Important Considerations for an Arboretum Propagator

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When one considers what is unique about an arboretum, the wide array of interesting plants quickly comes to mind. These plants are often unusual or very rare—frequently they are magnificent old specimens with a character all their own. Although the types of plants being grown and tested at an arboretum may vary with the institution's mission or region of the country, displaying a wide diversity of plants is central to most.

Because of the richness and diversity of arboretum collections, the propagation and production of these plants frequently present special challenges to the propagator. In many ways, propagating plants at an arboretum is unique. The work is:

- Highly diversified: a large variety of different plants are grown, although the number of plants per lot is typically rather small.
- Specialized: often plants are unique or rare, possessing unusual characteristics, such as variegated foliage or dwarfness.
- Challenging: often stock plants are aged and frequently in a declining condition; seeds may vary significantly in their trueness-to-type and viability.

Some of these challenges may also be encountered by the commercial nursery propagator who grows "specialty" plants. The purpose of this paper is to highlight the unique characteristics of arboretum plant propagation and production, and propose methodologies and practical solutions to help the propagator to be more successful.

DIVERSITY OF PLANTS

Diversity is both a blessing and a curse of propagating at an arboretum. Growing a wide variety leads to professional enrichment, but it also leads to an array of challenges and hurdles to overcome. Using The Morton Arboretum as an example, in the production facilities we are currently growing 152 different genera and 504 different species, varieties, and cultivars of woody plants. This breakdown is probably typical of many arboreta.

One of the challenges presented by this diversity is that, because of space limitations, plants that have different cultural requirements, e.g., watering frequency and type of potting media, must be grown close to one another. To be successful the propagator must be keenly observant; it is particularly important to understand the conditions under which the plant thrives and the conditions under which the plant fails. The failures can be the most telling and educational—make special note of what treatment did not work. Try not to make the same mistake twice!! (The cause of failure in production may also be helpful information to be used when the successfully propagated plant is sited in the collections).

Another important culture-related challenge is associated with their use of pesticides. Plants vary significantly in the tolerances to pesticide exposure.

Extreme caution is needed when trying a pesticide for the first time. Read the label carefully and search for warnings regarding the potential for phytotoxicity. Legal application of a pesticide requires that either the plant name must be included on the label, or the pesticide must be labeled for the particular insect, mite, disease, or weed to be controlled. Very few of the plants grown at arboreta are listed on pesticide labels. As a result, the problem to be controlled is usually the basis for which a particular pesticide is selected. Consider spraying a small number of different plants to get a "reading" on the potential for the pesticide to be phytotoxic. Several of the trifoliate maples, e.g., *Acer griseum* and *A. triflorum*, have proven to be highly sensitive to miticides. In considering insecticides and miticides specifically, the new flowable formulations have proven to be much safer than either wettable powders or emulsifiable concentrates.

SPECIALIZED—RARE/UNIQUE PLANTS

One of the challenges of growing rare/unique plants is that their propagation methods have not been well documented, or in fact, have not yet been determined. This is a special (and often interesting) challenge to the propagator. To be successful there are several avenues that should be pursued. First, one should review the literature that addresses the propagation of specific plants such as *The Reference Manual of Woody Plant Propagation* (Dirr and Heuser 1987), and the *Combined Proceedings* of the International Plant Propagators' Society. In the 42-year history of the Society, it is likely that plants related to the plant being investigated have been propagated.

It is important to keep accurate and thorough records of each propagation attempt. Record both successful and unsuccessful treatments. These records will eventually become an important source of information. Studying the unsuccessful treatments may help to determine which other treatments should be tried.

Botanical relationships can be a particularly useful aid in understanding what propagation methods to use. Oftentimes, related plants have similar requirements. The *Manual of Cultivated Trees and Shrubs* by Alfred Rehder (1990) is particularly useful in reviewing and understanding botanical relationships. For example, the seeds of cold-temperate members in the olive family (Oleaceae) such as *Chionanthus*, *Fraxinus*, and *Syringa* require warm stratification, followed by cold stratification, before they will germinate. The legendary Alfred Fordham, former propagator of the Arnold Arboretum, frequently took this approach—studying common propagation requirements of a family or genus for clues to the treatments required for a certain species. Studying taxonomic literature can also be helpful in determining which rootstock might be compatible with a rare plant being grafted. Generally, the closer the plants are genetically linked, the more likely they can be successfully grafted.

To be successful in propagating unique plants (e.g., plants bearing an unusual form, foliage type, or color), the propagator needs to have a good knowledge of the plant being propagated. It is important to be able to recognize the "true" plant from a mutation or reversion. This is particularly important for dwarf conifers; these plants are frequently known to produce branches that revert back to the parent-type. If one is not an astute observer, a more vigorous reversion, for example, one which produces more scion or cutting growth, could "replace" the original cultivar selection.

Other unique plant characteristics need special attention; these include leaf variegations and the physiological property of topophysis. Understanding the basis of the variegation can be critical in producing offspring that are true-to-type. For example, the leaf variegation of *Weigela florida* 'Aureo variegata', is successfully reproduced when the propagation method includes terminal and axillary buds, such as with stem cuttings. Methods that involve adventitious bud formation, such as root cuttings or some micropropagation techniques, may result in plants that are not true-to-type.

Topophysis is the inherent characteristic of a propagule to continue to grow in the same orientation as the branch from which it was taken. This problem has long been recognized by propagators—first being described in 1904. The practical implication of this is that a plant which is rooted or grafted onto a seedling rootstock will continue growing in the same orientation in which it was positioned before being propagated. It is particularly common in gymnosperms (e.g., *Ginkgo*, *Picea*, *Pinus*, and *Taxus*), but has also been recognized in some angiosperms, such as cultivars with a columnar or fastigiate growth form. We have experienced form differences based on the original position of the cutting on propagules of *Alnus glutinosa* 'Pyramidalis'. Only the cuttings from the very top produced fastigiate plants resembling the parent. The propagator should recognize which plants might express topophysis and be prepared to manage it. For some plants, staking young grafted plants may solve the problem; with others care may be needed to select cuttings or scions from vertically oriented shoots.

AGED AND DECLINING PLANTS

Often the most important plants for an arboretum propagator to produce are those that are aged; unfortunately, these plants may often be in a state of decline. Propagating plants of this type presents special problems. While seed may be the easiest method, it may not be a viable option due to the possibility for hybridization to occur. This will be discussed in greater detail later. To preserve genetically identical plants, asexual propagation methods, i.e., cutting and grafting, are required. Incompatibility is a potential problem with grafting, particularly since the plant being propagated may be uncommon, and its compatibility with various rootstocks may not be well understood. Also, from a "purist" standpoint, the resulting plant is not a true clone because it is growing on a genetically different root system. Ideally, the plant would be propagated via cuttings (either traditional methods or micropropagated) to produce an identical plant.

With most woody plants, particularly trees, cuttings from older specimens are significantly more difficult to root than cuttings from young plants. Entire books have been written on the biological basis of this phenomenon. As a plant "matures" it is believed that cellular and hormonal changes occur. These changes are described as the transition from the juvenile growth phase to the mature growth phase. Morphological changes, decreased rootability of cuttings, and the ability to flower and fruit are signals of this growth phase transition.

To be successful the propagator must be able to recognize and select cuttings in the juvenile growth phase, and also know how to rejuvenate a mature plant, thus allowing it to be successfully propagated. Selecting juvenile cuttings requires care—it may involve taking cuttings from near the base of a plant that shows a

juvenile leaf form and does not flower. Different leaf forms of juvenile and mature plants are frequently observed on *Euonymus fortunei* and *Hedera helix*. Selecting juvenile cuttings may involve collecting material from root suckers (as long as the plant was not grafted) or water sprouts. These have proven to root more readily.

The importance of juvenility has been recognized for years. Many commercial propagators maintain hedged stock blocks or drastically cut back a plant to help maintain or reintroduce juvenility; an arboretum propagator usually does not have this option. Often the parent tree or shrub is the only specimen; it cannot be destroyed or significantly altered.

One method that has proven successful in propagating own-root older and declining plants is serial grafting. This involves grafting the desired plant onto a seedling rootstock and testing the subsequent new plant for its rootability. If it does not root satisfactorily, then scions of the new grafted plant are collected and again grafted onto seedling rootstocks. This process is continued until success is achieved. Although this procedure may require several trials and take several years to be successful, it does preserve the genetic material of the parent tree while the attempts are proceeding. Serial grafting has been used successfully at The Morton Arboretum with old specimens of *Malus* and *Magnolia*.

SEED—THE IMPORTANCE OF SOURCE

Seeds are received through several different avenues. These include collecting trips to natural areas; collecting from arboretum collections; and seed exchange with other arboreta. (The seeds may be collected in their collections or in natural areas.) Where the seeds were collected is important. When seeds are collected in cultivated collections, there is an increased chance that hybridization may have occurred. Hybridization may be positive if new genetic combinations are desired, but it is undesirable if true-to-type plants are desired. Plant genera with only one species (monotypic genera), such as *Abeliophyllum*, *Cryptomeria*, *Ginkgo*, and *Oxydendrum*, can be grown from arboretum-collected seeds because the chance of hybridization is remote. In our experience, arboretum-collected seeds have resulted in hybrid offspring with the following genera: *Acer*, *Corylus*, *Crataegus*, *Fraxinus*, *Gleditsia*, *Malus*, *Morus*, *Populus*, *Pyrus*, *Quercus*, and *Tilia*.

The freshness of seeds is also very important. Although the seed viability percentage may vary with type of plant or particular year, some degree of success is usually achieved when the seeds are collected fresh and then cleaned, stored, and handled properly. With seeds received from exchanges, the success rate can be much more variable and is often species or genus specific. With some genera, e.g., *Aesculus* and *Quercus*, it is unusual to receive viable seeds from Europe or Asia. For other plants, such as *Acer*, *Crataegus*, *Cotoneaster*, and *Tilia,* there is often a "deeper" dormancy that may require two or three years to overcome. This "deeper" dormancy may be due to severe dehydration or other improper storage condition.

Because of reduced viability and the long period required to determine if the seed will germinate, many seed lots may be needed before the plant is successfully acquired.

IN CONCLUSION

Due to the diversity, uniqueness, and age of many plants produced by an arboretum propagator, special considerations are necessary. To be successful the staff must be knowledgeable and interested in learning more about plants. They also must be highly organized and possess strong observational skills. Propagating plants at an arboretum is as unique as the plants in its collections.

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