Research Summary: Early Performance of Climate-Ready Trees in an Urban Planting Program

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Cities across the western United States aim to expand their tree canopy cover to provide cooling in the face of climate change. However, the higher temperatures associated with climate change will also make it more difficult for many of the traditionally planted urban tree species to thrive, particularly when heat is paired with reduced water availability. In California, hotter and more drought-prone conditions are expected across much of the state (He et al., 2018), and urban water conservation strategies like lawn conversions can also reduce the amount of irrigation water in the landscape. For tree planting programs to make a meaningful and lasting contribution to urban canopy cover expansion, new trees must be able to withstand these hotter, drier conditions of the future. Crucially, they also need to survive through the establishment period and grow large enough to provide cooling benefits.

Here we report on the early performance of newly planted "climate-ready" trees—species that are currently rare or absent in a region's urban forests, but that are predicted to withstand future climate conditions (McPherson et al., 2018). The USDA Forest Service has been working to identify and evaluate promising climate-ready tree species for cities in Northern California since 1999. We tracked the growth, survival, and condition of climate-ready trees and other species planted in Davis, CA, in the Northern California Central Valley climate region. (The full methodology and results of this study can be found in *Arboriculture and Urban Forestry* [Solins et al., 2026]).

Methods Overview

In 2019, the City of Davis received a grant from the California Department of Forestry and Fire Protection (CAL FIRE) to plant 1,000 trees in partnership with Tree Davis, the local urban forestry nonprofit. The initiative was called the Community Canopy program. This extensive tree planting project offered the opportunity to track the performance of



Figure 1. **A *Pistacia* 'Red Push' tree planted as part of the Community Canopy program, shown in 2021 (left) and 2026 (right). *Photo courtesy of Tree Davis*.**

different tree species in a variety of landscape contexts. In particular, the planting palette included a selection of climate-ready tree species, some of which had already performed well in earlier tests in the area, and several of which were in the process of evaluation (McPherson et al., 2020). The Community Canopy program was one of the first efforts to plant climate-ready trees across an urban landscape. The project also included common urban tree species and three of the region's native oak trees. We grouped trees into the categories of climate-ready, common, and native oak for analysis.

We visited all trees at the end of the growing season over three years, from 2021-2023, to determine mortality status, and we also measured DBH and rated tree condition in 2021 and 2023. Condition scores were assigned separately for the trunk, scaffold and small branches, roots, and foliage, and these scores were combined for an overall score. Growth was determined as the change in DBH from 2021 to 2023. Trees were still being planted during this timeframe, so we have growth data for just over half of the 1,098 trees that were ultimately planted. Planting locations included parks, natural areas, median and greenbelt strips, rights-of-way in residential yards, and assorted private properties. Some settings had irrigation for lawns or other landscaping, while others were unirrigated.

Results and Discussion

Taken as a group, climate-ready trees had the highest survival, growth, and condition ratings in the Community Canopy program (Figures 1-2). This early success suggests that planting climate-ready trees could be a good investment for future canopy cover. Although there might be tradeoffs to fast early growth, climate-ready trees could potentially provide more cooling benefits sooner. In addition, they are likely to continue to perform well under changing climate conditions and reduced landscape irrigation (McPherson et al., 2020), increasing their chances of maintaining their cooling benefits into the future.

Of course, there was variation by species within the groups we defined, and not all climate-ready trees performed well (Figure 3). Persian ironwood (*Parrotia persica*), the least tested of the group, had particularly poor survival and growth, and may not warrant further planting in the area. In addition, smaller climate-ready trees, such as Oklahoma redbud (*Cercis canadensis* var. *texensis* 'Oklahoma') and desert willow (*Chilopsis linearis* 'Bubba'), will not provide nearly as much shade at maturity as the larger trees in the group. Some of these larger trees like the Triumph™ elm (*Ulmus* 'Morton Glossy') and Texas red oak (*Quercus buckleyi*) also had faster growth rates and would be better choices for settings where substantial shading is a priority.



***Figure 2. Quercus canbyi* and *Q. buckleyi* trees planted as part of the Community Canopy program, shown in 2020 (left) and 2026 (right). *Photo courtesy of Tree Davis*.**

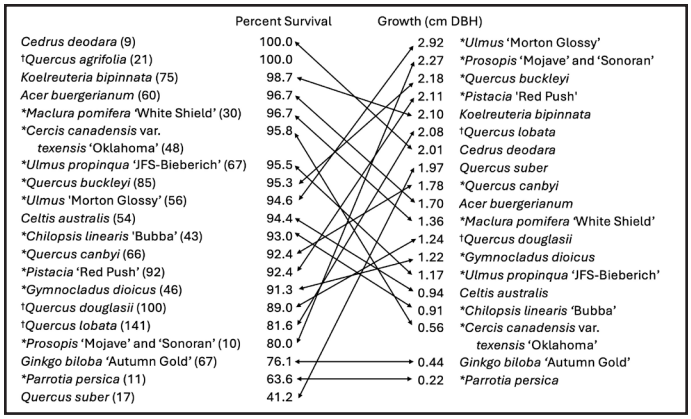


***Figure 3*. Species included in the Community Canopy program, organized by percent survival (left) and growth (right; median change in DBH from 2021 to 2023). Climate-ready trees are marked with *, and native oaks are marked with †. The number of trees planted is shown in parentheses. No *Quercus agrifolia* trees were planted before the 2021 data collection, so growth could not be assessed for this species.**

We also must include the caveat that our study only reflects the early success of these trees, and percent survival and growth for individual species may be influenced by their different planting timelines and numbers. We plan to continue monitoring in the future. One issue we have come across after the end of the 2023 data collection is the sudden death of about a dozen 'Red Push' pistache (*Pistacia* 'Red Push') trees (Figure 4) that had formerly appeared healthy. Although a fungal pathogen is suspected, we have so far been unable to detect any likely suspects in plant tissues. This species is otherwise performing admirably, and we will continue to investigate the cause of mortality to see whether we can provide management recommendations.

Beyond the performance of climate-ready trees, our study provides some general insights into planting program success. Overall, trees in the Community Canopy project performed well in their early years. The calculated average annual mortality rate was 3.7%, which is relatively low for urban tree planting projects (Hilbert et al., 2019). The high survival of Community Canopy trees likely reflects the substantial level of stewardship they received from Tree Davis staff and volunteers, which included mulching, pruning, and hand watering, especially for trees in unirrigated sites. These stewardship practices continued for the trees' first five years, and the success of the project inspired a change across the city to provide this level of care for all newly planted trees.

Despite hand watering in unirrigated sites, we found that the presence of site irrigation had a very strong influence on survival. The estimated four-year probability of survival for trees in irrigated sites was 0.94, but it was only 0.77 for trees in unirrigated sites. Native oaks were planted more often in unirrigated settings, likely contributing to lower survival rates for *Quercus douglasii* and *Q. lobata*. Site irrigation was also associated with greater growth for both climate-ready trees and common trees. Interestingly, though, native oaks grew more in unirrigated sites. Young native oaks may do better with the less frequent and deeper soaking from hand watering, provided they receive enough water to survive early on. As sites without landscape irrigation become more common, ensuring consistent and sufficient hand watering in unirrigated settings will be key to the success of future planting projects.

We also found that high condition scores in 2021 were associated with better survival and increased growth, highlighting the importance of choosing quality nursery stock and using careful planting practices. The most common condition problem for young trees was their foliage. However, poor foliage scores were less common in 2023 than 2021, suggesting that some trees can recover from early foliage



***Figure 4*. A *Pistacia* 'Red Push' tree that died suddenly, with a healthy tree of the same cultivar in the background. *Photo courtesy of Joanna Solins*.**

issues. On the other hand, we found that more trees had trunk injuries from landscaping equipment in 2023 than 2021. Marking and protecting young trees in managed landscapes is essential to avoid lower trunk damage that can significantly reduce growth in urban trees (Vogt et al., 2015). Finally, poor planting practices may have contributed to the reduced root scores we recorded. A focus on training and supervising volunteers during tree planting events could help prevent trees from being planted at the wrong depth, which can lead to later root problems (Wells et al., 2006).

The long-term success of tree planting programs starts with the selection of species. Our research suggests that vetted climate-ready trees for the Northern California Central Valley are a sound choice for planting programs in this region, and the concept of climate-ready species can be applied more broadly to inform planting palettes. Research into climate-ready trees is already well underway in Southern California (McPherson et al., 2019). However, because these trees are—by definition—not yet commonly planted in the areas where they are being tested, working with local nurseries to increase availability will be key to fostering widespread adoption. When climate-ready trees cannot be procured, more commonly planted trees can also perform well, particularly in irrigated settings. Given how important irrigation and early condition were in predicting survival and growth, our study underscores the importance of consistent and frequent watering protocols in otherwise unirrigated locations, as well as high-quality container stock, careful planting practices, and protection and maintenance after planting. Investing resources in young tree establishment and care is essential for efficient canopy expansion.

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