Vegetative Propagation of Rare and Unusual Conifers: An Alternative Approach

Kim E. Tripp
Arnold Arboretum, 125 Arborway, Jamaica Plain, Massachusetts 02130

INTRODUCTION

Vegetative propagation of rare and unusual conifers from stem cuttings serves diverse needs. At botanic gardens and arboreta these plants are grown for botanical study, ex situ conservation, and/or horticultural evaluation, and commercial distribution. Often, vegetative propagules are the first or only type of propagules available since, unlike viable seed, stems and shoots are available to collectors year round (i.e., whenever they may have the good fortune to locate the plants—especially when dealing with plants growing as small, isolated populations in remote areas). Vegetative propagation allows propagation of physiologically mature tissue resulting in whole, mature plants—which can greatly accelerate cone production in cultivation, either for taxonomic studies or seed production. Vegetative propagation may also be used as a back-up method when both seed and vegetative material are limited.

By definition, propagules of rare and unusual taxa are generally scarce and need to be multiplied before plants can be included in collections or distributed to other gardens or nurseries. In addition to the scarcity of the material itself, there is often an analogous lack of information as to how best to propagate the rare plant by vegetative means—either because it is new to cultivation, or it has not been routinely propagated to date using varied vegetative techniques. When propagation recommendations for rare conifers are available, they may be detailed for some taxa, but limited in critical detail, or even absent for others untreated at the time of publication (Fordham and Spraker, 1977). Reports may be of techniques that have been used successfully in a different climate (with different ambient light intensities, relative humidities, available substrate contents, etc.). Yet, the very scarcity of the material precludes the use of traditional, controlled, replicated comparisons of diverse propagation techniques to determine optimal methods. When faced with limited material of unfamiliar conifer taxa, an awareness of the plant's habitat can guide the selection of propagation treatments, increasing success rates significantly. This paper discusses and gives descriptive examples of this general approach.

AN ALTERNATIVE APPROACH

Amentotaxus, Austrocedrus, Callitris, Calocedrus, Cephalotaxus, Cupressus, Dacrydium, Fitzroya, Fokienia, Glyptostrobus, Keteleeria, Microbiota, Microstrobos, Phyllocladus, Podocarpus, Pseudotaxus, Saxegothaea, Taiwania, Thujopsis, and *Torreya* are some of the coniferous genera with rare or unusual species that can be propagated successfully by rooting stem cuttings (space constraints prevent discussion of all of these taxa but selected examples are discussed in the following section). Standard techniques may yield some success but I have found that minor but informed changes to routine procedure resulted in significant improvements in percent rooting and/or survival of rooted cuttings—improvements that may be critical to success in bringing the plant into cultivation.

When dealing with unfamiliar taxa, applying a few discriminately selected treatments to several small lots of cuttings offers the best likelihood for success. Rather than subject all of a limited quantity of wood to standard production techniques convenient in existing facilities, be prepared to alter season of harvest, media, bottom heat, and mist regimes to optimize propagation. For best results, adapt the system to the apparent requirements of the plant.

The challenge then becomes how to select a range of only a few treatments likely to succeed when dealing with limited quantities of wood—i.e., when traditional comparison studies of controlled, replicated treatments are impossible. Treatments selected after consideration of native habitat and specific growth and development characteristics have been determined can optimize results. In addition to the standard propagation literature, references and publications on habitat and biology for specific plants therefore become important sources when selecting propagation treatments. Avoid limiting treatment choices to only those detailed in existing propagation literature, i.e., avoid accidentally assuming any limitations imposed by an earlier technology and understanding of the plant's biology. A treatment that seems promising today in relation to current knowledge of plant habitat may be very different from any attempted in the past, yet it may ultimately be the one most successful in your region. The examples given below illustrate the general concepts of this approach as applied to selected rare and unusual conifers.

GENERAL METHODS AND EXAMPLES

The following list of examples illustrates how attention to the characteristics of a given plant's habitat in nature may optimize vegetative propagation of rare conifers by rooting of stem cuttings. Due to the small sample sizes necessitated by scarcity of propagation material, statistical analyses could not be performed on these results. Results, therefore, have been reported descriptively and any conclusions reached were necessarily circumstantial—as are any conclusions reached using small, unreplicated sample sizes. Results, however, showed useful trends, such that treatments which included the primary characteristics of a plant's native habitat always gave best results. For each example plant, a brief description of the plant, its primary habitat characteristics, and optimal propagation treatments, are given.

All cuttings were rooted in greenhouses using a range of standard treatments, depending on the plant. Comparisons were made of small quantities of cuttings allotted to each unreplicated treatment group (ca. 6 to 12, depending on availability). Not all plants were subjected to all treatment possibilities (see individual descriptions). Comparisons were made between season of cutting harvest (winter, after significant frost, vs. summer, after spring growth flush, or late summer, after some hardening); moisture retentive quality of the rooting medium (moisture retentive, perlite and peat [1 : 1, v/v] vs. well-drained, perlite and peat [3 : 1, v/v]); and degree of relative humidity as effected by intermittent mist regime (frequent, 6 sec every 6 min, vs. infrequent, 6 sec every 20 min). All winter harvested cuttings received bottom heat and no summer harvested cuttings received bottom heat. So that differences in rooting response would more likely be due to differences in environmental conditions, rather than an effect of hormone treatments, all cuttings were treated with KIBA at moderate concentrations in alcohol-free preparations (5000 to

8000 ppm, depending on the plant). All comparisons were made at one of two sites: either in Jamaica Plain, MA (USDA Zone 6b: Arnold Arboretum) or Raleigh, NC (USDA Zone 7b: North Carolina State University Arboretum). Cuttings were kept in treatments for 16 to 20 weeks, depending on the plant, after which time cuttings were lifted and percent rooting for each treatment was calculated. Cuttings were considered to be successfully rooted when at least one primary root was greater than 5 cm long. No comparisons between species were made.

Athrotaxis selaginoides is an evergreen tree native to a small area of Tasmania where it grows in a cool, moist, montane environment of very even moisture. Comparisons were made of winter and summer cutting harvests, and frequent and infrequent mist regimes, using a moisture-retentive medium. Highest percent rooting was obtained with winter-harvested cuttings and the frequent mist regime (i.e., cool, moist conditions).

Austrocedrus chilensis is an evergreen tree found growing in Chile and Argentina in the Andes region up to about 1500 m. It grows in both moderately moist and moderately dry areas, reaching the edges of the dry steppe in Argentina. Comparisons were made of summer and winter cutting harvests, moisture retentive and well-drained media, and infrequent and frequent mist regimes. Highest percent rooting was obtained with summer-harvested cuttings in either the well-drained medium with the frequent mist regime, or in the moisture-retentive medium with the infrequent mist regime (i.e., warm, with moderate moisture).

Cephalotaxus fortunei is a species of plum yew native to China. Plum yews are evergreen conifers superficially resembling true yews (*Taxus* spp.) but with significantly different reproductive biology and landscape performance. The genus is found in both cool and warm temperate climates in a diverse range of conditions. *Cephalotaxus fortunei* is found growing in nature in humid, warm-temperate and subtropical, low to middle elevation, understory habitats, on diverse moist substrates. Comparisons were made of summer and winter cutting harvests, moisture-retentive and well-drained media, and infrequent and frequent mist regimes. Highest percent rooting was obtained when cuttings were harvested in summer and rooted in the moisture-retentive medium under the frequent mist regime (i.e., warm, moist environment).

Fitzroya cupressoides is an evergreen tree reaching great heights in its native South America—analogous to those of *Sequoia*. *Fitzroya* is found growing in cool (not cold), moist, exceptionally uniform climates at middle to high elevations in Chile and Argentina. Comparisons were made of summer, late summer, and winter cutting harvests, and frequent and infrequent mist regimes, in a moisture-retentive medium. Highest percent rooting was obtained with late summer-harvested cuttings in the moisture-retentive medium under the frequent mist regime (i.e., uniformly moist environment with cooling conditions).

Fokienia hodginsii is an evergreen tree native to warm temperate and subtropical southeastern China with unique flattened foliage. Comparisons were made between winter and summer cutting harvests in moisture retentive medium with a frequent mist regime. Highest percent rooting was obtained with the summer cutting harvest (i.e., warm, moist conditions).

Keteleeria davidiana is an evergreen tree resembling true firs (*Abies* spp.) in appearance, native to southeastern and southwestern China. It is found growing in relatively hot areas with significant dry periods as well in areas with moderate moisture. Comparisons were made between summer and winter cutting harvests, moisture-retentive and well-drained media and frequent and infrequent mist regimes. Highest percent rooting was obtained with the summer harvest, using the well-drained medium and infrequent mist regime (i.e., warm, relatively dry conditions).

Saxegothaea conspicua is a large evergreen shrub or tree, native to South America where it grows in the cool, moist areas of Chile and Argentina at middle elevations. Comparisons were made between winter and summer cutting harvests, and frequent and infrequent mist regimes, in a moisture-retentive medium. Highest percent rooting was obtained with the winter cutting harvest and the frequent mist regime (i.e., cool, moist conditions).

Thujopsis dolobrata is an evergreen tree that grows for many years as a low shrub before eventually developing a leader and attaining heights of 15 to 20 m. It is quite shade tolerant and is found growing on deep, moist soils in central and northern Japan. Comparisons were made of winter and summer cutting harvests, moisture-retentive and well-drained media, and frequent and infrequent mist regimes. Best results were obtained with the winter cutting harvest, using the moisture-retentive medium, and the frequent mist regime (i.e., cool, moist conditions).

CONCLUSION

Vegetative propagation of rare and unusual conifers from stem cuttings benefits from a systematic approach to both the art and science of propagation. Determining successful propagation techniques becomes difficult when limited quantities of wood preclude traditional, replicated studies with a broad range of many treatments. Under these circumstances, informed selection of a few key treatments that account for the environmental conditions found in a plant's indigenous habitat can optimize results. Information on plant distribution and habitat therefore, becomes an important resource for this approach.

In general, English language regional floras can be especially helpful. Secondary references (e.g., Krussman) often cite primary references that give more detailed information on habitat. Manuals and expedition collection journals often publish the greatest detail on the specific microclimatic conditions associated with a given taxon. Another invaluable, but less accessible resource consists of the collection data recorded on herbarium specimens housed in research-oriented herbaria (such as those maintained at the Royal Botanic Garden, Edinburgh; Royal Botanic Garden, Kew; Harvard University Herbaria; and regional herbaria in the countries of origin). Selected references useful for uncovering specific information on given conifer habitats are listed following the literature cited.

Finally, conifer cuttings have the unique attribute of retaining viability for a much greater period of time than those of other plant groups. As a result, it is possible to successfully root conifer cuttings that have been subjected to a second round of treatments even when the first has failed to induce rooting. Green, vigorous cuttings can be lifted, the callus trimmed and/or wounded, and cuttings restuck in fresh medium. Cuttings can then be subjected to a different set of potentially more favorable treatments and conditions. This attribute, unique to conifers, is especially valuable when dealing with limited quantities of wood of rare conifers. This persistent approach recently led to the successful rooting of stem cuttings of the rare species *Torreya jackii* at the Arnold Arboretum. When rooting stem cuttings of rare conifers, persistence combined with informed selection of propagation treatments is often rewarded with success.

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