NebGuide

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Chip Budding: An Old Grafting Technique for Woody Plants With Rediscovered Advantages for Nebraska

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Chip budding is one propagation method used on woody plants. This NebGuide explains how to perform the technique and lists which plants can be successfully chip budded.

Chip budding is one of the primary grafting methods used for the asexual propagation of woody plants used to produce named cultivars (varieties) or clones of many ornamental trees, shrubs, fruit and nut trees. It is one of the two most popular budding systems used in nursery production, and it is the only budding system that can be done on rootstocks (stocks) that have either active or dormant vascular cambiums.

For successful chip budding, you must have:

- a compatible stock plant (rootstock) of the same genus and species as the cultivar, with at least a 1/2-inch (12 mm) stem diameter with an active or dormant cambial growth;
- mature "resting" buds, preferably in a quiescent condition from the superior cultivar/clone, for grafting onto the same species as the rootstock;
- a sharp grafting or budding knife that will maintain a razor sharp edge; and
- proper wrapping material that will tightly hold the bud in place on the rootstock, prevent desiccation, and keep excessive moisture from soaking into the bud union.

The chip budding technique is now preferred over the T-budding method for many woody plants. The benefits of chip budding include:

- Any professional or amateur propagator can learn this relatively simple grafting technique with a little practice.
- The technique is quick to do, a high percentage of the buds grow, and scionwood is conserved. Each lateral bud on the cultivar scionwood or budstick is a potential new plant.
- It can be used in nursery budding, bench grafting, container budding, and top working in orchards.
- It works well in regions of the world with shorter growing seasons and cooler night temperatures (including the central and northern United States), and it is an effective way to extend the regular budding season (April through September).
- Chip budding can be started in April in Nebraska (Climate Zone 5 [Z5]) instead of having to wait until May, as with T-budding, for active cambial (slipping) growth to occur.
- Chip budding in late summer (August through September) with current growing season's "resting" mature buds give excellent results when the rootstocks' cambiums are not active (Example: grapes).
- The propagator can perform chip budding anytime during the growing season rootstocks with active or dormant cambiums, whenever mature "resting" buds are available, giving a longer production "window" (Example: roses).
- Chip budding has better takes (success) with a stronger and superior union between the rootstock and the scion, and the new vigorous growth from the scion bud is straighter with more uniform tree growth than with the T-budding method.
- The chip budding technique assures cambial contact between the scion bud and the rootstock; however, it requires more skill in that the propagator must match the cambiums of the scion bud and the rootstock.
- Anatomical studies have compared the two main budding techniques and showed that chip budding heals more rapidly and with a more complete union of the xylem and the continuous cambial tissues than did T-budding.
- Mechanized budding machines can easily perform chip budding techniques.
- A wide variety of plant species of fruit and nut crops and ornamental plants can be chip budded, as well as thin-barked species that do not T-bud well. See page 4 for a list of these plant species.

Selecting Budwood/Scionwood for the Budstick

Growth from the current season should be collected for budwood from mature shoots of the desired cultivar. When selecting budwood from woody plants, choose vigorous shoots that have developed a terminal bud. These shoots will usually

have mature lateral buds in each leaf axil by mid-June in the Midwest United States (Zone 5). Cut off 12 to 24 inches (30 to 70 centimeters) from mature sections of the branch from the superior cultivar.

In order to prevent moisture loss in the scion(s), immediately remove the leaves from the budstick(s) by clipping them off and leaving a short length of the petiole below the bud. Place them in a labeled plastic bag and transport them in a portable cooler. The budsticks or scions, wrapped in slightly moist paper (damp but not wet) and placed in a polyethylene (PVC) bag marked to identify cultivar name, should be refrigerated at 34° to 40°F (1° to 4°C) for only one to three days until they are used.

Dormant budwood is cut from dormant stock plants during the winter months (after leaf-fall and up to four to six weeks before bud break), with mid-March being the best time in the Midwest (Z5). This scionwood is also wrapped in slightly moist paper and stored in polyethylene bags in refrigerated storage between 30° and 32°F (-1° to 0°C) for two to three months until spring when the understocks are ready to bud. This practice allows the commercial grower a longer period to bud the crop since the new growth on the plants in spring seldom has mature enough buds for budding purposes until late June (Nebraska, Z5).

Fresh buds can also be used when the above types of buds are not available. Resting buds can be found on shoots a year old or more. Normally, such a bud is found on a leafless section of stem and is quite small, often somewhat flattened against the stem. In this case, budwood is prepared by finding a useable bud, then cutting off the shoot three to four inches (7.5 to 10 centimeters) above and below the bud. Such budwood should be sorted the same way as dormant scion wood, but it cannot be expected to stay in a useable condition for as long. Consequently, you should use these buds as soon as possible.

Preparing the Rootstock for the Chip-Bud

Select a rootstock with an area where the bud chip scion will be budded onto a stem that is of equal or greater diameter than that of the shoot (scionwood) where the bud chip will be taken. Remove any interfering plant materials growing on the stock's stem where the chip bud will be placed. Bud placement is preferred on the shaded side of the rootstock as this protects the bud from strong sunshine and sunscald and prevents desiccation. Clean this area by rubbing with a terry cloth or a towel to remove soil and sand adhering to the stem. Some propagators also clean the area with a 10 percent bleach solution (which contains one part bleach to nine parts water). Make sure the scionwood is also clean of soil and free of diseases and pests. Use rubbing alcohol to disinfect your grafting knife between buds from time to time. These precautions help prevent the spread of disease organisms and may help improve your grafting percentages.

Procedure for making chip bud knife cuts on the rootstock

Remove a chip of bark from a smooth place between nodes near the base of the rootstock/stock (4 to 6 inches [10 to 15 centimeters] above the soil line) and replace with a scion chip of a slightly smaller size and shape from the budstick that contains a bud of the desired cultivar *(Figure 1, A through D)*. The knife cuts in making the chips on both the rootstock and budstick are identical. Knife cuts should be made with a single, smooth stroke of the knife, starting at the base of the knife blade and finishing near the tip. Whittling, sawing or forcing the same spot on the blade through the entire cut will result in an uneven cut surface and will reduce your success rate. The first cut is made downward in the side of the stock through the bark and shallowly with the knife held horizontally so that the bottom of the cut is about inch (3 millimeters) deep at a 45° angle from the bark toward the pith of the rootstock to form an acute lip (*Figure 1, A)*. This first cut is about 1/2 inch (12 millimeters) across. Withdraw the knife and make a second cut about 1 to 1 1/2 inches (25 to 38 millimeters) above the first cut. Cutting downward to meet the first cut, and the piece of wood will be released *(Figure 1, B)*. Next, remove the chip of stem tissue, leaving a cut shaped like an "∩" *(Figure 1, B).*

Preparation of the bud scion chip

Holding the budstick, make the first horizontal cut below the scion bud about 1/4 to 1/2 inch (6 to 12 millimeters) down into the wood beneath the bud at an angle of 30° to a depth of inch (3 millimeters) deep *(Figure 1, C)*. Start the second cut about 1/2 to 1 inch (12 to 25 millimeters) above the scion bud, cutting shallowly inwards and downward behind the bud *(Figure 1, D)* until it intersects the first cut, thus releasing a bud chip *(Figure 1, D).* The propagator can reverse the order of these scion bud cuts. Cut surfaces will dry very rapidly, especially on the scion chip bud. If the cut surface of the scion bud dries, the survival of the scion will be low. Try to have the chip bud placed on the rootstock within five to 10 seconds from the time you started to make the first cuts. Very few beginning propagators work this quickly while achieving smooth cuts. An alternative that works very well is to cut the scion bud first and immediately place it cut-side down on your tongue. Store it in your mouth while preparing the rootstock cuts. A scion bud can remain viable for hours in a propagator's mouth. Saliva is harmless to the bud and the plant's sap is harmless to the propagator unless a toxic pesticide has recently been applied to the plant. It might be possible to lay the precut scion bud on a damp sponge rather than placing it on the tongue. Dehydration of the cut curfaces can also be prevented by budding in a cool shaded area, early or late in the day and on a cloudy, humid day.

Remove the wood chip from the rootstock and replace it with the block-like chip with a scion bud from the budstick *(Figure 1, B, D and E)*. Hold the chip bud carefully between your thumb and forefinger. *Do not touch the cut surfaces!* The bark on the rootstock is generally thicker than that of the scionwood; therefore, the chip removed for the rootstock is slightly larger than the chip removed from the scion. The cambium layers of the bud piece must be placed to coincide with that of the stock, preferably on both sides of the stem, but at least on one side. **Note:** Placing the bud to one side in order to match the cambium of the stock defeats the concept of healing and completing the cylinder of cambium. Take the extra time to match the stock and scion by cutting the chip-like cuts on the stock shallower or deeper.

Firmly wrap the chip bud to seal the cut edges and to hold the bud piece tightly in place. This also enhances cambial contact since there are no protective flaps of bark to prevent the bud piece from drying out as with T-budding. Polyethylene film (poly tape) or precut poly strips from plastic bags works well for this and are superior to rubber strips, parafilm, budding bands, and patches. Most propagators prefer to use white or transparent plastic tapes. Poly tape that is 1/2-inch (12 millimeters) wide, two-mill (.002 gauge) in thickness and approximately 6 to 8 inches (15 to 20 centimeters) is used to wrap the graft union. One can also improve bud

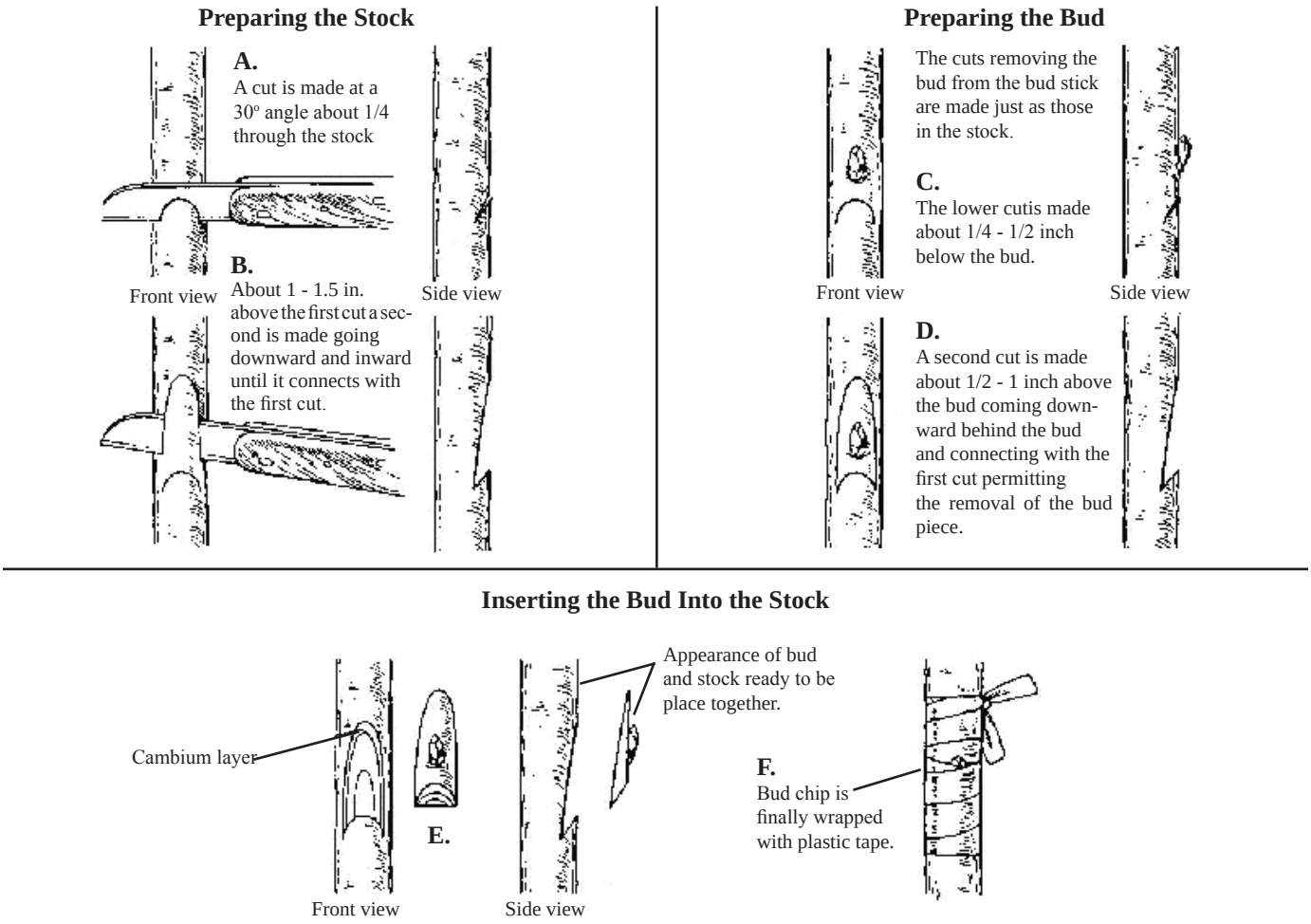

Figure 1. Chip Budding is widely used in propagating woody ornamentals and fruit trees. The bud piece is cut as shown here and covered completely with poly tape. Sometimes the bud is not completely covered (Kester, et al, 2002).

takes by covering the scion bud with this poly tape. Be sure to immediately wrap all cut surfaces to prevent desiccation. **Caution:** When using rapidly growing rootstocks, degradable budding bands (rubbers) that do not cover the actual bud works best. Parafilm can be placed over the budding band and bud for added protection. The poly wrap should be quite firm, stretching the tape almost to the point of breaking. The pressure or tautness of the tying strips must be snug enough to prevent the formation of large pads of undifferentiated rootstock callus (parenchyma cells), between the scion bud (bark) and the rootstock's wood (xylem), which will hold the scion in place but does not form a successful union with the xylem and pholem vascular tissues. Always wrap from the bottom of the bud to the top so that each layer sheds rainwater from the layer below it like a shingle roof. Cover the bud completely but do not leave any of the bases of the petiole (a leaf stem) attached below the bud eye (leaf scar) uncovered. If exposed, these petioles will quickly rot and decay and may spread to the scion bud. Properly wrapping the chip bud is the most *essential step* in this technique to obtain success. It may prove inadvisable to wrap or tie over the actual bud of some species, i.e., cherries, walnuts and pecan, particularly when the bud is very large and prominent. Do not cover buds with grafting wax. Thinly stretched parifilm can be used as a covering over the bud of the chip, providing it is only one to two layers thick and stretched. Parafilm permits a young, healthy bud to emerge through the film.

Care of the chip budded plants

Buds that are forced into growth in late summer do not have sufficient time to harden off before winter and are subject to damage by winter cold (Z5). The only thing to do is loosen the ties (later summer or fall) as the stem grows in girth (diameter) during September and October. In the spring of the next growing season, remove the top of the stock plant about 1 inch (25 millimeters) above the inserted bud (often referred to as a bud union).

Although budding bands and polyethylene tape are reported to decompose and generally do not need to be removed when T-budding, studies have shown that they must be removed when chip budding because binding or girdling of fast-growing stock plants may occur within one month. When the newly inserted bud begins to grow after forcing, some pruning and training may be necessary, especially on field grown plants. This will allow a stronger union to develop; otherwise, strong winds may cause the new vegetative growth to break off at the bud union. Vigorous new scion growth may need to be staked for proper training and upright growth.

Remove any new growth arising from below the bud union on the rootstock at the point of origin. This type of new sucker or water sprout growth may in time overgrow and dominate the grafted scion bud's growth, resulting in stunting or even loss of the desired cultivar.

A successful propagator needs to know how to perform the specialized techniques of budding and grafting woody

plants as well as the proper timing of such operations. However, even more important is the horticultural care given to the stock and rootstock plants one year prior through one year after performing the propagation technique (i.e., proper irrigation, fertilization, weed control and plant training and pruning). Rootstock plants grown under proper irrigation (normal rates) will bud easier, the bud union will heal more completely and these scion buds will force more successfully into new growth than plants grown under drought conditions. Use stakes to ensure that the growth from the scion buds will be straight upright growth. Straight stems/trunks are essential to the growth of high quality budded stock. To ensure top quality budded plants; it is essential to remove unwanted sprouts from below the bus union on the rootstock. To grow high quality budded plants one also needs to consider proper fertilization and weed control.

A propagator new to this technique should start on a small scale until they become familiar with what to expect, how the buds grow, how fast the shoot growth develops, and the time that is needed to properly train the new budded plants.

Plant species that can be chip-budded:

Actinidia (*kiwi*)
Almonds (*Prunus*)
Apples (*Malus*)
Apricot (*Prunus*)
Ash (*Fraxinus*)
Avocado (*Persea*)
Azalea (*Rhododendron*)
Birch (*Betula*)
Blackgum (*Nyssa*)
Buckeye (*Aescalus*)
Cherry (*Prunus*)
Chestnut (*Castanea*)
Cotoneaster (*Cotoneaster)*
Dogwood (*Cornus)*
Elm (*Ulmus*)
Ginkgo
Grape (*Vitus*)
Hackberry (*Celtis*)
Hawthorn (*Crataegus*)
Hazelnut (*Corylus*)
Hollies (*Ilex)*
Bean tree *(Laburnum)*
Linden (*Tilia*)
Locust (*Gleditsia*)
Macadamia
Magnolias
Mango (*Mangifera*)
Maples (*Acer*)
Mountain Ash (*Sorbus*)
Mulberry (*Morus*)
Oaks, English (*Quercus*)
Osage Orange (*Maclura*)
Pawpaw (*Asimina*)
Peaches (*Prunus*)
Pears (*Pyrus*)
Pecan (*Carya*)
Pistachio (*Pistacia*)
Persimmon (*Diospyros*)
Quince (*Cydonia*)
Redbud (*Cercis*)
Rhododendron
Rose (*Rosa*)
Saskatoon (*Amelachier*)
Serviceberry (*Amelanchier*)
Sweetgum (*Liquidamber*)
Walnut (*Juglans*)
[Bulman, 1989]

Budding/Grafting Supplies

Parafilm M™, Laboratory Film, American National Can, Neehah, WI 54956

Grafting knives, tools and supplies, A. M. Leonard Co., 241 Fox Drive, Piqua, OH 45356, 1-800-543-8955, **www.amleo.com** E-mail: **custserv@amleo.com**

Budding Supplies, Wilson Irrigation and Orchard Supply, 1104 E. Mead, Wilson, Yakima, WA 98903, Tel.: 800/232-1174 or (509) 453-9983, **www.wilsonirr.com** E-mail: **roger@wilsonirr.com**

Chip Budding Tape, Raintree Nursery, 391 Butts Road, Morton, WA 98356, Tel.: 360-496-6400, **www.raintreenursery.com** E-mail: **info@raintreenursery.com**

References

Bremer, A.H. 1977. Chip budding on a commercial scale. Comb. Proc. Intl. Plant Prop. Soc. 27:366-67.

Buley, N. 1983. Seven Oregon nurserymen share their grafting and budding techniques. American Nurserymen. March vol: 65-73.

Bulman, J. 1987. Tree improvement (black walnut). Iowa's conservationist. 46(9): 31- 32.

Garner, R. J. 1993. The grafter's handbook. The Royal Hort. Soc. Cassell, London, NJ 07458

Harmon, F.N., and J. H. Weinberger. 1969. The chip-bud method of propagating vinifera grape varieties on rootstocks. USDA Leaflet 513.

Howard, B.N. 1977. Chip budding fruit and ornamental trees. Proc. Intl. Plant Prop. Soc. 27:357-364.

Kester, D.E., F.T. Davies, Jr., and R. L. Geneve. 2002. Hartmann and Kester's plant propagation: principles and practices. 7th ed. Prentice Hall, Upper Saddle River

Macdonald, A.B. 1986. Practical woody plant propagation for nursery growers. Timber Press, OR.

McDaniels, J.C. 1985. Chip budding for propagating trees and shrubs. KY Nut Growers Assoc. Newsletter. The Nut Kernel. Summer vol.: 2-3.

Manners, M. 2001. Tips for successful budding. **http://www.texas-rose-rustlers.com/budding.htm**

Osborne, R. H. 1987. Chip budding techniques in the nursery. Comb. Proc. Intl. Plant Prop. Soc. 36:550-55.

Tubesing, C. E. 1988. Chip budding of magnolias. Comb. Proc. Intl. Plant Prop. Soc. 87: 377-379.

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