

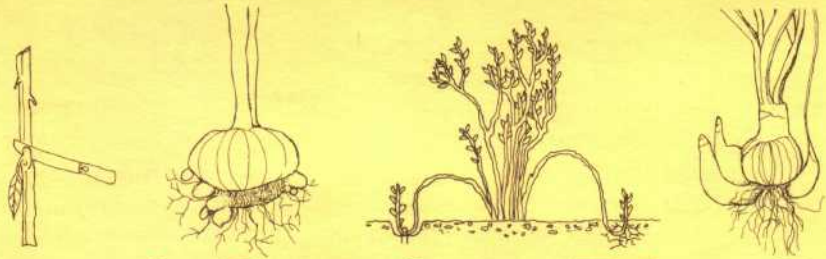
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Propagation of Garden Plants
Michigan State University Extension Service
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Propagation of Garden Plants¹

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Department of Horticulture

PLANT PROPAGATION deals with techniques for producing supplies of new plants of either a species² (*Quercus borealis* — Red oak) or a horticultural variety of a species (*Prunus serrulata* 'Kwanzan' — Kwanzan Japanese cherry).

With knowledge of propagation techniques, you can enlarge your garden by propagating your favorite plants using very little equipment and materials.

Seed (sexual) propagation is the oldest and simplest method for reproducing new plants. Seeds develop within fruits, which are derived from flowers after pollination³ and successful fertilization³. Annuals⁴ (marigold, peas, beans) and biennials⁵ (carrot, beet, onion, pansy) are usually commercially propagated from seed and sold to commercial growers and gardeners. Nevertheless, you may collect your own seed from selected varieties.

The seed of naturally self-pollinated varieties of flowers and vegetables, such as snap bean, pea, pepper and larkspur, can be collected provided they are not hybrids. Those taken from a hybrid variety will usually produce plants unlike, and less desirable than, the parent. Also, seed taken from

¹See "Plant Propagation", by Hartman and Kester, 1975, Prentice Hall, for greater detail on all aspects of propagation.

²Species is a scientific name (usually in Latin) used for a group of closely related plants which carry over certain structural and growth characteristics from one generation to another from seed. Plants within the same species will usually cross breed, and can generally be successfully grafted on each other.

³Pollination refers to the transfer of pollen grains from the stamens (male organs) to the pistil (female organ) of a flower. Fertilization is the union of a male gamete from the pollen grain with a female gamete in the pistil of the flower.

⁴Annuals are soft-stemmed plants such as bean that produce seed the year planted, and then die.

⁵Biennials are soft-stemmed plants which, in their natural habitat, take two years to produce flowers and seed before dying. Some biennials such as carrots and beets, are grown in the garden like annuals.

⁶A perennial plant is one which lives in the garden for more than two years. The tops of hardy herbaceous (soft-stemmed) perennials die back in late fall in northern areas, but regrow each spring. Both tops and roots of hardy woody perennials remain alive over winter.

cross-pollinated vegetables and flowers (cabbage, cantaloupe, onion, many other vegetables and most flowers) never come true to variety and should not be collected from the garden and planted in subsequent years.

Vegetative propagation involves the use of stems, roots or leaves, rather than seeds. All varieties of perennials⁶ are propagated vegetatively because they do not come true from seed due to their genetic complexity. Varieties of soft-stemmed perennials (asparagus, chrysanthemum, peony) and woody perennials (cherry, apple, maple, azalea) also have to be propagated vegetatively to preserve their special characteristics.

Propagation With Seedlings

Although varieties of woody plants do not come true from seed, seedlings of certain species are often used to produce an entire new plant or a part of one. Some species of woody ornamentals, such as the elms, maples, and viburnums, produce rather uniform plants from seeds. However, named varieties of woody species are often propagated by grafting them on rootstocks produced from seed. Seed sources include superior parent plants, random parents, isolated blocks of virus-free plants, and by-products of fruit processing plants.

Seed Collection

Mature, dry, or fleshy fruits may be gathered from the parent plants. Collect dry type fruits before they split open and release the seeds. Fleshy fruits should be picked when they are fully ripe.

Seed Handling and Storage

The seeds are removed from the harvested fruits and generally at least partially dried. The optimum moisture content for storage varies with the species. Most seeds store best in air-tight containers under cool conditions. You may use a glass jar with a tight fitting lid stored in a common household refrigerator.

Storage life of seeds varies with species. For example: under favorable storage conditions, onion

and sweet corn will keep only one year; peas, beans and marigold, three years; and lettuce, muskmelon and nasturtium, five years.

Viability of vegetable and flower seeds can be easily tested if there is any doubt about the germination capacity of the seeds. Using the "rag doll" technique, scatter about 20 seeds over a moistened piece of paper towel, and then cover with a second moistened towel. Roll up the two towels and tie the ends. Seal this "rag doll" in a plastic bag and keep at about 70°F for 3 to 5 days. After this, open it and determine the percentage germination by counting the number of germinated seeds.

Breaking Seed Dormancy

Nature delays germination of the seed of some species so that they will be more likely to develop under favorable conditions. Modern varieties of most annual vegetables and flowers have been selected for rapid germination when the soil is warm and moist. However, seeds of woody plants native to cold climates all require special preplant treatment. If you attempt to grow seedlings of woody plants, be prepared to treat the seed to break their physiological dormancy.⁷ If such seed is not correctly treated, germination either will not occur at all or will be delayed.

Stratification is a cool, moist treatment required for seeds of many woody plants native to cold regions. It simulates natural winter conditions and thereby breaks dormancy. Mix seeds with moist sand or peat moss in a jar or plastic bag. Tie the bag shut, or screw the lid tightly on the jar, then store it in an ordinary refrigerator for at least two months before planting.

Chemical seed treatment before stratification is required by certain species to insure germination. Hawthorn seeds, for example, should be soaked in sulfuric acid to break down the seed coat and allow uptake of water by the seed. This procedure must be done with great care, and is probably best left to nursery professionals.

Vegetative Propagation

Layerage

This method is accomplished by the rooting of a stem while it is still attached to the parent plant. It is probably the surest and easiest method of vegetatively reproducing most woody plants.

⁷Physiological dormancy of seeds of cool climate plant species refers to that phase of seed inactivity which cannot be broken for normal germination and seedling development, unless the seed is properly chilled - a minimum number of hours at 45°F or lower under moist conditions. This chilling requirement varies with species and horticultural variety.

In tip layerage, a flexible branch or cane of raspberry, forsythia or other shrub or vine is pulled down to the ground. The tip of the stem, or a few inches of stem just behind the tip, is held down to the ground with a stone or large wire staple, and covered with soil. In temperate climates, tip layering is done in midsummer. The covered stem portion will root by fall. In the spring, the rooted or "layered" stem tip can be cut from the parent and replanted.

Air layerage of woody plants is done by first removing about a half inch strip of bark from the one-year-old stem in the spring. Make two parallel horizontal knife cuts (about one-half inch apart) around the stem and one vertical cut. Wrap a handful of moist sphagnum or peat moss around about four inches of stem, including the girdled portion. Then cover the moss with a piece of polyethylene film large enough to be tied above and below the moss. The film will prevent the moss from drying out, and the moisture and darkness will encourage the development of roots above the girdled portion of stem. By fall, roots will be well formed on the layer. At this time the layer should be cut from the parent and planted outdoors. The layers should then be mulched for the winter, and also protected from rodents until well established in the garden.

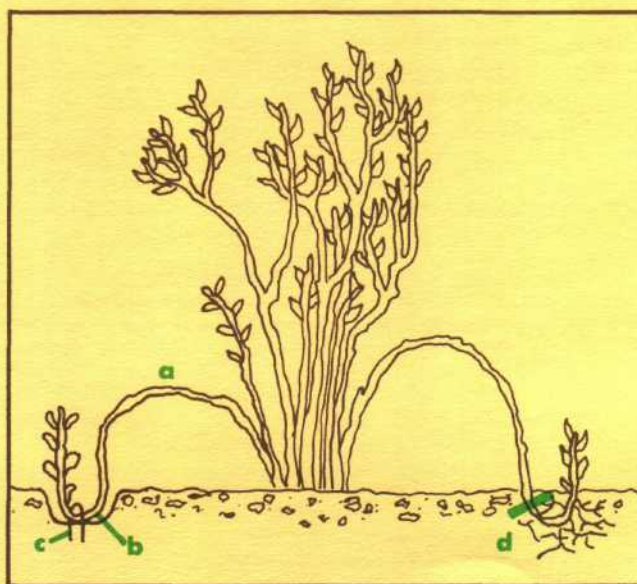


Fig. 1—Tip Layering

An easy way to get new plants. The flexible cane (a) of a mature shrub or vine is bent to the ground during the summer and turned upward at (b) 3 to 4 inches from the tip. It is held fast in a shallow hole with a staple (c) and the hole is filled with soil. In the fall or following spring, the rooted stem tip is cut from parent plant at (d).

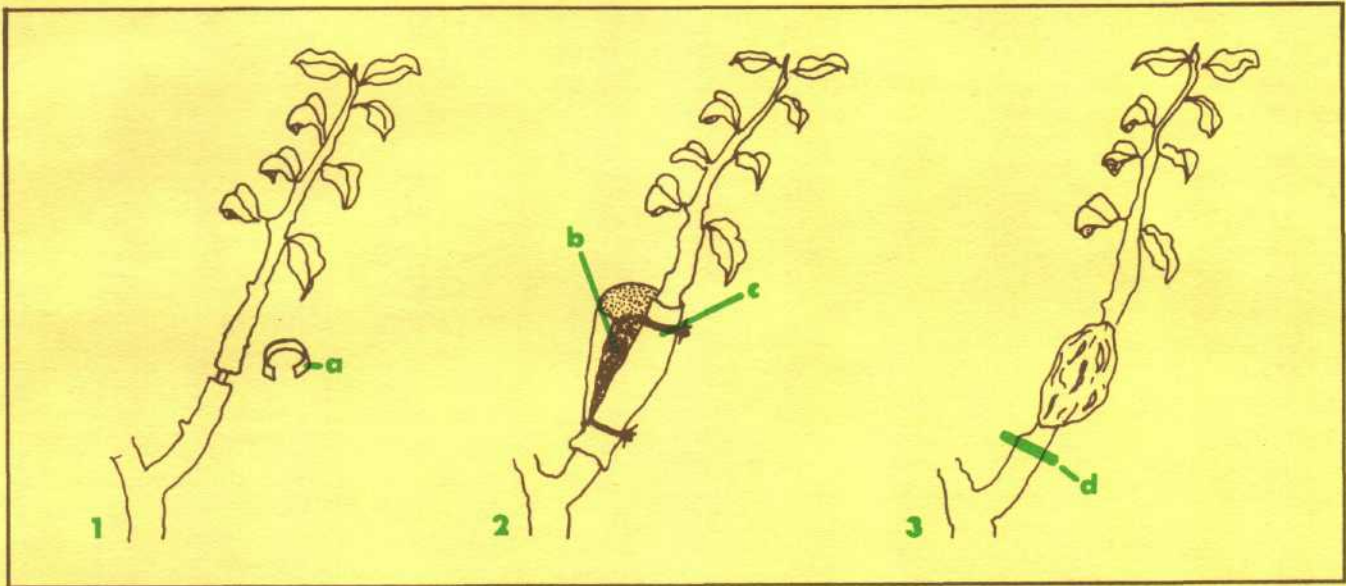


Fig. 2—Air Layering

One way to get a new, small plant when the old one has gotten too big. A strip of bark about one-half inch wide (a) is removed from the lower part of a small branch of a woody plant in the spring. A handful of moist sphagnum

or peat moss (b) is placed over the girdled portion of the stem, wrapped with polyethylene film (c) and secured at the ends. The rooted layer is cut from the parent plant at (d) and planted.

Mound layerage is most often used to propagate selected dwarfing apple rootstock varieties, but can also be used to obtain rooted shoots of other woody

plants which tend to sucker (See page 8). Cut the young mother plant back to about 2 inches from the ground in early spring before growth starts. Several new shoots will develop from the stump of the mother plant. When these are about 6 inches long, build a 3-inch mound of sawdust or peat moss around the base of the new shoots. The mounding should be repeated two more times as the shoots continue elongating, increasing the height of the mound 3 or 4 inches each time. If the mounding material is kept moist throughout the season, the shoots will develop roots within the mound. In the fall or the following spring, break down the mound and cut the rooted layers about 2 inches from the ground. You can then plant these and later graft them with a stem piece or bud of an appropriate variety.

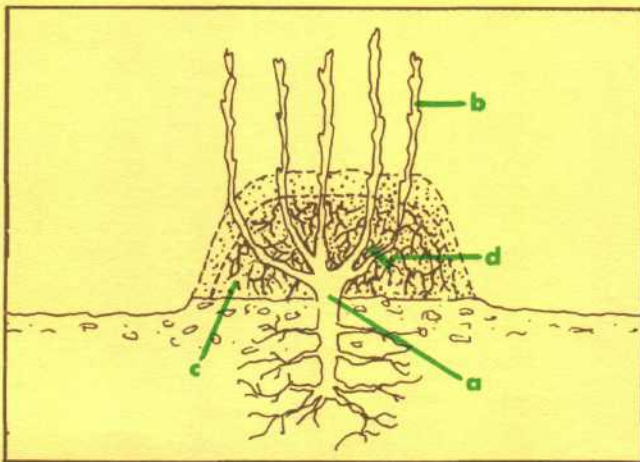


Fig. 3—Mound Layering

A common method used for propagating dwarfing rootstocks for apple. The mother plant of a young tree or shrub (a) is cut back to an inch from the ground in early spring before growth starts. When the shoots (b) develop about 6 inches from the stub, a 3-inch mound (c) of peat moss or sawdust is built up at the base of the clump of shoots. As shoots continue to elongate the mound is kept moist and is increased in two stages to a height of about 10 inches. In the fall or spring, rooted shoots or layers are cut from the parent plant at (d).

Cuttage

Cuttage is a method whereby a cutting of stem or leaf is rooted in an environment favoring root initiation. Root pieces of some species, handled in a similar way, can be induced to develop buds, shoots and more roots. Garden plants are often propagated from stem cuttings. Cuttage can be done indoors in the fall or winter in the home or greenhouse, or outdoors during the growing season within a simple plastic enclosure or directly in the garden.

Commonly available synthetic, root-promoting growth regulators can be used with difficult-to-root species. Dip the base of the cutting into the powder, or soak it in a solution of the chemical before putting the cutting into the rooting medium.

Rooting media for propagation should be sterile whenever possible to avoid disease problems, and also well aerated to encourage new root development. They should also retain moisture, but not an excessive amount. Soil alone is the least desirable medium and should be sterilized for rooting indoors. To sterilize, heat moist soil in an ordinary oven to 140°F (60°C) and hold that temperature for 30 minutes. Coarse sand alone, or sand mixed with peat moss, perlite or vermiculite, are common rooting media. These should all be kept moist, but not wet, during the rooting period.

Hardwood stem cuttings can be made with species or varieties of easy-to-root woody plants like forsythia, willow and grape. Use dormant stem pieces about 5 inches long with two or more buds. In cool regions, it is best to take the cuttings in the fall when the leaves have dropped. Make the top cut just above a bud, and the bottom cut just below the bud. The simplest technique is to wrap these cuttings in a piece of plastic, or seal them in a plastic bag, and then store them in a refrigerator until spring. During the winter, callus tissue and root initials

will form at the basal end of most of the cuttings. In the spring, the callused cuttings can be planted in the garden with at least one bud above ground. Planted closely together in rows, they should be watched carefully to make sure that moisture is adequate. To stimulate root development, work peat moss or decayed leaves into the soil.

Softwood stem cuttings (five to seven inches long) may be made from many species and varieties of herbaceous plants, and from woody plants which do not root easily from hardwood cuttings. The cuttings can be taken from herbaceous perennials any time during the growing season when stems are stiff and firm. Cut them from the new growth of hard-to-root woody plants like apple and rhododendron during early summer when these stems start getting woody.

The procedure of making softwood cuttings is complicated by excessive loss of water from the attached leaves, which may prevent successful rooting. To prevent water loss, a high humidity must be maintained around the cuttings. Do this by enclosing the propagation area of the garden in a frame covered with plastic film, shading cloth, or both, and by frequent periodic spraying with water. If plastic film is used, ventilate during the hottest part of the day to avoid overheating.

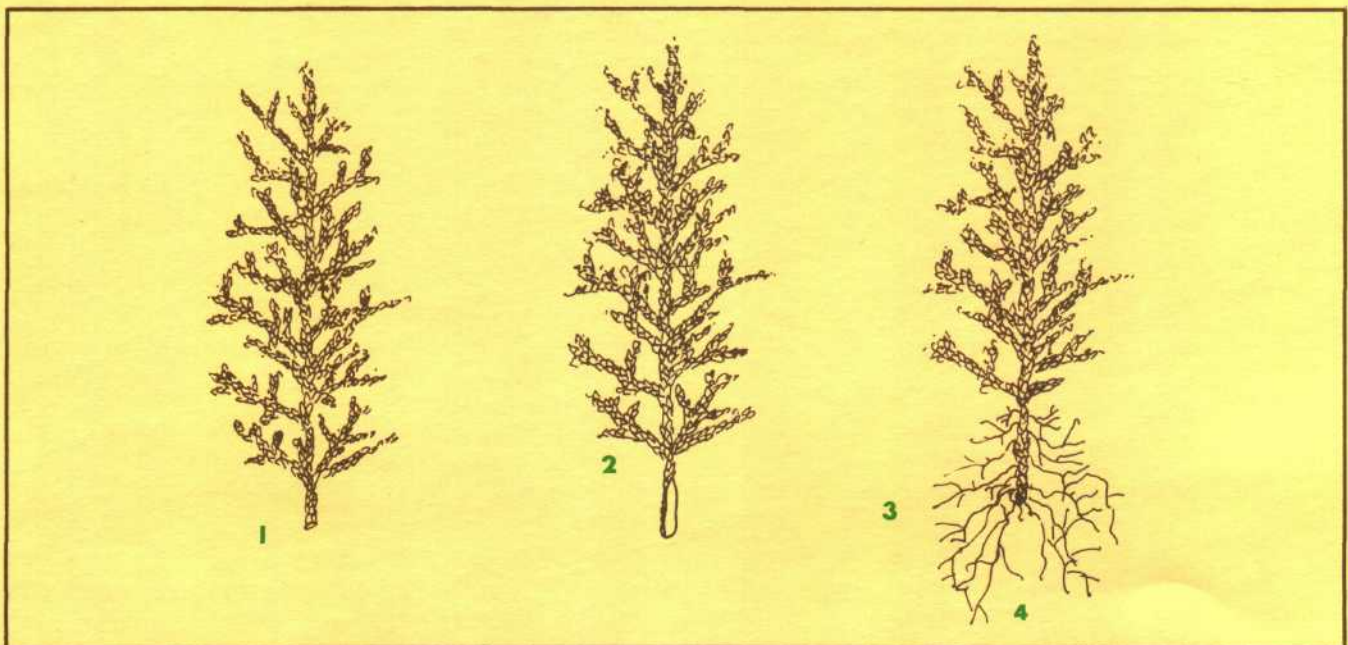


Fig. 4—Stem Cuttings (Juniper)

Hardwood stem cuttings of Juniper (1) and many other woody plants, usually from 4 to 6 inches long, are taken in late fall or early winter from the tips of branches. (2) The leaves are removed from the lower 2 inches of the cutting, that portion which will be within the rooting medium. (3)

Two shallow cuts on opposite sides of the lower part of the stem will increase the amount of rooting. (4) Good rooting of Juniper will occur if the process is done properly.

As soon as the cuttings are well rooted, they can be planted in the open garden. In cool climates, winter mulches are recommended to avoid root damage due to fluctuating soil temperatures which tend to push the shallow-rooted cuttings out of the soil.

Graftage

Graftage is the joining together of part of one plant with part of another. The most common graft is one in which a stem piece (scion) or bud of a variety of a woody species is joined to a seedling rootstock of the same species.

Another use for graftage is to propagate a species on a rootstock with special characteristics, such as dwarfing effect on the scion, or disease resistance. Graftage may also be used to repair a tree by bridging over an area of injured trunk.

Basic Requirements

Over the years many kinds of grafting techniques have been developed—cleft grafting, bark and whip-and-tongue grafting, T-budding, and chip-budding. One method may be preferred over another because of personal preference or because it may be most successful or easiest to accomplish with certain species. Whatever the method of grafting, each one must meet the following basic requirements:

Cuts must be straight when preparing the components for any graft, so that the cambium^a of the one component will contact the cambium of the other and eventually produce new tissue which will interlock and form a union of the two. If cuts are not straight, there will be only limited contact between cambial layers, and incomplete union of the components usually results. The cut surface of the scion must be placed against that of the stock so that their respective cambial tissues are in at least partial contact to insure a growing together of the two components.

Binding the graft components is also necessary to insure a good union. If the process of growing together is interrupted because one of the components is moved by the wind or any other force, then the graft will not "take". Fine nails, surgical tape or rubber bands are commonly used to hold grafts together.

A protective coating of commercial grafting compound (a black tar-like compound) or its equivalent, should be generously painted on any internal stem or root tissue that is left exposed to the air after a graft is made. If this is not done, the exposed tissues will dry out and die, or decay

^aCambium in woody plants consists of an extremely thin sleeve of tissue that exists between the inner bark and outer wood of stems and roots, and is capable of developing new bark and wood tissues.

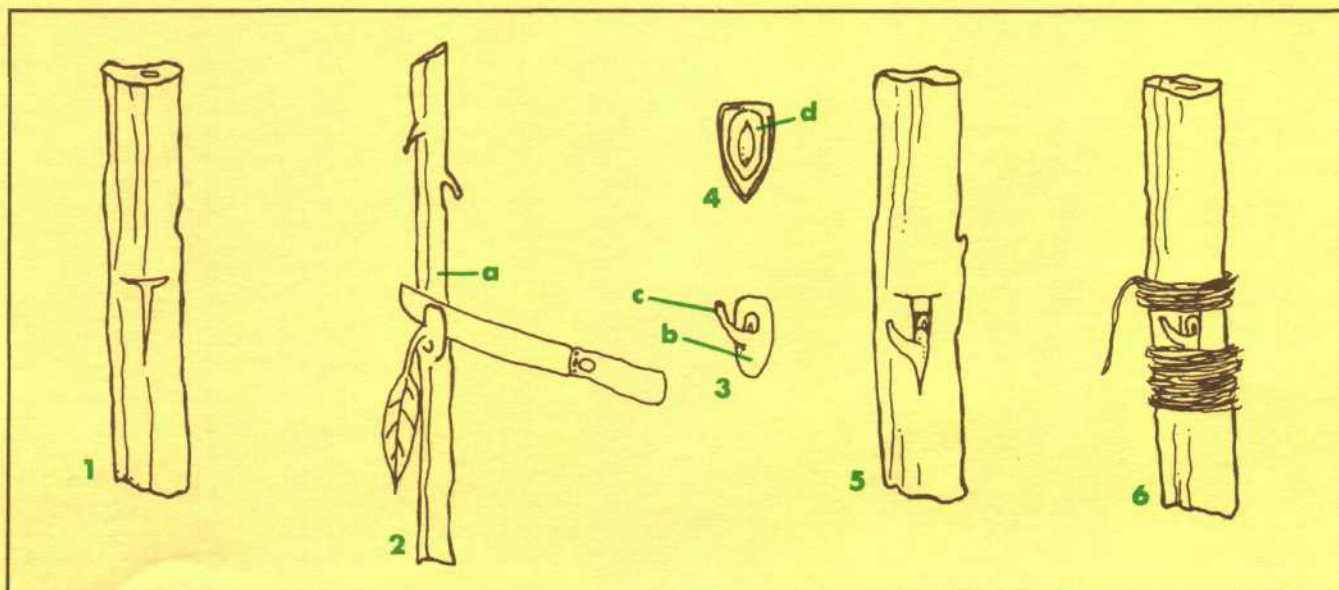


Fig. 5—T-budding

A grafting technique often used to propagate cultivars of woody plants on rootstocks. (1) Two cuts are made into the bark of the stem of the rootstock to form a "T," usually in late August. (2) A bud shield (b) is cut from bud stock (a). (3) The leaf blade is cut off leaving the petiole as a handle (c). (4) The underside of the bud shield shows the

cambium (d) which makes union with the rootstock possible, and small amount of wood tissue. (5) The flaps of bark are pried open and the bud shield is inserted and pushed well down into the opening. (6) The bark is finally tied with a rubber strip or tape above and below the bud.

organisms may infect the tissue, thereby greatly decreasing chances for a successful graft.

Separation and Division

Some herbaceous garden perennials develop fleshy, specialized organs such as bulbs or tubers below ground before their tops die back in the fall in a northern climate. The simplest method of propagating such a plant is to dig it up in fall or spring, and separate these specialized organs from each other by simply pulling them away from the mother plant. They detach easily, and can be replanted separately in the garden.

When the specialized organs have to be cut into pieces to provide a source of new plants, as with iris rhizomes, the process is called division. Plants such as chrysanthemums, which spread by simply developing an enlarged clump can be "divided" by

digging up the clump, cutting it into pieces, each with its own buds and roots, and replanting each piece.

Bulbs

Bulbs usually consist of fleshy leaf bases attached to a very short, flat, plate-like stem with roots developing from the underside of this stem plate. In the reproductive state, small bulbs or bulbets usually form within or alongside the parent bulb. These may be easily separated from the mother bulb in the fall and replanted separately. If the bulbs are to be planted the following spring, as with onions, store them indoors under cool, dry conditions. *Narcissus* (daffodil), tulip, lily, onion, and garlic, all produce bulbs.

With scaly bulbs such as lilies you can easily separate the scales of the bulb from each other and plant the individual scales. Those will form tiny

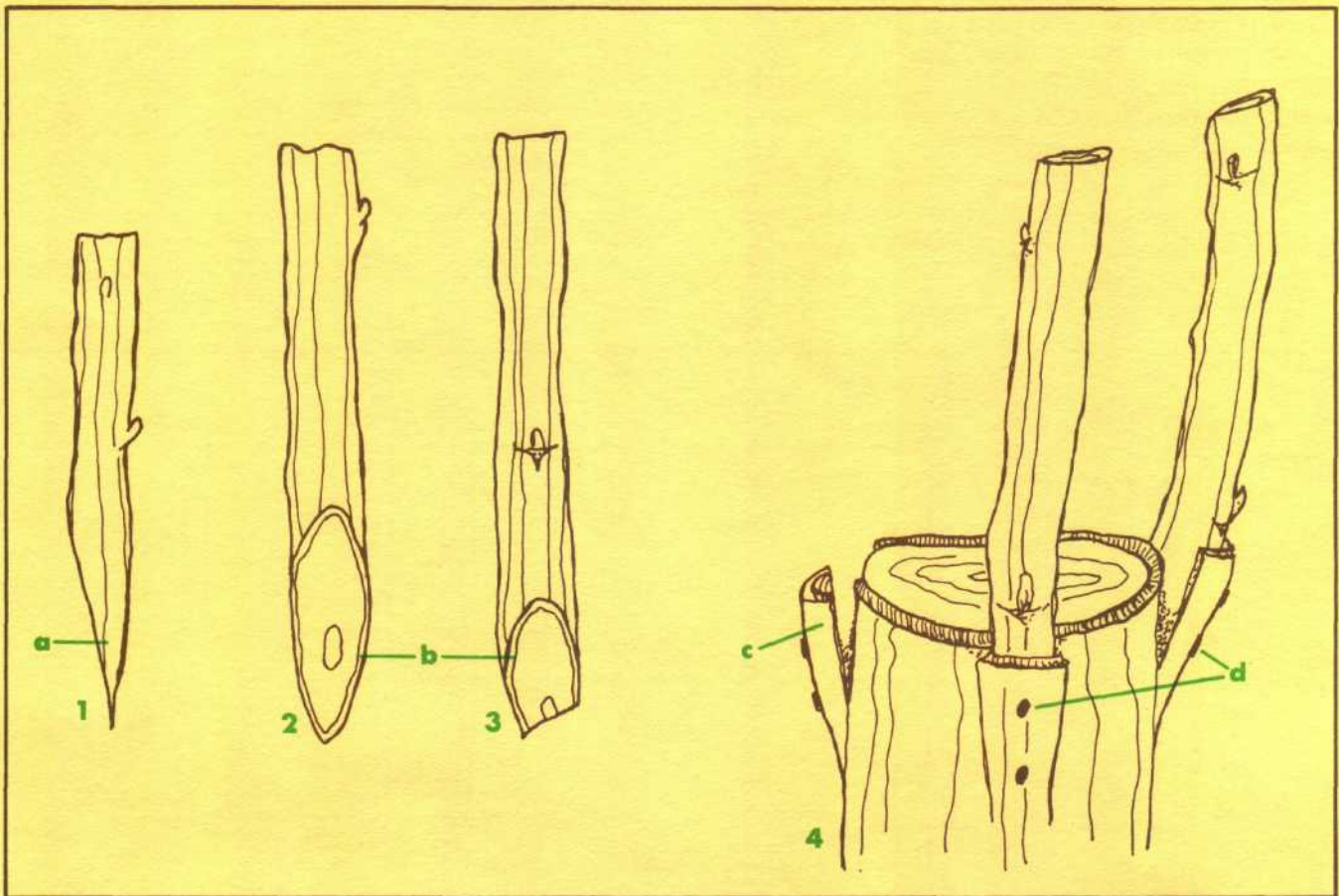


Fig. 6—Bark Grafting

A type of graft commonly used on individual limbs of fruit trees in the spring. (1) Sideview of the dormant stem piece (scion) taken from a tree of the variety wanted, after a one inch slanted cut (a) is made. (2) View of cut surface of scion which will be placed against the exposed cambium (b) of the tree limb being grafted. (3) Backview of the scion, showing one half inch cut, against which

bark strip will lay. (4) The bark strip (c) is lifted and the scion is inserted in the exposed slot. The bark strip is laid against the base of the scion and nailed (d) in place, holding both bark and scion to the limb. Only one scion will eventually be allowed to remain and renew the limb.

bulbs at their bases. It will take at least two years to grow an acceptable flower or edible product from either a scale or a bulblet.

Corms

Corms are bulb-like, enlarged underground stems that develop annually at the base of certain plants as they mature. Small corms (cormels) often form toward the base of the mother corm for later planting in the garden either in the fall, as with crocus, or in the spring with gladiolus. Because gladiolus is not a hardy plant, its corms and cormels have to be stored indoors over winter under cool, fairly moist conditions.

Tubers

These enlarged fleshy stems develop at the tips of slender, elongated underground stems. The edible part of the Irish or white potato is a tuber. In the fall, when the top of the potato plant dies back, the tubers in the soil are mature and ready for digging.

The tubers separate readily from the plant as they are dug. After being stored indoors through the winter in a cool, humid environment, the tubers (seed potatoes) to be used for planting are often divided by cutting them into two to four pieces so that each piece includes at least one eye (bud). Small potatoes, an inch or so in diameter, should be planted intact.

Tuberous roots

Enlarged fleshy storage roots are produced by some plants in a cluster, below ground, immediately below the main stem, as in sweet potato and dahlia. In the north, the tuberous roots of the tender dahlia are dug in the fall. The entire cluster of tuberous roots with some stem is stored indoors much like Irish potatoes. In the spring, divide the individual tuberous roots from each other by cutting them apart so that each piece includes a portion of the stem. Each of these is capable of producing a new plant.

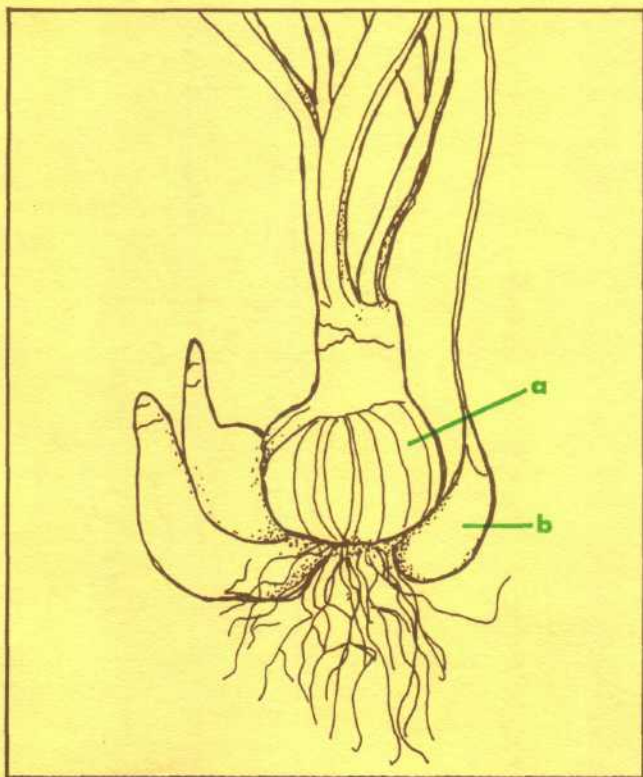


Fig. 7—Bulbs (tulip)

Some perennial, herbaceous (soft-stemmed) plants form underground storage organs consisting largely of fleshy leaf bases from which the new growth develops the following growing season. These are called bulbs (a). Tulips form daughter bulbs (b) which can be easily separated (pulled away) from the parent bulb, if the clump is dug up toward fall, after the tops have died back.

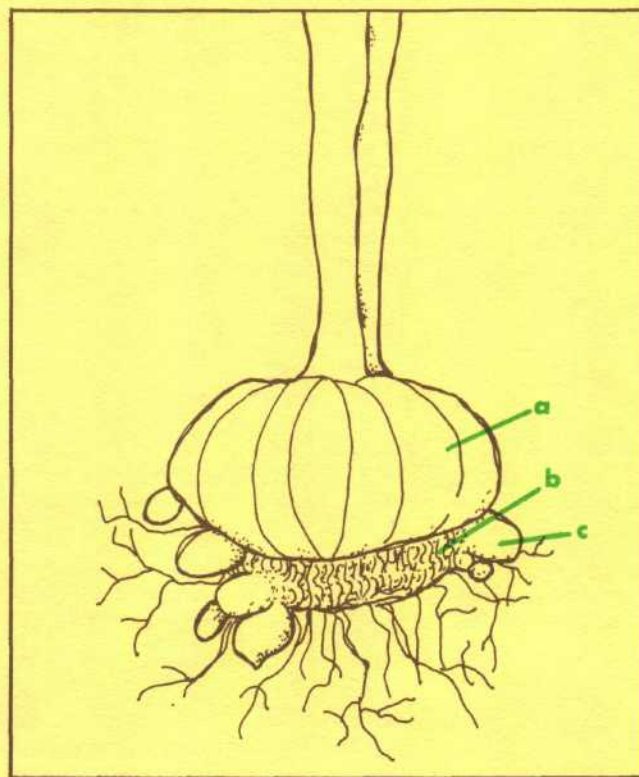


Fig. 8—Corms (gladiolus)

Some perennial herbaceous stems form bulb-like underground storage organs called corms, at the end of their season. Corms consist of stem tissue at the base of the plant; (a) is the new corm; (b) is the remains of the old corm, and (c) is one of many cormels (small corms) which tend to develop between the old and new corm. Cormels can easily be separated from the mother corms in the fall.

Suckers

New shoots sometimes develop from the roots of woody plants, and eventually develop their own roots. Red raspberry and common lilac sucker readily. The suckers of ungrafted species can be dug up in the spring or fall, divided from the parent plant, and replanted. However, suckers of grafted plants should not be used because they originate from the rootstock rather than the scion variety and therefore lack the preferred variety characteristics of the scion.

Runners

Slender, horizontal, above-ground, trailing stems enable plants such as strawberries to spread naturally. Runners form rooted plantlets at their tips. The rooted plantlets may in turn form additional runners and plantlets during the same season. The following spring, the runners can be

detached from the parent plant and the plantlets replanted in new rows in the garden. Bent grasses in lawns and putting greens for golf courses are propagated by planting pieces of runners.

Offsets

Offsets are somewhat like runners, except that the horizontal stems are quite short, and the new plantlets (offsets) develop close to the mother plant, touching each other as they enlarge. These offsets can be cut off and used in a new location. Hen-and-chickens is a common garden plant which spreads by offsets.

Rhizomes

These horizontal stems form the main axis of certain plants and enable them to spread. Unlike runners and offsets, rhizomes occur partially or completely underground, sometimes branching as they spread. They may be slender (lily-of-the-

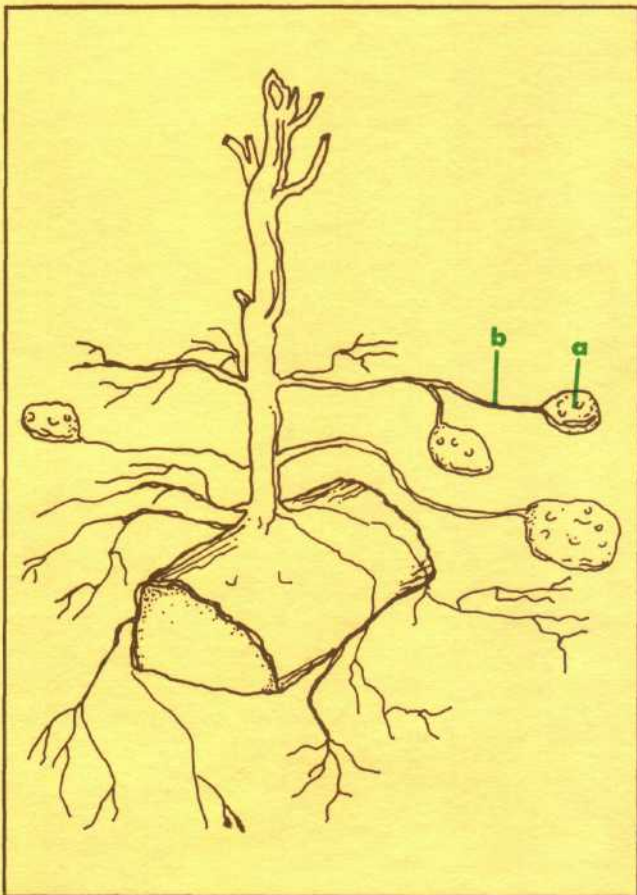


Fig. 9—Tubers (Irish potato):

Plants like the Irish potato form enlarged storage stems (a) at the ends of slender underground stems (b). The potato tuber is easily separated from its slender stem when the hill is dug up, and stored indoors in a cool, humid atmosphere over winter. Large tubers are usually cut into two to four pieces of seed potato and planted in the spring.

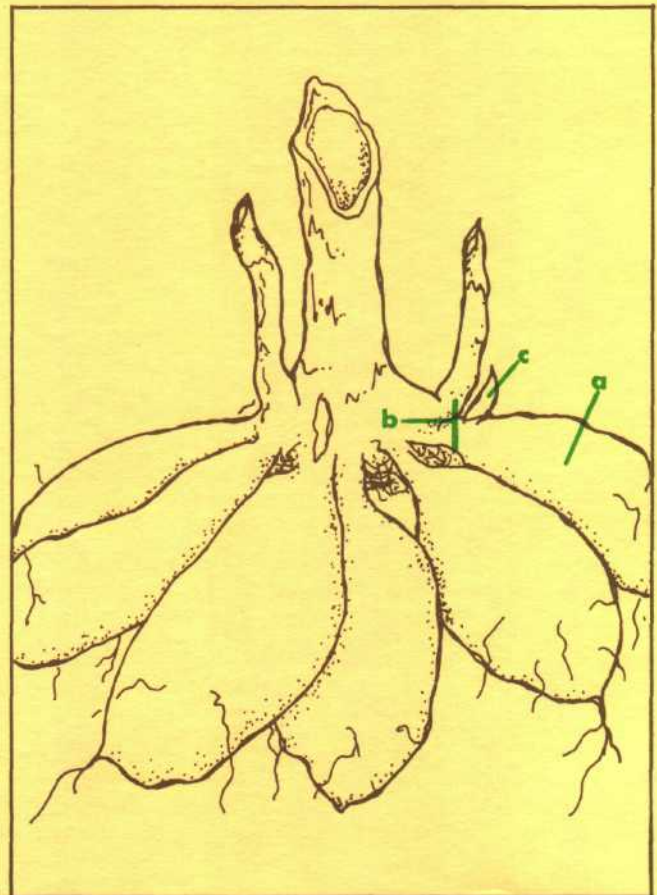


Fig. 10—Tuberous roots (dahlia):

Some perennial herbaceous plants have storage organs consisting of a cluster of fleshy tuberous roots (a) at the base of the plant. Plants like dahlia may be divided by cutting the tuberous root at (b), making sure that each fleshy root has a bud (c) toward the top end from which a new plant can develop.

valley) or rather thick (iris). In some plants (asparagus), buds from subsurface rhizomes produce aerial stems, as well as new rhizomes. Rhizome-producing plants can easily be propagated in spring or summer by digging up an old clump and cutting the rhizome into pieces, each of which has a bud. Such pieces are capable of producing new plants.

Summary

Seed propagation of annual vegetables and flowers is generally best left to reliable seed companies which can provide the best, highly productive, disease resistant varieties for your garden.

Soft-stemmed perennial flowers and vegetables in your garden can readily be multiplied so that they retain variety characteristics, by separation or division of clumps, or by specialized plant parts

such as bulbs and tubers. Propagation of trees, shrubs and woody vines usually requires more skill than does propagation of soft-stemmed perennials. An exception occurs in species where varieties are not involved, in which case they can usually be seed propagated relatively easily.

Layering of woody perennials is a fairly simple process, while graftage is much more complicated and less certain. The average gardener would probably be wise to buy grafted plants. It is worth the investment, since they will last for many years, given good care. If you are one of the more avid gardeners, you may find it challenging and rewarding to learn how to root cuttings or use the more difficult grafting techniques for the propagation of trees and shrubs. Grafting several varieties of apple on one tree can be fun, once you've developed the necessary skill.

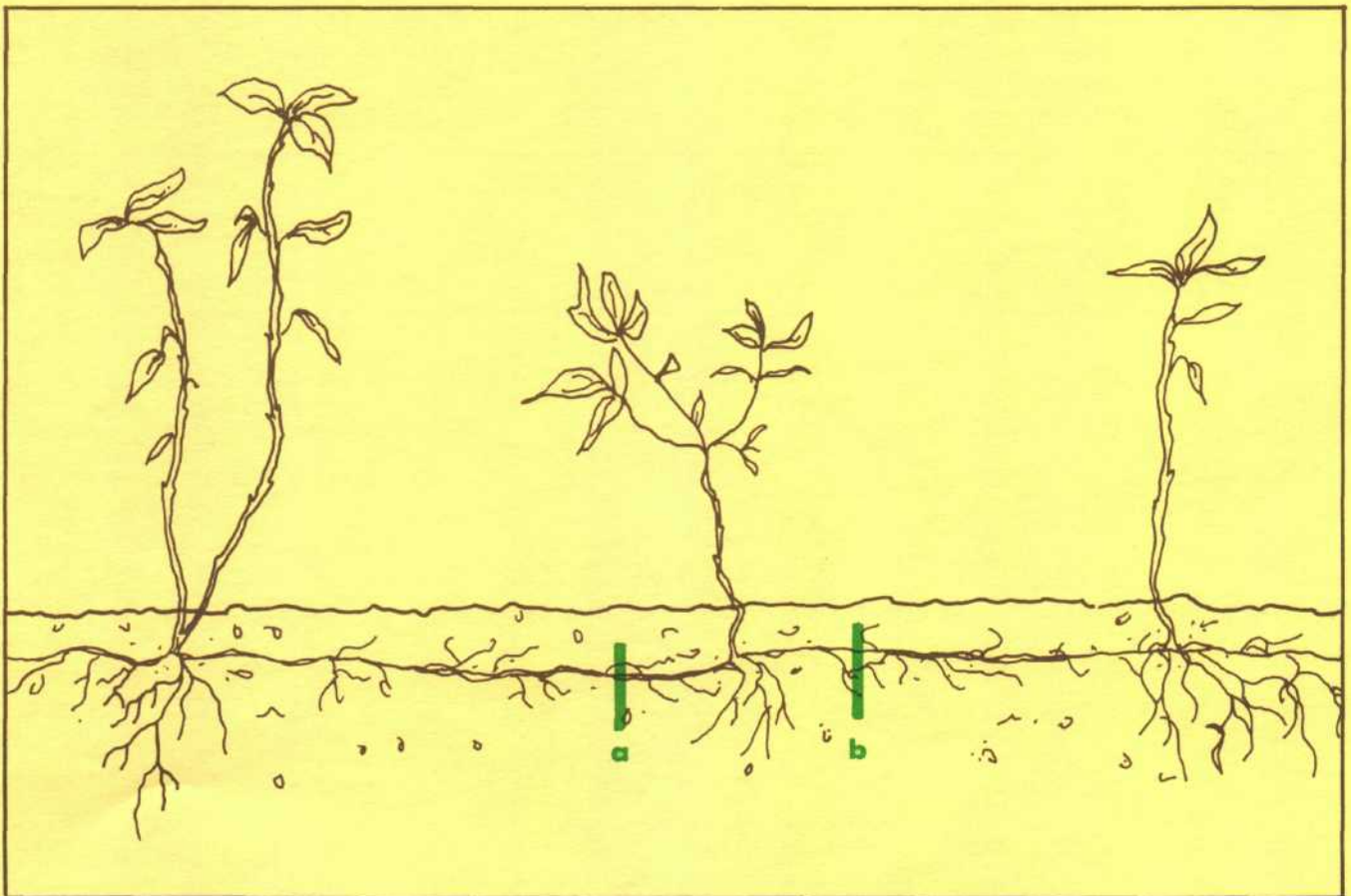


Fig. 11—Suckers (red raspberry)

Suckers are stems that develop from roots at the base of or at some distance from certain trees and shrubs. Suckers can be dug up and separated from the roots of the

parent with cuts at (a) and (b) late in the spring of the season during which they develop, or in the following spring.

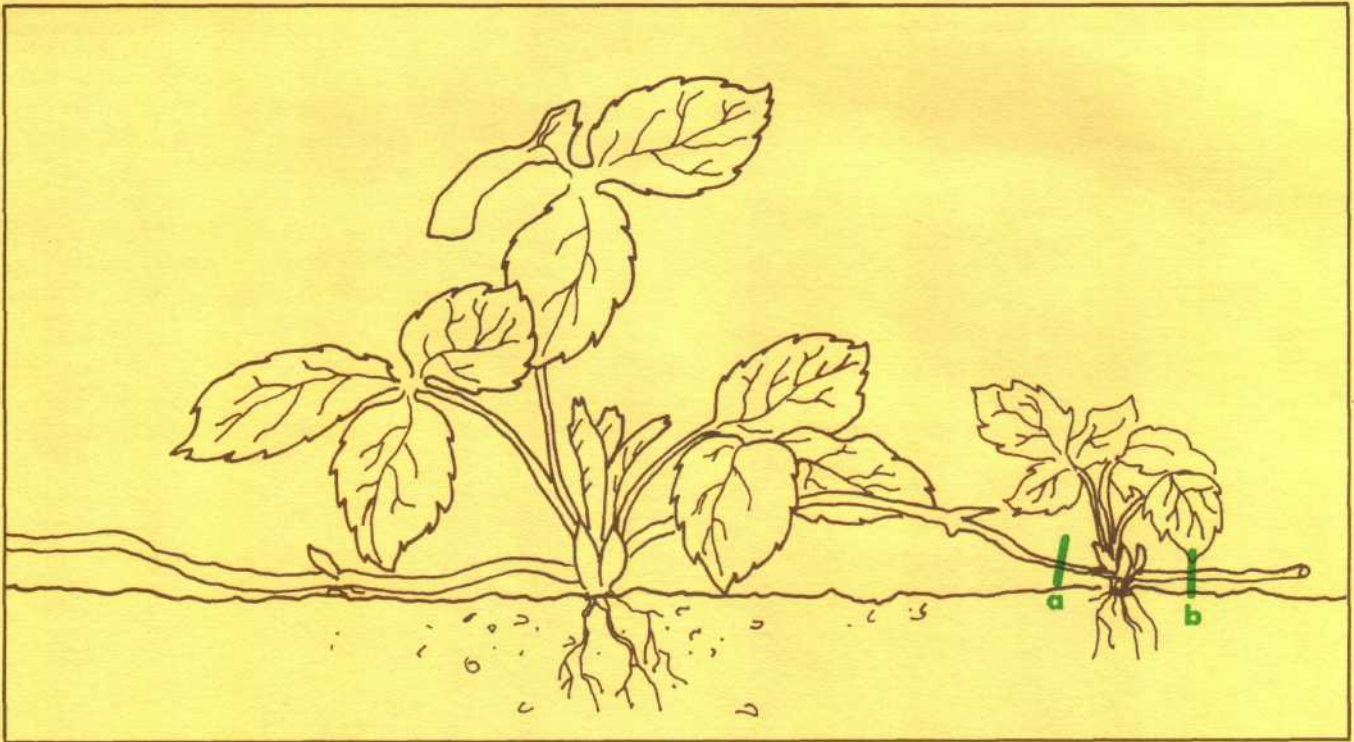


Fig. 12—Runners (strawberry)

Slender horizontal stems, called runners, lay on the ground and enable plants like strawberry to spread. Runners terminate with plantlets which may form new

runners. Each plantlet can be separated from the rest of the plant by cutting the runner at (a) and (b).

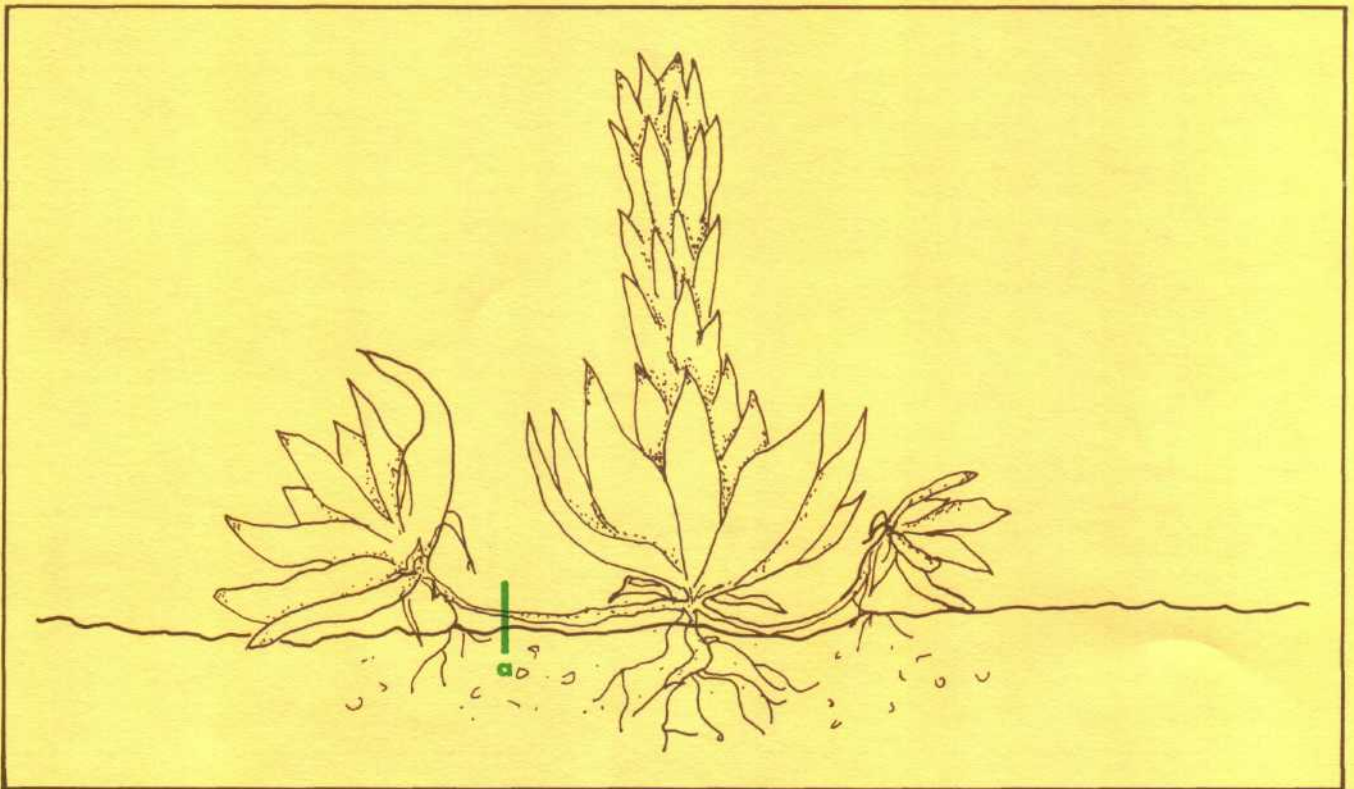


Fig. 13—Offsets (hen-and-chickens)

Some species develop very short, slender horizontal stems terminating in plantlets called offsets. The new

plantlets, or offsets, can easily be cut from the mother plant at (a) and replanted.

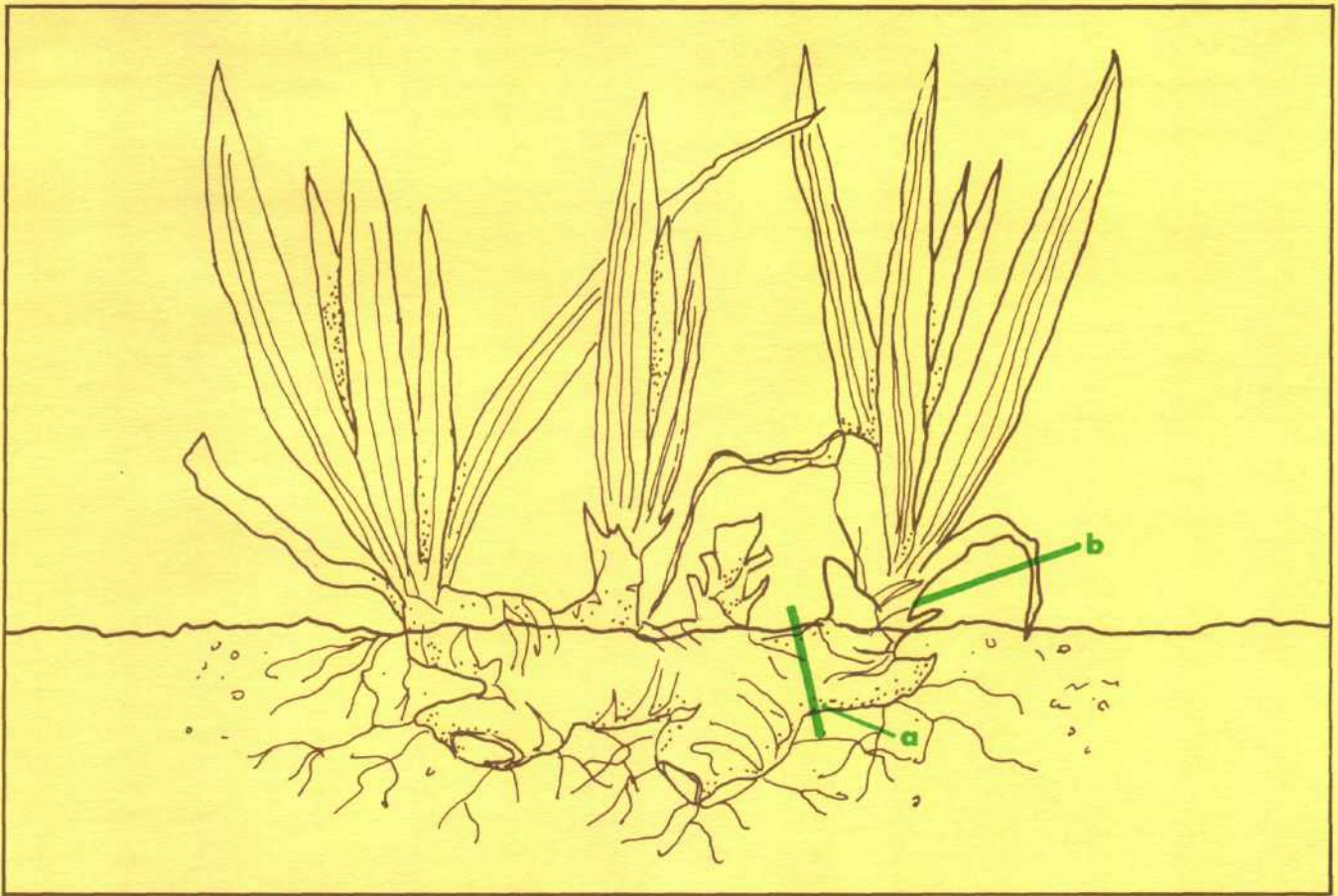


Fig. 14—Rhizomes (iris)

Horizontal, often branched, usually enlarged, fleshy stems by which some plants spread. These develop partially or entirely underground, and are easily divided

by digging up the plant and cutting (a) the rhizome into pieces. Each piece should have at least one or two buds or shoots (b).

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