

ROOTING HARDWOOD CUTTINGS WITH BOTTOM HEAT

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At L. E. Cooke Co., a wholesale nursery located in the San Joaquin Valley of central California, the use of hardwood cuttings allows a quick and uncomplicated means of clonal propagation for trees, shrubs, understock, and grapes. Due to their quick callusing properties and rapid root initiation, plants such as poplars, willows, and pomegranates can be direct stuck as uncallused hardwood cuttings in the spring. Marianna plum, an understock for stone fruits, is planted as uncallused cuttings also. Planting in late November allows the Marianna cuttings to callus and initiate roots in winter months so shoot growth commences early in the spring.

Grape hardwood cuttings are buried upside down, in moist sand for two months to allow callusing, and often initiation of roots, prior to planting. The sun warms the two to three in. of sand covering the basal ends of the cuttings, enhancing callusing. This method of burying the cuttings upside down in sand is also used, sometimes in combination with hormone treatments, for figs and sycamores.

London plane sycamores generally callus adequately in the sand pits to allow acceptable rates of establishment in the field. Other sycamore species, such as Yarwood sycamore, oriental sycamore, California native sycamore, and Arizona native sycamore, are slower to callus and are more difficult to establish as hardwood cuttings. The latter two species do not require clonal propagation to insure blight resistance, as is the case with the Yarwood and Oriental and, as a result, the native sycamores are grown from seed as much as possible.

To enhance callusing and subsequent field establishment, bottom heat was tried on three sycamore species (Oriental, Yarwood, and Arizona native). Cuttings were made in late January and held in cold storage for three weeks. After hormone treatment (#8 Hormex, Dip N'Grow/water, diluted 1:6) and fungicidal dip (Captan) the cuttings were placed upright over electric heating cables buried 2 in. deep in sand. More sand was piled around the cuttings to about $\frac{1}{3}$ their height and some sand was placed on top of the bundles to cover the cut ends. The cuttings were kept covered by a simple box-like structure that was open at the sides to allow ventilation yet kept the cuttings shaded to keep air temperatures cool around the tops. Outside air temperatures during the time the cuttings were on bottom heat averaged 40°F minimum and 60 to 65°F maximum. Temperature at the base of cuttings was kept at 65° to 70°F by a thermostat.

The sycamore cuttings were left on the bottom heat for approximately four weeks until planting in the field. While no quantitative observation was made, visual comparison showed that the hormone powder treatment yielded the greatest callusing and root initiation on the Yarwood and Oriental sycamores while the liquid hormone yielded the most callus and root initiation on the Arizona native sycamore. No attempt was made after planting to differentiate survival among the different treatments but response was considered significantly improved over previous year's attempts at callusing in sand pits.

The use of bottom heat to callus hardwood cuttings prior to planting out was also used over several seasons on various shrub liners such as spirea (*Spiraea* sp.), desert willow (*Chilopsis linearis*), althea (*Hibiscus syriacus*), and cistena plum (*Prunus* × *cistena*). The extra effort was made to pre-callus cuttings due to some difficulty in getting good field establishment rates when planting late. Due to wet field conditions or lack of available equipment planting-out was sometimes delayed until mid-April. In the San Joaquin Valley temperatures of 100°F are not uncommon in April, and such conditions can stress and desiccate unrooted or poorly rooted cuttings, particularly if bud break has occurred. To prepare the cuttings, immediately after collection the cuttings were treated with hormone and placed on bottom heat in a method similar to that previously described for use on sycamores. When callus formation was judged adequate, generally requiring 7 to 28 days, the cuttings were taken off the bottom heat and put in sawdust in cold storage until field planting was possible. The callused cuttings demonstrated vegetative bud break and shoot development earlier than the uncallused control, and field establishment appeared to occur more rapidly. Large increases in rooting percentage were not apparent in easy-to-root species, such as althea and pomegranate.

Desert willow, spirea, and cistena plum showed greatly improved rooting percentages under our conditions.

General observations on the use of heating cables to callus hardwood cuttings:

—Sand media gave the best results (compared to peat/perlite or sawdust) in providing moisture retention and aeration.

—Uniform distance from heating cables to cutting bases insures more uniform callusing in the bundles.

—Fungicides minimize mold in the warm, moist environment at the cutting base.

—Both liquid and powder hormone treatments proved beneficial in combination with the bottom heat.