

# Performance Evaluation for Promising Climate-Ready Trees in the Sacramento Area

Greg McPherson, Ph.D., Alison Berry, Ph.D., Natalie van Doorn, Emily Griswold and Erika Teach

California's Fourth Climate Change Assessment (Cayan and Wilhelm, 2018) predicts that over the next several decades the Sacramento Valley will have 100 additional days of temperatures above 95 degrees F and more extreme heat waves with longer durations. Urban forestry is recognized as a cost-effective strategy to mitigate climate impacts by cooling urban heat islands, reducing stormwater runoff, storing carbon in tree biomass and promoting human health and well-being. One obstacle to realizing these benefits is the limited supply of trees that are well-adapted to climate stressors such as heat, drought, salinity, extreme wind and pests. If urban forestry is going to become a long-term climate adaptation strategy for cities, there is urgent need to shift the tree palette to climate-ready species.

Table 1 identifies trees that are potentially well-suited to Sacramento, California area-growing conditions but are difficult to find in local nurseries. Previous research used a numerical rating system to identify the most promising climate-ready species (McPherson et al., 2018). In 2015 twelve species were selected for testing and planted in a UC Davis plot and four Sacramento parks. Tree survival and performance are being evaluated annually and early results from this and other studies are incorporated in this document (McPherson et al., 2017). Our recommendations for these trees are preliminary as we have observed performance for only 5 years and this is a 20-year study.

Because resources for planting and testing new species were limited, this table includes other promising species that are not being field tested. There are four Performance Classes so that users can gauge the level of risk associated with incomplete knowledge about how these species are likely to perform over time. There are three mature size classes: Large (> 50' tall), Medium (30-50'), and Small (<30'). Relative carbon (C) storage combines size and species wood density. Classes are Very High (VH; large and high or very high wood density), High (H), Medium (M), Low (L; small and low wood density), and N/A (not available).

## PERFORMANCE CLASSES

- **LARGELY PROVEN:** Planted in a wide variety of sites for continued evaluation (e.g., Kentucky coffeetree, Texas red oak).

---

- **SOMEWHAT PROVEN:** Performance testing underway.

---

- **PROMISING NOT PROVEN:** Planted in limited numbers in a variety of sites to evaluate.

---

- **NOT RECOMMENDED:** Shown to NOT be well-adapted to a variety of sites in the region, so not recommended for planting. Further evaluation is needed for site types and management regimes that have not been tested.

---

Greg McPherson, Ph.D.<sup>1</sup>  
Retired Urban Forest Researcher  
Email contact: [egmcperson@gmail.com](mailto:egmcperson@gmail.com)

---

Alison Berry, Ph.D.<sup>2</sup>  
Plant Science Professor Emeritus

---

Natalie van Doorn<sup>1</sup>  
Urban Forest Researcher

---

Emily Griswold<sup>2</sup>  
Director of Arboretum Horticulture

---

Erika Teach<sup>1</sup>  
Research Associate<sup>1</sup>

---

USDA Forest Service, Pacific SW Research Station,<sup>2</sup>  
University of California, Davis

SCIENTIFIC NAME	COMMON NAME	SIZE	C STORAGE	NOTES
<b>LARGELY PROVEN</b>				
<i>Chilopsis</i> <sup>1</sup> cvs.	desert willow	S	M	Gold fall foliage; nice summer flowers; 'Bubba' evaluated
<i>Gymnocladus dioica</i> <sup>3</sup>	Kentucky coffeetree	L	VH	Males lack pods; 'Espresso' evaluated
<i>Pistacia</i> 'Red Push' <sup>1</sup>	'Red Push' pistache	M	H	Initially slow growing; excellent spring & fall leaf color; no fruit
<i>Prosopis</i> cvs. <sup>1</sup>	thornless mesquite	S	H	Pruning required; avoid overwatering young trees
<i>Quercus buckleyi</i> <sup>1</sup>	Texas red oak	L	VH	Excellent structure and fall color; rapid growth; evaluated
<i>Q. fusiformis</i> <sup>1</sup>	Texas live oak	L	VH	Evergreen; excellent structure; evaluated
<i>Q. muehlenbergii</i> <sup>1</sup>	chinquapin oak	L	VH	Gold fall foliage; strong wood; wildlife value
<i>Ulmus americana</i> 'New Harmony' <sup>4</sup>	'New Harmony' elm	L	H	Nice form and structure; large leaves; DED resistant; pruning required
<i>Ulmus</i> 'Triumph' <sup>4</sup>	'Triumph' elm	M	H	Compact form; small glossy leaves; DED resistant
<b>SOMEWHAT PROVEN (currently testing)</b>				
<i>Acacia aneura</i> <sup>2</sup>	mulga	S	H	Evergreen; nice flowers; thornless; very tough; requires pruning
<i>Acacia stenophylla</i> <sup>2</sup>	shoestring acacia	S	H	Evergreen; nice flowers; thornless; few pests; striking specimen
<i>Cercis texensis</i> <sup>5</sup> 'Oklahoma' and 'Alba'	redbud cvs.	S	M	'Oklahoma' (pink flowers) 15' x 15'; drought- and soil-tolerant. 'Alba' (white flowers) grafted to <i>C. canadensis</i> rootstock
<i>Corymbia papuana</i> <sup>2</sup>	ghost gum	M	VH	Smooth white bark; gray-green foliage; low survival rate
<i>Dalbergia sissoo</i> <sup>2</sup>	rosewood	M	H	Aspen-like evergreen foliage; drought-tolerant; root sprouts may be a problem
<i>Maclura pomifera</i> <sup>2</sup> 'White Shield'	'White Shield' Osage orange	M	VH	To 35' x 35'; glossy foliage; thornless; fruitless; drought- and soil-tolerant; pest free
<i>Quercus canbyi</i> <sup>2</sup>	Canby's oak	L	VH	Semi-evergreen; rapid growth; good structure; drought-tolerant
<b>PROMISING (not proven)</b>				
<i>Acacia pendula</i> <sup>5</sup>	weeping acacia	S	H	Fragrant flowers; nice form; drought- and soil-tolerant; ISHB susceptible
<i>Cordia boissierii</i> <sup>5</sup>	Texas wild olive	S	M	To 20' x 15'; evergreen; nice white flowers; low maintenance; pest free
<i>Corylus columna</i> <sup>5</sup>	Turkish hazel	L	VH	To 75' x 30'; nice, deciduous foliage; possibly drought- and soil-tolerant
<i>Hesperocyparis guadalupensis</i>	Guadalupe Island cypress	L	H	Peeling bark; 'Greenlee's Blue Rocket' 60+ years at UC Davis
<i>Dermatophyllum secundiflora</i> <sup>5</sup>	mescal bean	S	M	Nice, fragrant flowers; widely used in Texas; poisonous seeds
<i>Eucalyptus microtheca</i> <sup>5</sup>	coolibah	M	VH	High canopy; nice flowers and bark; dense shade; low maintenance
<i>Eucalyptus spathulata</i> <sup>5</sup>	swamp mallee	M	VH	To 40' x 20'; nice flowers and bark; drought tolerant
<i>Eucommia ulmoides</i> <sup>5</sup> (many cvs.)	hardy rubber tree	L	N/A	To 60' x 30'; fragrant leaves, turning gold in fall; dense shade; low maintenance; possibly drought- and soil-tolerant; pest free
<i>Mariosousa willardiana</i> <sup>5</sup>	palo blanco	S	H	Semi-evergreen; weeping specimen tree; tough but hardness questionable
<i>Melia azedarach</i> <sup>3</sup> 'Elite'	'Elite' chinaberry	M	M	Dense shade; fruitless; drought- and soil-tolerant; weak wood
<i>Parrotia persica</i> <sup>5</sup> (many cvs.)	Persian ironwood	S	N/A	To 30' x 30'; dense shade; striking flowers, bark, and fall color; drought-tolerant; low maintenance; pest free
<i>Pinus roxburghii</i> <sup>5</sup>	chir pine	L	H	Long, graceful needles; tough; drought- and heat-tolerant

SCIENTIFIC NAME	COMMON NAME	SIZE	C STORAGE	NOTES
<i>Pterocarya stenoptera</i> <sup>5</sup>	Chinese wingnut	L	N/A	To 80' x 50'; gold fall color; drought- and soil-tolerant; possibly invasive roots
<i>Quercus laceyi</i> <sup>5</sup>	Lacey oak	M	H	Deciduous; excellent performance in Texas; young trees doing well at UC Davis
<i>Sapindus drummondii</i> <sup>5</sup>	western soapberry	M	VH	Attractive flowers and fruit; drought-tolerant; possible root-suckering
<i>Styphnolobium affinis</i>	Eve's necklace	S	N/A	Tough, small desert ornament from Texas
<i>Taxodium mucronatum</i> <sup>5</sup>	Montezuma cypress	L	H	Drought-tolerant once established; ideal for swales and raingardens
<i>Ungnadia speciosa</i> <sup>5</sup>	Mexican buckeye	S	N/A	Similar habit to redbud; popular in Texas and doing well 30+ years at UC Davis; pruning may be required

**NOT RECOMMENDED**

<i>Celtis reticulata</i> <sup>2</sup>	netleaf hackberry	S	L	California native; shrubby habit; yellow fall color; requires significant pruning
<i>Parkinsonia</i> 'Desert Museum' <sup>1</sup>	'Desert Museum' palo verde	S	M	Evergreen; showy yellow flowers; thornless; requires little water once established; tough; requires significant maintenance and pruning

**Key to superscripts in the table:**

\* Only species in the genus so seldom vulnerable to pests

1. Evaluated since planting in 1999 in Davis
2. Evaluated since planting in 2015 in four Sacramento parks
3. Species evaluated since planted as street trees in Davis in 1960s
4. Evaluated since planting in 2005 in UC Davis elm cultivar testing. No irrigation since 2011
5. Not evaluated in the field locally but highly rated in numerical evaluation of climate-readiness (McPherson et al., 2018)

**Selected References:**

Cayan, D.; and S. Wilhelm, (eds). 2018. Fourth California Climate Assessment. <http://www.climateassessment.ca.gov/>.

McPherson, E.G., A.M. Berry, and N.S. van Doorn. 2018. Performance testing to identify climate-ready trees. *Urban Forestry and Urban Greening*, 29: 28-39. doi.org/10.1016/j.ufug.2017.09.003

McPherson, E.G., A.M. Berry, N.S. van Doorn, J. Downer, J. Hartin, D. Haver, and E. Teach. 2017. Climate-ready tree study - update for Central Valley communities. *Western Arborist*, 43: 44-51.

McPherson, E.G., and A.M. Berry. 2015. Climate ready urban trees for Central Valley cities. *Western Arborist*, 41(1): 58-62.

McPherson, E.G. and S. Albers. 2014. Evaluation of seven drought tolerant tree species for central California. *Western Arborist*, 40(3): 10-15.

McPherson, E.G., S. Albers, L. Costello, J. Harding, and E. Aguaron. 2014. Summary of new elm selection trials. *Western Arborist*, 40(1): 40-44.

McPherson, E.G. 2008. National elm trial: Report from Northern California. *Western Arborist*, 35(3): 32-36.

For more information visit the Climate-Ready Trees website at: <http://climatereadytrees.ucdavis.edu/>





◀ *Acacia pendula* - This weeping acacia was planted 4 years ago in the UC Davis Arboretum. It is an attractive specimen tree that grows 20-30 feet tall. Although tolerant of drought, its cold hardiness has not been well tested, and it is vulnerable to invasive shot hole borer.



*Quercus canbyi* - Canby's oak shown here at Laguna Creek Park is proving to be a reliable performer in all the Sacramento park sites. It is an excellent species for carbon storage because of its dense wood and large mature size.



◀ *Ulmus americana* 'New Harmony' - 'New Harmony' elm is one of the best Dutch Elm Disease resistant elms available today. It has the large, oblong leaves and the upward branching structure of American elm. This tree was planted in the 2005 National Elm Trial plot at UC Davis. It has not been irrigated since 2010.





*Quercus laceyi* - The Lacey oak has Texas A&M Texas Superstar® status in Texas, where it is native. This deciduous tree is one of several that were planted next to a parking lot at UC Davis 5 years ago and are growing well. This tree has great landscape potential and merits increased planting and evaluation in California.



*Maclura pomifera* 'White Shield' - The 'White Shield' osage orange has proven to thrive in a variety of growing conditions and is very resilient to drought. This 5-year old tree is at Fisherman's Lake, where summer heat is intense and watering is irregular. The wood of this species is very dense, making it a good choice for carbon storage.

**We are going virtual!**

**Reach your Highest Peak**  
 86th Annual Conference & Tradeshow  
 November 9-11, 2020  
 An Online Experience





▲ *Quercus fusiformis* - Texas live oak is a very drought tolerant central Texas native. The tree shown here was planted 21 years ago in the Shield's Oak Grove at UC Davis. Its evergreen foliage intercepts rainfall year-round and its carbon storage potential is very high. It is an excellent tree for parks and other large areas.

*Styphnolobium affinis* - Eve's necklace is a small ornamental tree native to most all of Texas. This tree was planted 27 years ago in the UC Davis Arboretum. The fruit pods are pinched in at each seed, giving it the appearance of a string of beads. ►



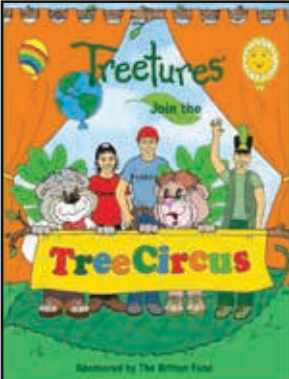







▲ *Parkinsonia* 'Desert Museum' - The 'Desert Museum' palo verde has been prone to blow-over due to its vigorous top growth. This tree at the Kohl's Bikepath site has survived five years after planting, despite heavy pruning for clearance. Also shown are the 'White Shield' osage orange and 'Shoestring' acacia. Only 4 of the 8 palo verde planted in our Sacramento sites remain alive.

*Hesperocyparis guadalupensis* - Guadalupe Island cypress ► is native to Baja California, Mexico and it is a very drought tolerant tree. This specimen was planted over 30 years ago at UC Davis and reaches 40-ft tall.





**TREE CIRCUS 2020**  
would like to thank  
the sponsors;


Sponsored by The Britton Fund





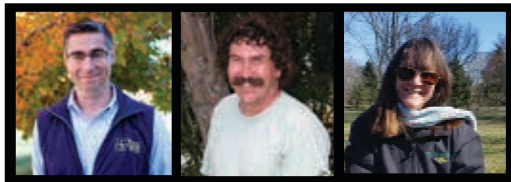
*Cercis canadensis var. texensis* 'Oklahoma' - This species of redbud is a Texas native that is more drought tolerant than the eastern redbud (*C. canadensis*). This cultivar has pink flowers, and the cultivar Alba has attractive white flowers in the spring. The tree pictured here was planted in 2016 at UC Davis.



*Taxodium mucronatum* - Montezuma cypress is more drought tolerant than the commonly planted bald cypress (*T. distichum*). Its bright green foliage and pendulous branches are striking. This tree is one of several that were started from seed at UC Davis 28 years ago and receives no irrigation.



**WESTERN CHAPTER ISA  
MONTHLY WEB SERIES**  
1st Wednesday of each month



**October 7**  
**Weeds and Soils**  
Igor Lacan, Ph.D.  
UCCE, Half Moon Bay, CA

**November 4**  
**Proper Pruning**  
James Downer, Ph.D.  
UCCE, Ventura, CA

**December 2**  
**Field Soil Testing for Arborists**  
Tracey Takeuchi  
Agricultural Advisor,  
Norco, CA

**DETAILS:**

- All sessions are scheduled from 11:00AM -12:30PM. 1 hour of instruction and .5 hour for Q & A
- You must register to attend the sessions.
- All registered attendees will receive a confirmation email (receipt) and a separate email with a link to the Zoom Webinar. An email reminder will be sent via zoom the morning of the session.
- 1 Continuing Education Unit (CEU) will be given for live presentation only.
- CEUs will be collected by survey link at the end of each session.

Take advantage of our **COVID-19 discount!\***  
\$10.00 off all webinars  
*\*LIMITED TIME OFFER*

**Register online at [wcisa.net/events](http://wcisa.net/events)**  
**Questions call 866-785-8960**





*Dalbergia sissoo* - The rosewood is a very tough tree that can grow in grassy parks as well as hot dry sites. The light-green leaves are attractive, similar to aspen but evergreen. Rosewood is a good tree for carbon storage as the wood is dense and it can grow to 50-60 feet tall. We are assessing its maintenance needs, such as sprouts in the foreground of this photo at Fisherman's Lake.



*Ulmus 'Triumph'* - 'Triumph' elm is a Dutch Elm Disease resistant cultivar with a compact form and small glossy leaves. It is resistant to other pests that attack leaves and bark. It has remained healthy and attractive without irrigation over the past 10 years at the UC Davis National Elm Trial plot.

## WE'RE GOING VIRTUAL

Join others from across the globe in industry leading networking and learning opportunities.

- Earn CEUs
- Educational sessions on demand
- Gain global insight on the industry
- Connect with ISA Partners

ISA  
**20 VIRTUAL  
 20 CONFERENCE**  
 7-11 DECEMBER

[www.isa-arbor.com/conference](http://www.isa-arbor.com/conference)

