

Landscape Plant Propagation Workbook: Unit II. Propagation by Cuttings¹

Dewayne L. Ingram²

This is one in a series of educational units presenting the basic principles of landscape plant propagation. This workbook is intended to be used in conjunction with a video taped presentation on using cuttings for plant propagation in the landscape plant industry. There is more detailed information in this publication than can be covered in the video presentation and additional sources of information are listed. Study questions designed to provide a review of important points are included.

Rooting of cuttings, a type of asexual or vegetative propagation, is the most common means of propagation in the landscape plant industry. It is the simplest way to be assured that the propagated plant has the same characteristics of the parent plant. Many plants in the nursery industry are clones, which means they were vegetatively propagated from a single plant. Therefore, to ensure continuation of the clone, these plants are propagated by cuttings. Some plants such as *Juniperus conferta* 'Blue Pacific' do not produce viable seed and can only be propagated asexually. Propagation by cuttings usually results in plants of saleable size faster than seed propagation, especially when large cuttings can be successfully

rooted. More plants can usually be propagated from a single plant by seed, and this could be important if cutting material is limited.

Root initiation and initial development occurs inside the stem, leaf or root before roots are visible on the outside of the tissue. Root formation is independent of callus formation on the base of cuttings. Callus formation in a plant is a normal process to cover a wound and is a different process than root initiation and development. Excessive callus formation can physically restrict emergence of developing roots.

Unit Objectives

At the conclusion of this unit you should be able to do the following:

1. Present advantages and disadvantages of propagation by cuttings.
2. Define and explain the importance of physiological age of cutting wood.

1. This document is CIR 724, one of a series of the Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date November 30, 1986. Revised June 29, 2004. Reviewed April 1993, June 2004. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.

2. Dewayne L. Ingram, former Professor, Environmental Horticulture, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville FL 32611.

3. Examine the characteristics of auxins, the primary plant hormones involved in root initiation and development.
4. Outline steps and procedures involved in propagation by cuttings.
5. Describe methods and materials for environmental modifications during propagation.
6. Present techniques for proper pruning during propagation.
7. Present techniques for post-rooting care of liners produced from cuttings.

Propagation Methods

Cutting Types

Cuttings are taken from either stems, leaves or roots. Stem cuttings can include the tip with terminal bud or they can be taken from secondary sections of the stem. Some plants can be propagated from either, but many plants root best from tip cuttings. Sections of leaves may be cut and stuck in propagation media, as in the case of *Sansevieria*, or the entire leaf of plants such as *Begonia* may be wounded and placed flat in contact with propagation medium. Cuttings composed of sections of stem with a single leaf and the associated axillary bud are called leaf-bud cuttings and are used with some herbaceous tropical plants to maximize the number of cuttings taken from a single plant.

Root cuttings are used infrequently in the nursery industry because of the labor required in taking the cuttings and the fact that plants produced from root cuttings may not be true to type or may have characteristics different from the parent plant. *Rhus*, *Rhododendron*, *Carya*, *Malus* and *Hibiscus* species are among the plants that can be propagated from root cuttings.

Age of Cuttings

The physiological age of cuttings greatly affects the rooting success. It is more appropriate to discuss optimum age of cutting wood in terms of physiological age rather than time of year. This is

because many landscape plants produce multiple flushes of growth during a growing season or year, and cuttings of a particular physiological age will be present several times per year. The time of year is important when considered in relation to root development before cold weather, day length or flowering period. Cutting wood is usually characterized as softwood, semihardwood or hardwood.

Softwood and semihardwood cuttings are taken from current season's growth. The softwood cutting is quite succulent or soft, since there has not been adequate time for development of dense wood. Tissue of softwood cuttings will usually collapse when bent and not snap or spring back when released. Semihardwood cuttings are more mature but are not woody. Many woody plants are propagated from semihardwood cuttings. Semihardwood is usually characterized by a snap when bent; the tissue is firm enough to stay intact when bent, but not woody enough to spring back.

Hardwood cuttings are generally thought of as last year's growth, whether the cuttings are taken just before or during the dormant period. Many deciduous plants can be propagated in the winter months from hardwood cuttings. Hardwood cuttings are mature enough to spring back when bent and released.

Rooting Hormones

Auxins are hormones produced primarily in plant shoot meristems that stimulate root initiation and development. Auxins are transported down the stems to other plant parts. The concentration of auxins in plant tissue at any one time differs from plant to plant, and with tissue maturity, the time of year and the growth environment. The primary auxin produced in the plant is indoleacetic acid (IAA), but there are synthetic auxin-type compounds that stimulate rooting. Synthetic auxins can be added to the base of cuttings to elevate the auxin concentration above the threshold level for optimum rooting.

The two most common synthetic auxins are indolebutyric acid (IBA) and naphthalenacetic acid (NAA). Although NAA is usually used in combination with IBA, NAA by itself is not extremely useful. These materials can be obtained

from nursery supply companies and chemical supply companies, or through advertisements in nursery trade magazines. Prepared formulations are available if propagators do not wish to make their own rooting preparation, but the concentrations available may not be the optimum for many plants.

IBA and NAA are marketed as reagent-grade white powders or as potassium or sodium salts of these chemicals. The pure grade of these chemicals is relatively insoluble in water and must be dissolved in alcohol before adding water. The lower concentrations of these compounds (100 to 10,000 ppm) will remain in solution at room temperature if the solution is only 25 percent alcohol. With concentrations greater than this, the solution must contain near 50 percent alcohol. This is important because alcohol concentrations greater than 50 percent in liquid formulations have been reported to injure the base of some cuttings.

Salts of IBA and NAA are soluble in water and little or no alcohol is required. The salts are more expensive than the pure compound and are less effective on weight basis. The potassium salt of IBA is only 75 percent as active as the pure compound, and the sodium salt of NAA is 90 percent as effective as pure NAA. This means that 1.33 times as much potassium salt of IBA is required to do the same job as IBA, and 1.12 times more sodium salt of NAA is required than NAA.

Auxin solutions can be stored for relatively long periods of time if kept in a refrigerator at 40 to 45°F and not exposed to light. The activity of auxins and auxin-like compounds is reduced by prolonged exposure to light. Amber bottles or clear bottles wrapped completely with aluminum foil are suitable containers. Solutions should be at room temperature before use. This is necessary because the rooting compounds may not be completely dissolved at lower temperatures and the solution would be less effective. Propagators may consider mixing the quantity of solution needed for a day to eliminate the need for refrigeration or the time necessary for solutions to warm to room temperature before use. Do not contaminate the stock solution by pouring used solutions back into the stock solution.

Stock Plants

Cuttings can be taken from production plants, from stock plants maintained as a cutting source, or from plants in a landscape planting. The health and vigor of stock plants are extremely important, because problems brought into the propagation area are usually multiplied or magnified, resulting in inferior liners. Therefore, taking cuttings from plants outside the propagator's control is not advisable and could result in liners of less than desirable quality.

Stock plants should be monitored for systemic diseases such as root rots and insect infestation. These pests can be transmitted easily from the parent plant to the cutting, even though the symptoms may not be evident on cuttings from the parent plant. The stress on the cutting during propagation and the ideal environment for disease and insect development can result in symptom development in propagation or during hardening after rooting.

Proper nutrition and care of stock plants must be provided because care and nutrition affect the success of rooting as well as the initial growth of rooted cuttings. The proper rate of fertilization must be applied at the optimum frequency and the balance of nutrients in the fertilization program is also important. Periodic pruning or tipping of stock plants can result in improved cutting material in some species.

Taking and Preparing Cuttings

Cuttings with the desired characteristics and of the proper age should be selected from the stock plants. Cuttings from the portions of the plant canopy receiving higher light levels seem to root best. The position of the cutting on the plant can also affect growth after rooting. For example, stem cuttings from lateral shoots of Norfolk Island pine will always grow laterally and result in an unmarketable plant.

The optimum size of a cutting differs with the species and the time of year. Generally, a semihardwood stem cutting from a woody plant will be 4 to 6 inches long, but larger cuttings are possible for some plants. The proper length of root cuttings will vary with cutting diameter. Two- to 4-inch sections are acceptable for root cuttings 1/2 to 1 inch

in diameter, while smaller root sections should be 4 to 8 inches long.

Cuttings taken in the field should be handled in such a way as to reduce water stress. Placement of cuttings in a moist grass or burlap bag works well. Keep the cuttings in the bag out of the direct sun and take them to the preparation or mist area as soon as possible. If preparation of the cuttings is delayed, store them in the mist area, in a shady, cool spot, or in a refrigerated cooler. The proper storage temperature will differ with plants, but a temperature of 45 to 50°F is suitable for most woody plants. Cuttings to be shipped should be moist but not wet and should be placed in a waterproof carton. Ice might be added to the carton if refrigeration is not possible.

Placing cuttings into the propagation medium is usually referred to as "sticking" the cuttings. The cuttings can be prepared for sticking at the time they are taken or they can be transported to a preparation and sticking area. The most efficient schedule and location for cutting preparation depends on the overall production scheme of the propagator and on whether rooting hormones are to be applied.

The lower leaves are removed from stem cuttings to reduce leaf contact with the propagation medium, which would encourage foliar disease. Stem cuttings should be cut to approximately the same length to aid in development of a uniform crop of liners. Rooting hormones are best applied just prior to sticking the cuttings into the propagation medium. The bottom 1/2 to 3/4 of an inch of the cutting stem is dipped into the hormone concentration in talc or liquid. This will assist in obtaining a better distribution of roots on the cutting.

Sticking the Cutting

The cuttings are stuck into the medium only deep enough to support the cuttings and hold them upright, even in somewhat windy conditions. Generally, stem cuttings are stuck to a depth of 1/2 to 1 inch. Root cuttings are generally pressed into the surface of the propagation medium and covered lightly. The base end of the cutting should always be inserted down into the propagation medium. While this is obvious with stem tip cuttings, it may not be so obvious with secondary stem or leaf cuttings. The proper selection

of a propagation medium is extremely important; the basic principles of container media were presented in Unit I of this series, Landscape Plant Propagation Workbook: Unit I. General Principles of Plant Propagation.

There are many different containers and beds in which to place the propagation medium and stick the cuttings. Generally, cuttings stuck in beds or flats are stuck quite densely and must be removed as bare root liners soon after rooting. The length of time rooted cuttings can be left in a container or flat depends upon the rate of root and shoot growth and the density of sticking. Generally, liners that are harvested bare root are moved into production containers or the field without delay. Delays can reduce liner survival and quality. Thus, the time of year in which bare root liners can be transplanted in the southern states is limited. Transplanting most woody plants as bare root liners is not recommended during extremely hot and dry months.

Liners produced in containers can be transplanted during hotter and dryer conditions than those required for bare root liners. The roots are undisturbed and the propagation medium remains intact to provide protection, water, air and nutrients to the liner during transport and establishment. Production of liners in containers is recommended if they are to be sold and transported to other nurseries.

Environmental Modifications

The environment must minimize stress of the cutting during root initiation and development. This is best accomplished with near 100 percent relative humidity on or surrounding the leaf surface to minimize water loss from the cuttings.

Such an environment is commonly provided by intermittent mist that showers the cutting with fine water droplets on some regular schedule or when a sensor indicates the leaf surface is dry. The optimum mist interval and duration depend upon solar radiation, wind and air temperature. The mist should be applied just as the film of water on the leaf surface dries. The ideal duration of each mist will just moisten the leaf surface without applying enough water to keep the propagation medium too wet. A

mist system normally is programmed to provide mist from sunrise to sunset.

It is important to observe the propagation area frequently, because if the mist system malfunctions, a cutting crop could be lost in a few hours. There are some safeguards to help prevent such a loss. The electrical solenoid valve could be in a normally "on" mode and the electricity would turn the valve off during the times between mists. This would mean that during an electricity failure the mist would remain on and not allow the cuttings to desiccate. Of course, this is assuming the water pump has an auxiliary electrical source. A battery-powered alarm is another safeguard that could be installed to warn of a power failure or an equipment malfunction.

Pruning

Plants may require pruning while in the propagation area to develop desired and uniform growth habit. The number of prunings depends on the plant and the length of time between rooting and potting into production containers. Many plants should be pruned at the time of potting to develop the desired branching habit. It may be most efficient to prune these plants in the propagation area before potting.

Post-Rooting Care

As soon as roots emerge they can absorb nutrients. Therefore, fertilization must begin in the propagation phase of production. The propagator can choose from many fertilizer methods, including liquid, soluble inorganic and several slow-release materials. Take extra precaution to keep the soluble salts in the desired range, 700 to 900 ppm. Over-fertilization can increase the soluble salts to a point where new developing roots would be burned.

Liners must be hardened before they are transplanted into larger containers and moved to the field. Hardening liners involves gradually altering the environment to be more like the environment to which they will be transplanted. Conditions in the field are typically more stressful, with more intense light, higher temperatures and less moisture. Therefore, the environmental conditions must be changed gradually from the relatively cool, moist

environment to conditions similar to those in the field. The interval between mistings is gradually lengthened, and mistings may be scheduled for fewer hours during the day. The light conditions should be gradually changed to approach field conditions. Proper hardening of liners will minimize transplanting shock and help decrease the time required for liner establishment in the production container.

Although the optimum procedures for rooting landscape plants differ with plant species and cultivars within species, the principles discussed in these materials can be applied to optimize propagation by cuttings. The procedures are more critical for some plants than others, but proper propagation practices will result in healthy, vigorous liners.

References

Hartmann, H. T. and D. E. Kester. 1983. *Plant Propagation Principles and Practices*. Fourth Edition. Prentice-Hall, Inc.: Englewood Cliffs, NJ.

International Plant Propagator's Combined Proceedings. Published annually since 1951 by The International Plant Propagators' Society, Inc.: P. O. Box 3131, Boulder, CO, 80307.