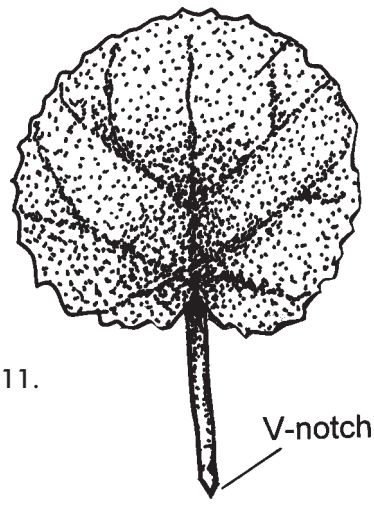
Sketch 9. Cuttings: stem cuttings placed in perlite.

Variations in Cuttings

Anyone who has ever grown African violets, jade plants, peperomias or wax begonias knows that these beautiful plants are easily propagated by using leafpetiole cuttings *(Sketch 10)*. For these and other plants, always use the best looking leaf — not too old or too immature, but one which is healthy, vigorous, and of a dark-green color. Using a sharp, clean knife, carefully cut a choice leaf from an inner circle of the rosette of leaves. Then before placing it in the medium for rooting, cut the end again to make it into a "V." This will provide more plantlets from the base of the cutting *(Sketch 11)*.



Sketch 10.

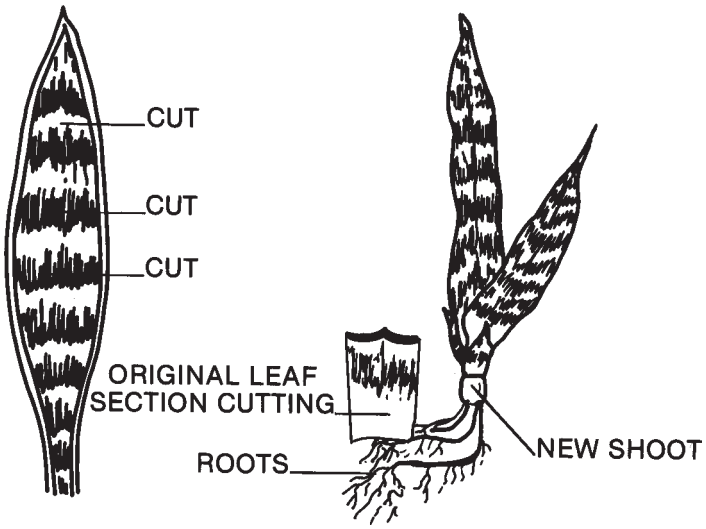


Sketch 11.

If you follow the accepted practice of rooting the African violet in water, opt to use rainwater, water from a dehumidifier or distilled water rather than tap water. Most tap water contains some chlorine and dissolved salts which inhibit rooting.

Look for roots to form in four to six weeks. As the water level goes down, add fresh water and change completely once per week to prevent stagnation.

Some plants such as the Rex begonia and Sansevieria can be propagated by using just leaf sections *(Sketch 12)*. As long as the leaf cutting sections each have a major vein, a new plant can be generated at that point.



Sketch 12.

Runners and stolons are similar stem-like structures which emerge from the crown of the plant and spread horizontal to the ground surface. They both root at the nodes and can be easily separated from the parent plant to propagate a new individual. Examples of plants with these structures are the strawberry, spider plant *(Chlorophytum* spp.) and Ajuga.

Offshoots are lateral shoots that develop from the base of the main stem in certain plants. These occur in monocots such as pineapple, banana or date palm, which are not found naturally in the Midwest. Generally, these can be removed from the parent plant after they have been notched and new roots have formed.

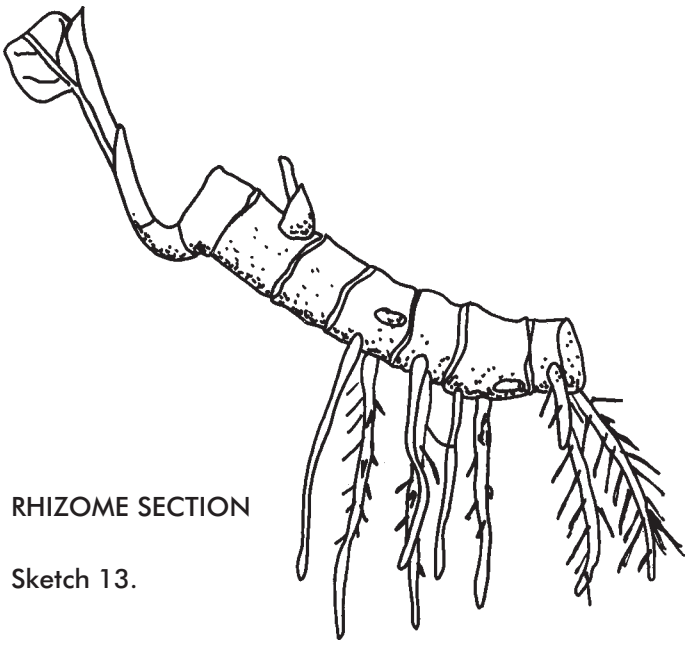
Suckers are well known to most gardeners. They are actually vigorous shoots arising from underground roots. Raspberries, some dogwoods and Canada red cherry *(Prunus virginiana* 'Schubert') are examples of plant species which sucker easily.

Bulbs, Corms, Rhizomes, Tubers and Tuberous Roots

Landscape plantings commonly include tulips, hyacinths, and daffodils, which are all propagated by bulbs. Bulbs are modified storage organs consisting of fleshy, compressed stem axis and flower primordium enclosed by thick, fleshy scales.

A corm, while bulb-like in appearance, is a compressed stem structure with nodes and internodes. The scale-like covering over this stem is known as a tunic and functions to protect it from injury or dehydration. The most common example of a corm is the gladiolus.

A rhizome is an underground stem structure which grows just below the soil surface *(Sketch 13)*. Examples of rhizomes are iris, bamboo and lily-of-the-valley. Being a true stem, a rhizome possesses nodes and internodes.

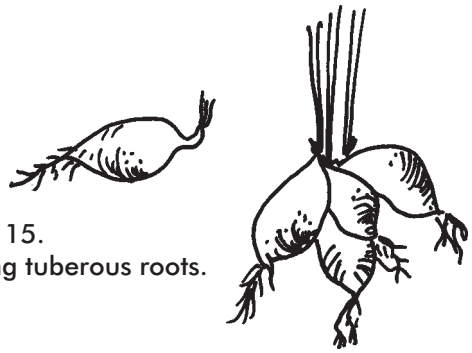


RHIZOME SECTION

Sketch 13.

Tubers are swollen, underground stems, possessing nodes in a greatly enlarged structure. The Irish potato is a conspicuous example *(Sketch 14)*.

Sketch 14. Underground stem: potato tuber.



Sketch 15.
Dividing tuberous roots.

Tuberous roots are true roots which develop swollen, underground structures. Sweet potato and dahlia are structures of this nature, producing adventitious shoots on the proximal end (nearest crown) and adventitious roots on the distal end (farthest from crown). These structures contain no nodes or internodes *(Sketch 15)*.

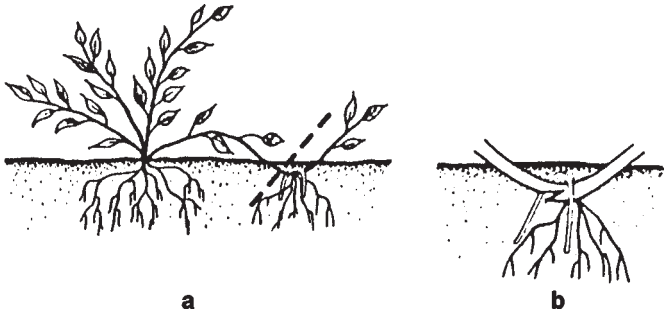
The tuberous begonia, often grown as a tender annual in shady locations, is a tuberous stem. These structures are vertically oriented with one or more vegetative buds produced on the upper end or crown.

Propagation of these structures is shown and briefly described in *Figure 1* (page 8).

Layering

For the homeowner, two types of layering are worth considering: simple layering and air layering.

For simple layering (Sketch 16), select a woody shrub you wish to propagate (grape, raspberry, forsythia, etc.) and early in the summer after new growth appears, pull a branch of this shrub down to the ground (works best in sandy soil), burying part of the branch with several nodes three or four inches deep. Anchor the tip in place with a stake so wind movement will not disturb it. To accelerate root development and improve chances of success, try wounding the branch and dusting with a rooting powder before burying. In September (or the following spring), carefully dig up to see if any roots have formed at some of the nodes. If so, separate it from the parent plant and a new plant is produced.



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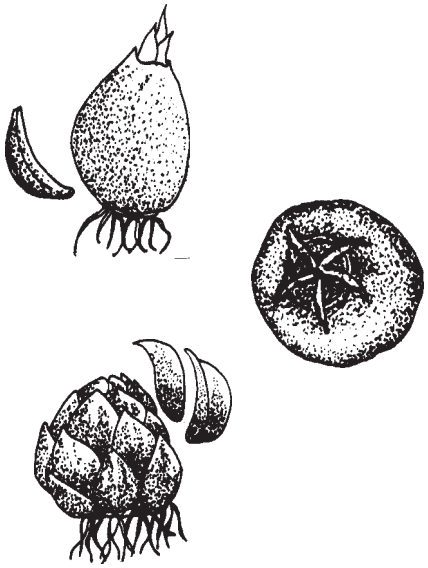
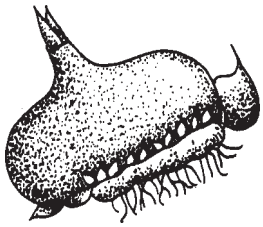
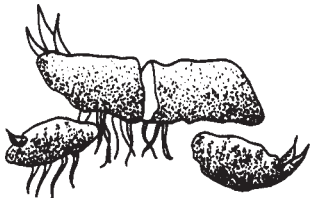
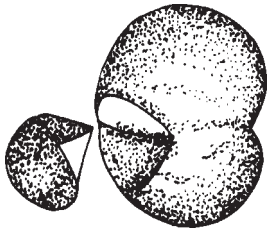
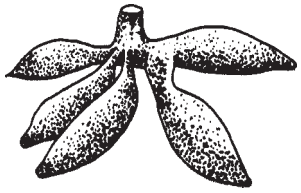
Sketch 16. Simple layering.

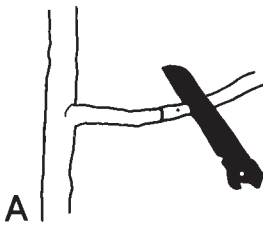
Figure 1. Propagation of some underground structures.

Structure Name	Description of Propagation Method	Sketch
Bulbs	Tulips, Daffodils, Hyacinth, Lilies — Allow foliage to remain intact after flowering. Dig in September, separate bulblets or scales (lilies) and replant. Hyacinths — Scoop, scale and plant. Remove bulblets second year and plant.	
Corms	Gladiolus — Plant in spring, dig in September, separate new corms (larger) from cormels (smaller). Replant following spring. Corms will flower, cormels will require two seasons to flower.	
Rhizomes	Iris — Remove from parent plant. Cut into pieces, each one containing a node. Replant.	
Tubers	Irish Potato — Plant whole tuber or cut up with at least one eye remaining on each piece.	
Tuberous Roots	Dahlia, Sweet Potato — Plant whole. Dahlia — dig in fall and separate the tuberous roots with a shoot bud on each. Sweet Potato — after shoots emerge, separate from mother root and plant.	

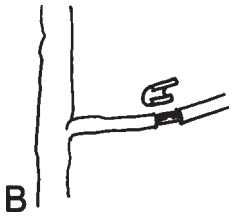
Air layering is perhaps the most useful technique of plant propagation for the homeowner to know. With this method, roots can be produced on stems above the soil. If, for example, a rubber plant has grown to the point that it reaches the ceiling, air layering is a way to save the top section of the stem and start a new plant. Or, if the plant has lost most of its lower leaves, looks unsightly, but continues to grow, air layering can be used to start a new plant.

Air layering involves one of two processes, depending on the plant species. The first process involves making an upward, slanting cut about onethird of the way through the stem, about one foot from the tip. (This is commonly carried out with Dieffenbachia spp.) The cut is held open with a bent toothpick, dusted with a rooting powder, and packed with damp sphagnum moss (unmilled). Wrap the sphagnum moss with shrink film, plastic or a split sandwich bag. Hold in place with twist ties or electrician's tape *(see Sketches 17, 18 and 19)*.

The other process, more frequently used with dicots, is to cut a ring of bark about one inch wide and remove completely from the stem. The xylem cylinder is then carefully scraped to remove any cambial tissue so that a bridge of callus tissue will not form *(Sketch 20 and 21)*. Continue with same procedure as described earlier with the slanting cut.



Sketch 20

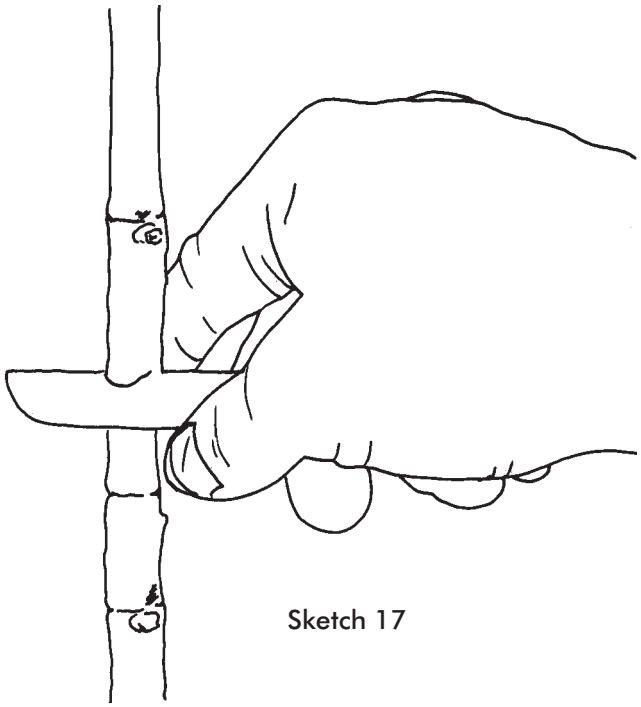


Sketch 21

In about four to six weeks, roots should be apparent. Once the roots have filled the ball of sphagnum moss, remove the plastic covering and sever the stem beneath the moss. Pot the new plant using an appropriate soil mix, water well, and cover loosely with a clear plastic bag, keeping it out of direct sunlight. This bag covering will help retain moisture around the plant leaves and keep it from wilting. It is generally needed for only a couple of weeks.

Unless more air layers are desired, the parent plant from which the air layer was made can probably be discarded. Lateral buds often develop after the air layer is removed, but their growth is usually ungainly.

Another alternative is to remove the top and root as a tip cutting in a plastic bag. The remaining basal portion can often grow into a new, attractive plant.



Sketch 17

Sketch 18

Sketch 19

Air layering: hold the wound open by inserting a matchstick in it.
Air layering: cover the moss with clear plastic and fasten it in place.

Division

The simplest propagation technique is division. This involves dividing up a plant into a series of pieces *(Sketch 22)*. Plants from African violets to peonies can be divided. The only basic requirement is that each division must have some roots and eyes. Then simply plant, give away or discard the pieces divided from the original crown or plant.

Houseplants such as African violets can be divided anytime the crown becomes crowded; outdoor plants such as phlox or peonies can be dug and divided in the fall.

Sketch 22

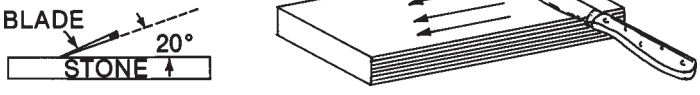
Grafting

This process of propagation involves two separate plants; one provides the root system and the other provides the desired foliage, flower or fruit. The root system is referred to as the understalk, while the branch system is known as either budwood or scion wood.

Stories abound about the success of grafting in the nursery profession, from saving grapes from root eating insects, to imparting hardiness to roses and tree fruits, to producing dwarfing or multiple varieties on one rootstock.

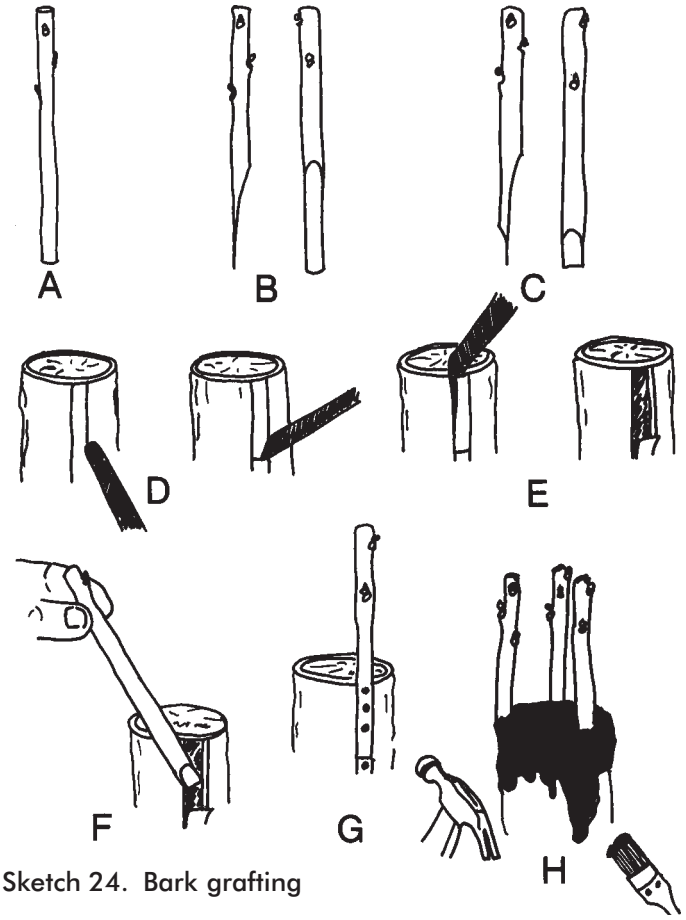
With grafting or budding (a form of grafting), success or failure depends primarily on three conditions: (1) the compatibility of the two plant parts, (2) the closeness of fit, and (3) cambial contact. This process of asexual propagation has definite limitations; it is limited to dicots and must be carried out between varieties of the same species and genus.

In all grafting techniques, a sharp knife is essential. Be sure to have it carefully sharpened on a stone as **illustrated in *Sketch 23* to get as smooth a cut as** possible for good tissue contact. Dull knives result in wavy cut surfaces and more cut fingers.

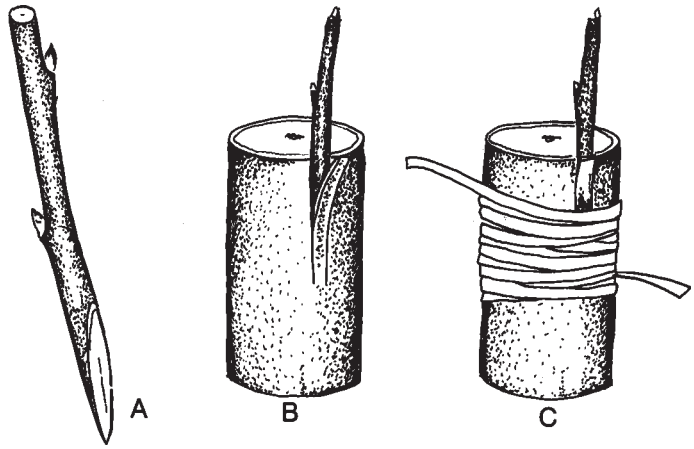


Sketch 23

Bark grafting, using the steps shown in sketch 24 the easiest technique for the homeowner to carry out when topworking a tree is desired. For smaller material a side graft is used. The illustrations in sketch 25 show the steps in this process. A small cut about 1½ to 2 inches long is made on the side of the understock, lifting a flap from the stem but leaving it attached at the base. The scion is then cut in a similar manner on both sides, but the pieces in this instance are removed. The scion base is then trimmed obliquely and placed against the side of the understock. The outer cut on the scion is



Sketch 24. Bark grafting



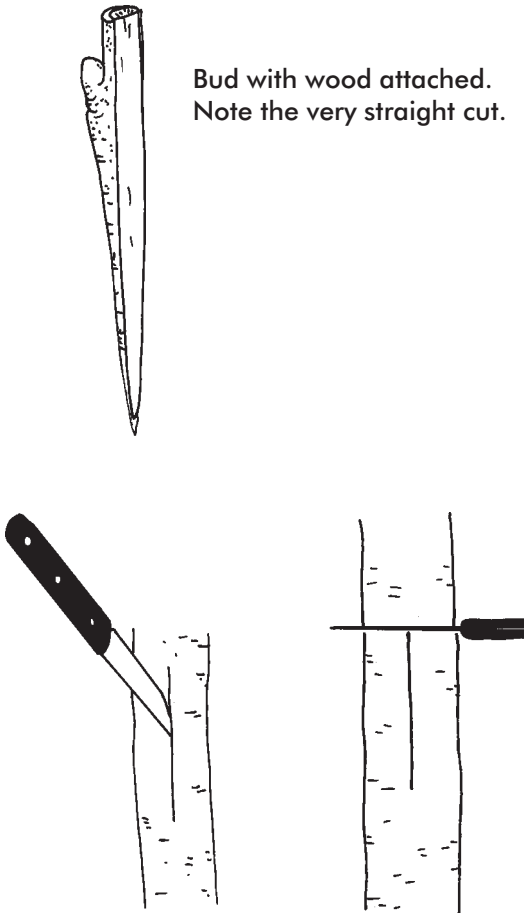
Sketch 25. Side graft.

covered by the flap which was left for this purpose on the understock. Once inserted, the graft is bound together with electrician's tape.

Budding, a method of grafting, is commonly used for producing fruit trees, roses and some ornamental trees and shrubs. Budding offers the advantages of speed, relative ease and greater success than other typical methods of grafting. Stronger unions are also formed from budding operations than with other grafts.

The best time to bud (or perform any graft for that matter) is in the late spring or early summer when the bark is slipping — easily separating from the wood.

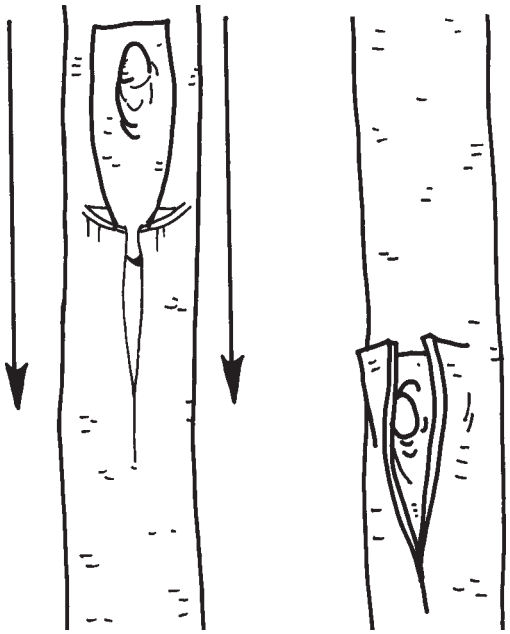
The bud makes the union with the rootstock during the first year. The following spring all wood is pruned off above the bud and the shoot elongates into a new plant. Care must be taken from this point on that no new growth emerges from below the bud union. If any should appear, remove immediately.



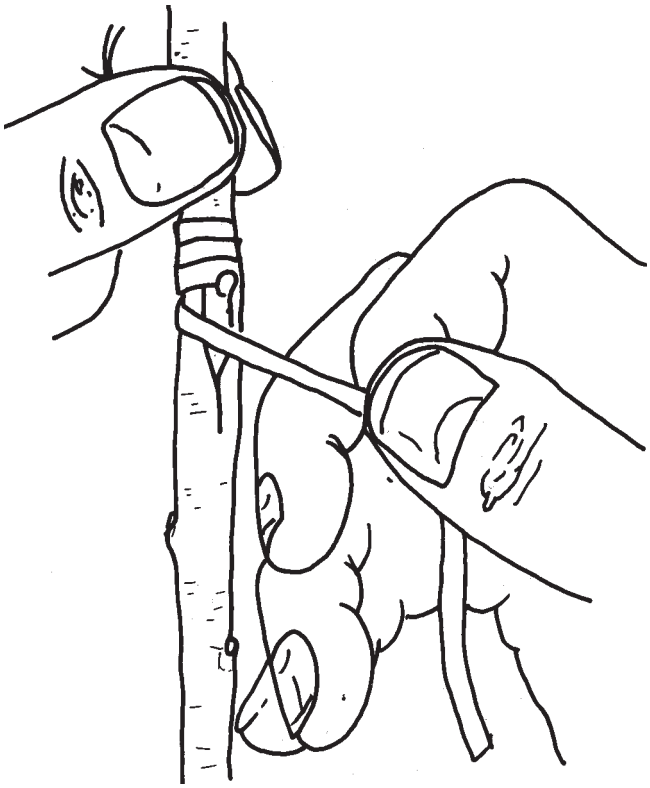
Bud with wood attached.
Note the very straight cut.

Sketch 26. Forming a "T" cut in the stock.

Although other types of budding exist, it is best for the homeowner to stay with the "T" budding technique as outlined in *Sketches 26, 27 and 28*.



Sketch 27. Slide the bud into the vertical slit until the top is even with or below the cross cut.



Sketch 28. Wrap the bud tightly with a budding rubber.

Aseptic-Micropropagation Techniques

While keeping plant parts clean for disease free culture requires diverse procedures in a commercial operation, a simplified general procedure and culture medium can be used in the home. The few basic supplies are available from local grocery, drug, or health food stores.

The home tissue culture medium described here was tested on African violet leaf/petiole sections, Boston fern rhizome tipes, and wandering Jew shoot tips. The medium was compared to a commercial complex medium and had the same results.

For one pint of medium, mix the ingredients in *Table 1* together. While constantly stirring, bring the medium to a boil. Continue to boil it until the agar flakes dissolve completely, approximately two to five minutes.

Once the agar flakes dissolve, pour the medium into heat-resistant glass receptacles, such as baby food or canning jars. Pour medium at least 1 inch deep into each jar.

Loosely screw on the lids when all of the jars are filled. They are now ready to be sterilized, along with water, tweezers, and razor blades that will be used later. Place the water in heat-resistant jars with lids loosely screwed on or with the foil covers. Wrap the tweezers and razor blades in paper towels.

Sterilize by placing the items in a pressure cooker at 15 psi for 15 minutes. Slowly release the pressure after 15 minutes and place all the items in a clean area. Tighten the lids on the jars with the medium and allow it to cool and solidi*. If the jars won't be used for several days, place a clean layer of foil over them to prevent dust from gathering.

Table 1. Home tissue culture medium (Bridgen and Brand, 1985).

Medium Constituent	Amount[1]
Table sugar	1/8 cup
Tap water	1 cup
All-purpose soluble fertilizer[2]	1 cup of stock solution
Inositol tablet (250 mg)[3]	½ tablet
Vitamin tablet with thiamine	¼ tablet
Agar flakes	2 tablespoons

[1] This mixture makes 1 pint of medium.

[2] Prepare the fertilizer stock solution by mixing ¼ tablespoon of a balanced, water-soluble fertilizer, such as 10-10-10, in a gallon of water.

[3] lnositol is sometimes sold as myo-inositol.

Plant Culture

Micropropagation will only succeed in a sterile environment. Do all transferring of plant material into the jars as quickly as possible in a clean area. Scrub your hands and counter tops with soap and water just before you begin to disinfect plant material. Rubbing alcohol or a 10 percent bleach solution (one part commercial bleach to nine parts water) can be used to wipe down the working surface.

After the medium is cool, prepare the plant material for culture. Plants must be disinfected before placement on the medium because plants usually harbor bacterial and fungal spores. Bacteria and fungi can grow on the medium faster than the plants and dominate the culture.

Various plant parts can be cultured, but small, actively growing portions usually result in the most vigorous plantlets. Ferns, for example, are readily propagated by using only one-half inch of a rhizome tip. For other species, one-half to one inch of the shoot tip is sufficient.

If using the shoot tip, remove the attached leaves and discard. Place the tip into a 10 percent bleach solution for 10 minutes. Be sure that all plant tissue is submerged in the bleach solution. Rinse off excess bleach by placing the shoot tip in sterile water.

Once the plant material has been disinfected it should be touched only with sterile utensils. Sterilize utensils with the medium in the pressure cooker or soak them in isopropyl alcohol (rubbing alcohol). Make sure all alcohol has evaporated from the utensils before they touch the plant material. Hasten evaporation, if necessary, using a burning alcohol lamp.

Remove any bleach-damaged tissue with a sterile razor blade after rinsing the plant material. Remove the lid of a culture jar and place a plant part in the jar, making sure that it is not completely submerged under the medium. Recap the jar quickly.

Growing On

Place the cultured plant material in a warm, well-lighted location (not in direct sunlight) to encourage growth. Any contamination of the medium will be obvious in three to four days. Remove and wash contaminated culture jars as quickly as possible to prevent the spread of disease to other uncontaminated cultures.

Transplant the plantlets into a standard growing medium when they reach a sufficient size. Handle the plantlets carefully because they are moving from a warm, humid environment to a harsher, drier one. After transplanting, water the plants thoroughly and place them in a clear plastic bag for several days. Gradually remove the bag to acclimate the plants to their new environment.

Although this home tissue culture medium and procedure has worked for some plants, success of the process may vary. The precision of the aseptic procedures and types of fertilizer, vitamins, water, and plants may affect the results. If you enjoy intriguing projects, give home cloning a try.

Propagation to Repair Damaged Woody Plants – Bridge Grafting

Our landscape plants, especially the fruit trees, get damaged during winter months from rodent activity. Or, because the turfgrass is growing right up to the trunk, damage may be initiated from mower impact. Wrapping the trunk with galvanized wire — "hardware cloth" — will prevent rodent damage, and removing the sod from the base of the tree for at least two feet will eliminate mower damage.

Bridge grafting, while not a propagation technique in the strict sense, takes advantage of some of the principles of propagation to save valuable trees. Damage usually becomes evident as the snow melts in the spring. As soon as the "sap flows" or the "bark slips," usually in late April or early May, bridge grafting may be carried out.

Water sprouts or suckers which are about pencil size in diameter can be collected from the tree.

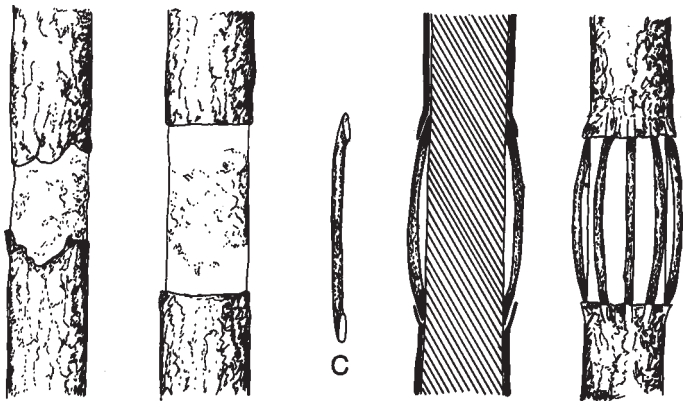
Before an area is to be bridge grafted, the ragged edges must first be trimmed away. This is accomplished by cutting into living tissues above and below the point of injury. Scions are then cut so that when in position, both ends will extend into healthy tissue. The scions (at least six will be needed to repair a complete girdling) are held in the place they will occupy over the injury, and a channel for each end is marked on the trunk to facilitate a perfect fit once nailed into place. The scion wood is beveled on both ends and the marked positions on the trunk are cut slightly shorter than the length of the scion.

The scions are then inserted into the cuts, keeping the tops oriented to the top of the tree. If a power stapler is handy, use it to secure the bark flaps over the scion ends. If not, wire brads can be hammered in. After inserting, the scions should have a slight bow to them to allow for normal tree movement.

Once all scions are in place, grafting wax or grafting paint is applied over the surface to prevent drying.

If buds should sprout on the inserted scions, simply rub them off.

The scion inserts will act as conductors of the products of photosynthesis, moving them into the root system for utilization the following spring *(see Sketch 29)*.



Sketch 29. Details of the bridge graft. A and B, the injured trunk before (left) and after (right) trimming; C, the scion, showing method of shaping cuts; D and E, the complete graft prior to waxing.

Methods of Dividing and Propagating Selected Herbaceous Plants

Alcea rosea
Hollyhock. A biennial that can be grown from seed in summer for blooming the following year. Transplants easily.

Alyssum saxatile
Goldentuft. A hardy perennial that can be grown by seed that needs warm temperatures for germination — 70 F — so summer sowing is suggested for bloom the following season. Propagate by division or softwood cuttings in spring.

Aquilegia spp.
Columbine. A hardy perennial that grows easily from seed. May need light and moist chilling to stimulate germination. Barely cover seeds, and sow when spring temperatures are still cool.

Arabis spp.
Rockcress. A hardy perennial that is grown from seed sown when soil temperatures are at 68 F needs light to stimulate germination; cover seeds lightly.

Aruncus dioicus
Goat's beard. A hardy perennial that is ideal for border or specimen planting. Seed must be cold stratified. Best propagated by division.

Asclepias tuberosa
Butterfly weed. A hardy perennial that needs warm temperatures for successful seed germination. Transplanting and division not recommended.

Aster spp.
Hardy perennials. Seeds germinate at about 68 F. Dig in fall and divide with each section having roots.

Astilbe spp.
Astilbe. A hardy perennial that is propagated by division in early spring when they are about 1 inch tall. Seed germination is slow and does not come true.

Begonia spp.
Tuberous begonias. Seed propagation or by tuberous stems that are divided into sections with each one bearing at least one growing point. Leaf, leaf-bud, and short stem cuttings can be easily rooted. Fibrous-rooted begonias — these are the wax and Christmas begonias — can be propagated by leaf or softwood cuttings taken from young shoots in spring or summer. Rhizomatous types, the Rex begonias, are divided into sections via the plants or rhizomes. Propagated by stem or leaf cuttings.

Boltonia spp.
A hardy perennial that can be seed sown or divided in spring or fall.

Campanula carpatica
Carpathian bellflower. This, and the Canterberry bells, are hardy perennial and biennial plants, respectively. The perennial is propagated by seed, or divided in early spring or August. The Canterberry bells are propagated by seed, under lights, indoors for best results.

Canna spp.
These tender perennials are propagated by splitting the rhizome, making sure each division has a generous portion of stem tissue for restarting. Dig and store in fall after frost blackens foliage, then store in a frost-free area during winter. Start indoors in containers in early March for transplanting outdoors when danger of frost is over.

Cerastium tomentosum
Snow-in summer. A hardy perennial that can be propagated in summer by softwood cuttings, or by division in the fall.

Chrysanthemum spp. (Dendranthemum).
A large genus of annuals and perennials. The garden mum produces lateral shoots that develop from the base of the flowering stems, especially if the tops are cut back. When these shoots are 3-4 inches long and are firm but not woody, they can be used as cuttings for rooting under an intermittent mist system. Rooting will be enhanced with the use of a rooting compound like IBA. Otherwise, the plant crowns can be divided in either the spring or fall.

Coleus blumi.
Ego builders for those just starting out; root easily from stem cuttings. A frost sensitive annual.

Convallaria majalis
Lilly-of-the-valley. Another easily grown, hardy perennial that can be grown from divisions of the rhizome system the plant develops. Dig and divide in early autumn and get planted by late autumn before freeze-up. Individual "pips" or buds on rhizomes can be stored in refrigeration in sphag-num moss and planted in late winter or early spring for blooms in summer.

Dahlias

Plants grow from large tuberous roots, which are dug in the fall before freeze-up and stored over winter in a cool (below 50F) location, covered with vermiculite or sphagnum moss. In spring when new sprouts appear, divide the clumps so that each has at least one sprout. Plant outdoors after frost periods have passed. Dahlias also root from softwood or leaf-bud cuttings.

Delphinium spp.

A genus that includes the larkspur, hardy perennials and annuals. Seeds readily germinate; plants can be propagated by softwood cuttings or by root divisions in spring or fall. For better longivity, use seed or cuttings rather than root divisions.

Dicentra spp.

Bleeding heart. Sow seeds in fall for natural stratification requirements and flowering the following year. Divide clumps in spring or fall; stem cuttings can be rooted if taken after spring flowering. Root cuttings can likewise be taken after flowering.

Digitalis spp.

Foxglove. Light sensitive seed; do not sow too deep. Propagate in fall by dividing crowns.

Gaillardia spp.

Indian blanket flower. Another species that has light sensitive seed. Perennial types can be divided in spring or fall.

Gypsophila spp.

Baby's breath. G. paniculata is a hardy perennial that can be started by seed or by division of crown in spring or fall. Some double-flowering types are grafted.

Hemerocallis spp.

Daylily. Divide clumps in spring or fall, separating into rooted sections. Establishes easily and is excellent for soil stabilization.

Hosta spp.

Plantain-lily. Propagate by clump division in spring.

Iris spp.

The rhizome types are divided after bloom, discarding the old portion and keeping only the vigorous side shoots. Cut leaves back to about 4-6 inches. The bulb types are planted in the fall for spring blooms. The original bulb disintegrates, leaving a cluster of different sized bulbs. Separate and grade, using the largest for flowering next spring, with the smaller being used for further development.

Lavandula spp.

Lavender. Cuttings from side shoots will root in late summer; divide clumps in the fall.

Myosotis sylvatica

Forget-me-not. A biennial that is grown as an annual. M. scorpioides is a seed started perennial that can be divided in the spring.

Oenothera spp.

Evening-primrose. Divide clumps in the fall.

Paeonia spp.

Peony. Seed propagation is not practical for home gardener, as it takes seven years to produce a flower. Best propagation method is fall division, giving each piece at least three buds or "eyes."

Papaver nudicaule

Iceland poppy and other species of perennial poppies. Sow seeds directly in desired location as they do not transplant well. For propagation, cut up roots into pieces in the fall when foliage dies, 3-4 inches long, lay horizontally and cover with about 1 inch of soil.

Phlox paniculata

Garden phlox. Although softwood cuttings will root, better results may be realized if root propagated in the fall. Cut all roots off from the crown, leaving just 2 inches remaining. Replant the crown. Cut roots into 2 inches sections and place in flats of sandy soil. Clumps can be divided in spring or fall.

Sedum spp.

Many species make up this genus. Most are easily propagated by direct sticking of cuttings, or by simply cutting the mat-forming species into desirable sizes and transplanting.

Thymus spp.

Thyme. Seed is light sensitive; do not sow too deeply. May be increased by division or softwood cuttings taken in summer.

Valeriana officinalis

Valerian. Hardy perennial. Root is used in sedative preparations. New plants can be obtained from clump division in spring or fall.

For more information on this and other topics, see: www.ag.ndsu.nodak.edu