From Seed to Tree and Back Again

Boosting Propagation at the Dana Greenhouses

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The more than 15,000 trees, shrubs, and vines gracing the Arnold Arboretum landscape showcase the rich diversity of woody plants in the temperate zone, but for all their differences our collected plants share at least one thing in common: they began their lives as propagules in the Arboretum's greenhouses. As the new propagator at the Arnold Arboretum, I follow in the footsteps of plantsmen who built this remarkable collection from the ground up by careful investigation and thorough documentation—coaxing seeds of previously unknown taxa to germinate and grow. After nearly 150 years, this experimentation continues daily at the Dana Greenhouses and Nursery. It also finds new currency through the cross-institutional efforts of the Campaign for the Living Collections, which will funnel 400 taxa selected for acquisition through our production facilities.

Director of Operations Steve Schneider collects nuts of Oriental beech (*Fagus orientalis*) at 1,000 meters in Tbilisi National Park (aka Sagurmo Reserve) with Grigoli Otari Deisadze of the National Botanical Garden of Georgia. Photo by Andrew Gapinski.

While plants targeted for the Campaign derive from a variety of sources, most arrive as seeds from expeditions, as they have since the Arboretum's founding. When Arboretum staff collect seeds from the wild, they must count, clean, and package them for shipment and routine inspection for pests and disease. When we receive seeds at the Dana Greenhouses, our staff begins to work immediately—timing can be critical, as some seeds can be short-lived without proper protocols for care and storage. We assign a unique accession number to each seed lot, and this number will forever identify this particular plant (or plants) at the Arboretum. Accuracy is fundamental because we use this number to collect and record data on the plant's progress at every stage of propagation and production, including pre-treatments, germination, transplanting success, and survival in our shade-house and nurseries.

Each seed begins a new story on the day it is collected, and the staff at the Dana Greenhouses help shape and steward a living history.

Plants have evolved a wide array of mechanisms to disperse their seeds, and these methods often guide how we process and treat them. Short-lived seeds may require immediate sowing; for others, the embryo inside a seed may require long periods of warm or cold temperatures to overcome dormancy. Many seeds can tolerate (or may require) being dried down, while others must remain moist after collection. Getting it right begins with the detailed written and digital records at our command, holding more than a century of institutional knowledge on our propagation successes as well as our failures. Novel species—those we have never attempted to grow or that lack guiding literature—may require multiple treatments across the seed lot to identify the right recipe for success. Of the plants targeted in the Campaign, roughly 150 have never been cultivated successfully in our landscape previously, presenting new and exciting challenges.

Thorough documentation of propagation experiments lays the groundwork for future trials of related species, and deepens the knowledge we share with horticulturists, plant scientists, and the public.

On expedition last fall in the Republic of Georgia, Director of Operations Steve Schneider and Manager of Horticulture Andrew Gapinski collected *Fagus orientalis* (Oriental beech) to preserve germplasm from populations never before collected by the Arboretum. Since *F. orientalis* has long been cultivated in the Arboretum's collections (plant explorer Frank Meyer collected it in the Caucasus in 1910, as just one example), we referenced two previous seed lots that successfully produced seedlings and followed their example for cold stratification, the process of pretreatment required to overcome embryo dormancy. After three months in our cooler set at a chilly, but not freezing, 36-40 degrees F (2-4 degrees C), the seeds were sown in early February and the first seedlings began emerging less than 2 weeks later. These seedlings delighted us due to the striking ginkgo-like appearance of the cotyledons (or seed leaves) which emerge before the first true leaves. Seedlings transplanted from this expedition will continue in our production cycle until they are ready for either transplanting in our landscape or distributing to colleague institutions to expand preservation efforts for this population of Oriental beech.

Additional Campaign targets sourced by Steve and Andrew on this trip were a number of oaks including *Quercus iberica* (Georgian oak). Acorns can be tricky propagules—pests like acorn weevils may burrow into the hard outer tissues to lay their eggs and cannot be removed simply by cleaning. To protect our ecosystem from hidden invaders like these, USDA-APHIS inspectors may fumigate propagules of high-risk genera like oaks, and in this case there was a high probability that the seed had been destroyed by this treatment. Despite this, to our relief, we achieved remarkable germination of *Quercus iberica*, as well as *Q. robur* ssp. *imeretina*, a subspecies considered vulnerable to extinction.

While the Campaign seeks to acquire European and Asian taxa of cultural and ecological significance like these oaks, it also targets many North American natives. Our Living Collections Fellows, Robert Dowell and Jenna Zukswert, organized a collecting trip last fall to Southern Appalachia (see *Silva* Spring/Summer 2017) where they explored that region's wonderful plant diversity. One prize they sought was *Hypericum buckleyi*, a rare St. John's wort found only in high elevations of the Carolinas and Georgia. A colleague on the trip, Tom Clark of the Mount Holyoke Botanic Garden, led them to a population above 6,000 feet in Pisgah National Forest, below the summit of Sam Knob. At the Greenhouses, we achieved phenomenal germination for this low groundcover after three months of cold stratification. The seedlings we planted in our shade-house early this summer are thriving, and may eventually grace the Arboretum's "Rockery" on Valley Road—an environment comparable to the one where Robert and Jenna collected it.

Each seed begins a new story on the day it is collected, and the staff at the Dana Greenhouses help shape and steward a living history. The seedlings whose stories I have highlighted here will spend a minimum of three years in our care. Once they "graduate" from our nurseries, the best individuals will be planted in our living collections to be continuously documented, studied by scientists, and enjoyed by the visiting public. Their stories may be retold for centuries through the repropagation and sharing of our important lineages. The Arnold Arboretum continues a rich legacy of preserving our natural heritage while pushing the boundaries of horticulture—a humbling experience to be a part of every day.

After arriving at the Arboretum and spending three months chilling in a cooler to overcome embryo dormancy, seeds of Oriental beech begin germinating in February at the Dana Greenhouses. The seedlings are currently maturing outdoors in the Arboretum nursery. Photo by Sean Halloran.