

**Saratoga Horticultural Research Endowment Grant Final Report**  
**Introduction and Testing of Texas Trees in Sacramento Valley Landscapes**

August 31, 2020

**Investigators**

- Emily Griswold, Director of GATEways Horticulture and Teaching Gardens, UC Davis Arboretum and Public Garden
- Abbey Hart, Nursery Special Projects Manager, UC Davis Arboretum and Public Garden

**INTRODUCTION**

With support from the Saratoga Horticultural Research Endowment, we launched the first year of a multi-year project to introduce and test new landscape trees from arid zones in west and central Texas in Sacramento Valley landscapes. With climate change, California's interior cities are projected to become significantly hotter, which will reduce the palette of urban trees available to shade streets and sequester carbon. There is a pressing need to expand the palette of climate-ready trees available for California's urban landscapes in the Central Valley, which are predicted to shift to more desert-like climate conditions by the end of the 21<sup>st</sup> century. Many native plants of the Chihuahuan Desert region and Hill Country of Texas are well-adapted to extreme heat, drought, and alkaline soils. Trees from this region already comprise some of the recommended low-water species for desert climates in California. The first year of our project focused on gathering information about the performance of trees from west and central Texas in interior California landscapes and acquiring and propagating plants from a target list of 37 taxa for future field testing in the Sacramento Valley climate.

**MATERIALS AND METHODS**

***Expert Survey***

At the outset of the project we identified 37 target Texas taxa that represented the most promising candidates for propagating and trialing based on information from Michael Powell's *Native Plants in Landscaping* and the Lady Bird Johnson Wildflower Center's Native Plant Database. We generated an online survey to gather feedback from California and Texas tree experts about the landscape performance of our 37 taxa and received ten responses (see Figures 1 and 2). Following up on the survey, we consulted with several experts in person while traveling in Texas, and their feedback has guided the addition of new taxa to our list. A few Texas horticulturists also provided propagation advice that supplemented information that we gathered from Jill Nokes' *How to Grow Native Plants of Texas and the Southwest* and the Lady Bird Johnson Wildflower Center Native Plant Database.

Experts consulted via survey or interview for this project include:

#### **California**

Jim Downer

*Advisor*

*UC Cooperative Extension Ventura County*

Donald R. Hodel

*Environmental Horticulture Advisor Emeritus*

*UC Cooperative Extension Los Angeles County*

Greg McPherson

*Emeritus Scientist*

*USFS Pacific Southwest Research Station*

David Muffly

*Consulting Arborist*

*Oaktopia*

Warren Roberts

*Superintendent Emeritus*

*UC Davis Arboretum and Public Garden*

Stewart Winchester

*Horticulture Instructor*

*Merritt College*

#### **Texas**

Adam Black

*Director of Horticulture*

*Peckerwood Garden*

Seth Hamby

*Head Gardener*

*Chihuahuan Desert Nature Center*

Dan Hosage

*Owner*

*Madrone Nursery*

Andrew McNeil-Marshall

*Arborist*

*Lady Bird Johnson Wildflower Center*

Michael Merritt

*Regional Urban Forestry Coordinator*

*Texas A&M Forest Service*

Michael Powell

*Professor Emeritus and Herbarium Director*

*Sul Ross State University*

David Richardson

*Arborist*

*University of Texas Southwest Medical Center*

Phillip Schulze

*Site Manager*

*Lady Bird Johnson Wildflower Center*

#### ***Plant Acquisition***

Introducing new plants to cultivation in California was a major focus of this project. Because the targeted trees are not readily available in the California horticultural trade, traveling to Texas to collect propagation material directly from the source was a key element of the project. Due to phytosanitary concerns, we chose not to bring any rooted plants or soil back to California. Instead, we focused our efforts on seed collection.

Each seed collection was accessioned in the UC Davis Arboretum and Public Garden's plant records database with detailed information on the collecting locality (including geographic coordinates), surrounding habitat if applicable, and the condition of the parent plant (see Figure 3). Whenever possible, care was taken to collect seeds from individual plants that exhibited superior health and a form that would be favorable in an urban landscape setting.

The majority of seed acquisition for the project occurred on a collecting trip to Texas that was timed for mid-September to maximize the availability of ripe seeds. Emily Griswold, Abbey Hart, and student intern Ellen Sanders-Raigosa traveled to Texas from September 12 to 19, 2019 to learn more about our study trees and collect propagation material. Adam Black, Director of Horticulture for Peckerwood Garden was our local guide and collecting partner, and he arranged access to several private properties with landowner permission to collect. Most seeds were collected directly from wild populations.

Collections from cultivated plants at the Lady Bird Johnson Wildflower Center and the Chihuahuan Desert Research Institute supplemented this material. Based on feedback from Texas horticulturists, we expanded our palette to include 12 additional species.

We were unable to collect some taxa on our target list while we were in Texas. Some species were not accessible to us on our itinerary and others lacked sufficient ripe seed for us to collect for our project. For seven of the target species that have ranges extending into Arizona, we were able to opportunistically collect seeds for those taxa while performing field work for another project in that state. Three species with late ripening seeds were collected in November by Lady Bird Johnson Wildflower Center arborist Andrew McNeil-Marshall and mailed to us. Seeds for two taxa were also collected from cultivated plants in the UC Davis Arboretum.

See Figure 3 for a full list of plant acquisitions and their sources, collection locality, specimen and ecological details. This list does not include plants that were already in propagation before the project began.

### ***Propagation***

Performing rigorous propagation trials for each tree species was beyond the scope of this grant project. However, we kept detailed propagation records to allow us to track and share the results of our efforts. Nursery student employee Ellen Sanders-Raigosa took the lead on cleaning seeds, researching recommended propagation protocols, and implementing and recording propagation efforts. For taxa where conflicting or no protocol information was found, we did preliminary trials of various propagation treatments.

Each propagation attempt was recorded with a unique propagation number along with details including: the plant accession number, date, seed pretreatments, pot/flat type, and growing environment (heated greenhouse, mist, cold). Records were updated when seedlings were ready to be up-potted to track germination rates and propagation success.

Depending on size and quantity, seeds were sown communally in flats or individually in plug trays or cone-tainers. Species with seeds that are attractive to rodents (acorns, walnuts, and pecans) were grown in protective wire mesh cages. We built a second cage structure to accommodate our expanding inventory (see Photo 6). As seedlings have developed, they have been shifted up to 4" wide and 8" deep air pruning pots (Pioneer Pot™) to encourage the development of a fibrous root system. Faster-growing seedlings are currently being up-potted to several types of 3-gallon and 5-gallon pots to be ready for planting out in winter 2020-21 for field trials. We are trialing air pruning RootMaker® 3-gallon (RootTrappers and Injection-molded) pots to continue the development of fibrous, non-circling root systems as well as conventional 3-gallon and 5-gallon tree pots to compare and trial. Supplemental liquid fertilizer has been provided as needed to address the high levels of boron and sodium in our irrigation water supply.

See Figure 4 for the detailed results of all propagation efforts. See Figure 5 for a current nursery inventory and summary of propagation results for each taxon.

## **RESULTS**

Please see the following figures and photos at the end of this report for our project results:

Figure 1. Expert Survey Results Ranked by Performance Rating

Figure 2. Horticultural Performance Chart

Figure 3. Plant Acquisitions and Source Information

Figure 4. Detailed Results from all Propagation Attempts

Figure 5. Taxon Propagation Results and Inventory Summary

Figure 6. Sample Interpretive Sign

Project Photographs

## **DISCUSSION**

Our collection and propagation efforts have been even more successful than we anticipated. Through collection trips to Texas and Arizona and contributions from partner institutions, we were able to collect 75 unique accession items of 44 taxa. This included twelve taxa not originally in our proposal. Propagation of these items has been highly successful resulting in more than 1,100 tree seedlings of 41 taxa (including four taxa that were already in production before the project began). The COVID-19 shelter-in-place orders posed a significant challenge to our operations this spring, but maintaining and continuing the research became the primary priority of Abbey Hart's essential duties, and we were able to avoid plant losses.

The majority of the species we collected show promising results in this first phase of trialing their horticultural performance in a nursery container environment. Future research is needed where we had inconsistent or no propagation success with the following taxa: *Morus microphylla*, *Fraxinus albicans*, *Prunus serotina* var. *virens*, *Tilia americana* var. *caroliniana*, *Pinus remota*, *Pinus cembroides*, *Styphnolobium affine*, *Diospyros texensis*. Our research will continue with the support of the Saratoga Horticultural Endowment grant through 2020-21 by beginning field trials of approximately 10 taxa. We will also expand our nursery capacity to accommodate the growing inventory of over 1,000 trees for this project in preparation for the next series of field trials in 2021 and beyond.

The success of this project is in great part thanks to the collaboration and assistance of the 14 experts highlighted in the Methods section. We have gained valuable insight through the survey we developed and disseminated, the in-person meetings in Texas and in ongoing consultations with regional experts. This collaboration helped guide the species we chose to trial, their collection localities and propagation methods.

In order to build on and further disseminate this knowledge, we aim to share our findings with horticultural professionals and students as well as the public as this project continues. Abbey Hart wrote an article for the fall 2019 issue of *The UC Davis Arboretum and Public Garden Review* describing the research project and its goals. This publication was distributed to the 1750 members of the Friends of the UC Davis Arboretum and Public Garden and is also accessible to the public as a blog post on our website which receives approximately 500,000 visits per year. With funding from Saratoga Hort for the

2020-21 year, we plan to further improve access to our work by building a user-friendly web resource for sharing research information and results.

Public engagement and student learning and career development training through the Learning by Leading™ internship program have been instrumental to the success of this project and will continue in the coming year. In our first year, Nursery interns and Museum Education interns have played important roles in implementing and sharing stories about this research. The Museum Education interns interviewed Nursery interns and staff to create a series of temporary interpretive signs about the project for installation in Shields Oak Grove (see Figure 6 for an example). Our oak collection includes examples of several Texas species that are part of this project which are highlighted by the signs.

This January we also selected and hired two additional student interns to assist with the project through summer of 2021. They have been assisting with propagation, plant care, and record-keeping in the nursery, and are in the midst of planning implementation of fall field trials. They are also helping develop the curriculum for a new Learning by Leading™ Urban Tree Stewardship student intern team focused on tree propagation, young tree care, and urban forestry that they will launch in winter 2021 with the goal of involving more interns in the project. The experience these students are getting in horticultural research, as well as the unique opportunity for field-work experience that Ellen Sanders-Raigosa received, are critical to the development of the next generation of horticultural leaders.

#### **WORKS CITED**

Lady Bird Johnson Wildflower Center Native Plant Database. Accessed summer and fall 2019.  
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Powell, A. Michael, and Shirley A. Powell. *Native Plants in Landscaping: Trees, Shrubs, Cacti, and Grasses of the Texas Desert and Mountains*. Iron Mountain Press, 2005.