Combined Proceedings IPPS 71:164-170. 2021.

Keeping Ornamental Winners and Losers in the Record Texas Freeze of February 15-21, 2021

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Keywords: Hundred-year freeze, tome, low-temperature - woody ornamental plant stress tolerance, plant evaluations

Summary

There was a record 100-year freeze in Texas from 15-21 February 2021. Temperatures dropped as low as -20°C (-4°F). For landscape plants, going from Zone 8b to a 5 was a bit much. Besides the low temperatures, the heavy ice and snow load further stressed plants in the Pineywoods of East Texas. We are developing a tome that describes the immediate and long-term impact of winter storm Uri on the Texas landscape. Recording a list of plants that thrived, survived or died would be useful to future landscape planners. While the tolerance of common plants was evaluated, the focus was on rarely encountered ornamentals. Stephen F. Austin Gardens (SFA) Gardens is a perfect platform to deliver freeze data - because it is a collector's garden of exotic plants. Hundreds of new plants are added to the landscape each year, which is a perfect crucible to test a wide variety of ornamentals exposed to extreme temperatures. The focus of this paper is limited to a few select genera, particularly those with adequate numbers for evaluation at SFA Gardens.

INTRODUCTION

In the last forty years, three freeze events stand out in Texas; December 1983, December 1989 and February 2021 (Fig.1). The most recent event, winter storm Uri, arrived in Texas in mid-February and every county in Texas fell under a freeze alert. Besides the human pain and billions in infrastructure losses, the winter storm emergency left a mark on the Texas landscape that will be long in the healing. The low temperatures broke records across the state. Nacogdoches is typically considered Zone 8B. Citizens were stunned when temperatures dropped to -20°C (-4°F) on February 16, 2021. City and residential water lines broke, the electric grid failed, and it was obvious Texas wasn't quite poised for record cold. For landscapes, going from Zone 8b to a 5 was a bit much. If it wasn't the cold, it was the heavy ice and snow load in much of the Pineywoods that proved too much. Patriarch pines, oaks, sweetgums and elms all suffered limb damage or total collapse.

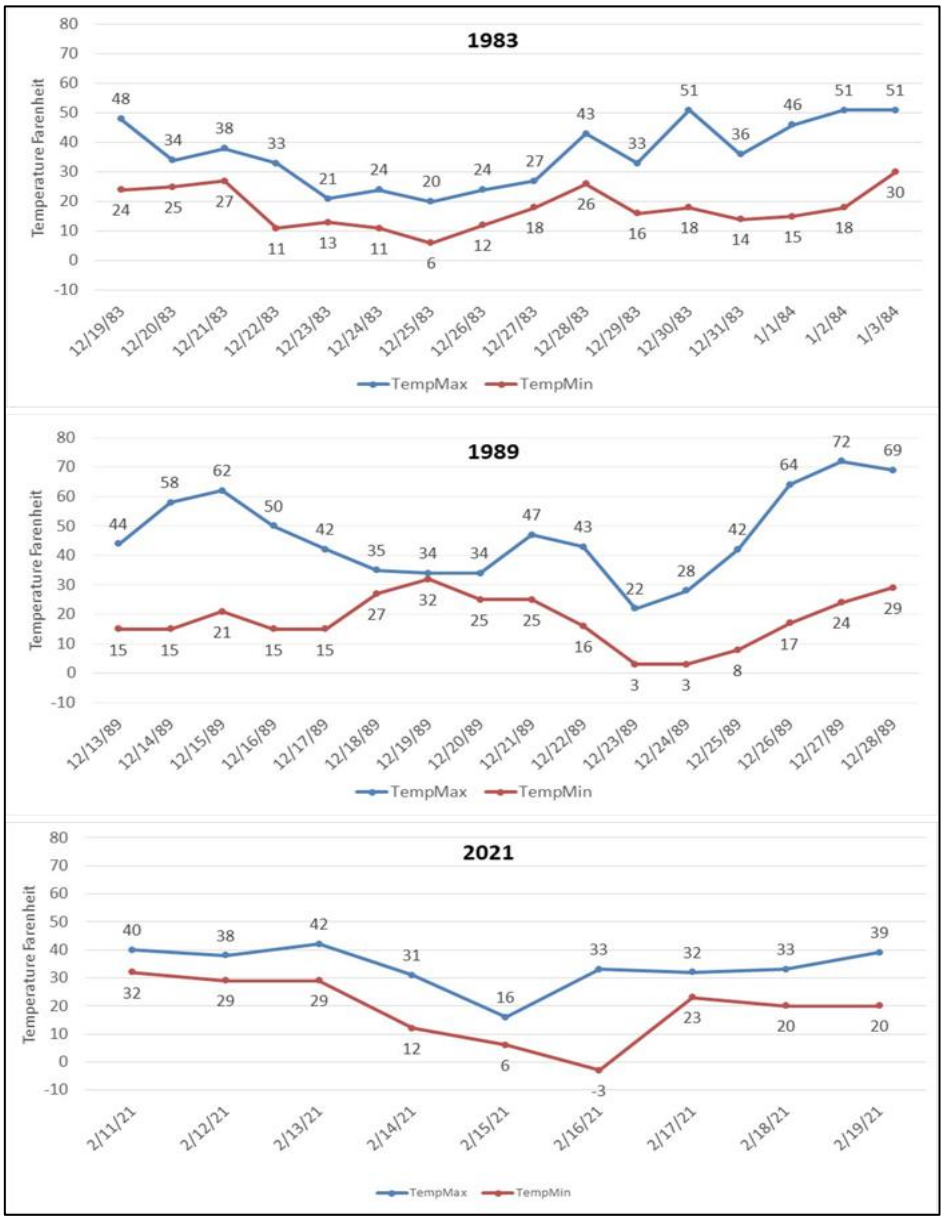

Figure 1. Temperatures encountered with three recent mega freezes, Nacogdoches, Texas

THE SFA GARDENS

For a background, SFA Gardens comprises 128 acres (58 ha) of on-campus property at Stephen F. Austin State University (SFA), Nacogdoches, Texas. SFA Gardens is the umbrella organization responsible for the activities, growth and development of five main theme gardens. Representing the oldest plantings, the 10-acre (4.5 ha) SFA Mast Arboretum was initiated in 1985, was dedicated in 1997, and includes the horticulture facility of the Agriculture Department. Second, the Ruby M. Mize Azalea garden was dedicated in April, 2000, and is an 8-acre (3.2 ha) garden of primarily azaleas, camellias, Japanese maples and an assortment of rarely encountered species and varieties. Third, the 42-acre (19 ha) Pineywoods Native Plant Center (PNPC) was dedicated by Lady Bird Johnson in April 2000. The SFA's Recreational Trail and Gardens was dedicated in March 2010 and comprises 68-acre (31 ha) acres of mostly undisturbed forest and includes the Gayla Mize Garden, an 8-acre (3.2 ha) garden that features woody ornamentals primarily. SFA Gardens is a collectors garden and features a wide diversity of species, varieties and genotypes: https://dcreech-site.com/2020/04/13/plant-glossary/.

Past record freezes in Texas

The February 14-17, 1895 snowstorm is still referred to as the Valentine's Day freeze, an event known for record snowfall on the Texas coast. Galveston reported snowfall over 15" with Houston, Orange, Stafford, and Columbus all reporting twenty inches. Even Brownsville at the southern tip of Texas received five inches and the huge "winter garden" vegetable industry was destroyed. To add to the wound, only a few years later, one of the worst winter storms ever in Texas struck Feb. 11–13, 1899. The entire state was impacted and newspapers then described it as the worst freeze ever known in the state. To this day, 1899 holds the record low for many Texas locations. There are other epic freezes in Texas history, of course. My Dad spoke of the 1929 freeze when ponds froze and it was bitterly cold for weeks. Yes, 1947 and 1951 brought serious low temperatures and 1960 brought record snowfalls. 2011 had a single digit cold snap and in January 2018, Nacogdoches dipped to 10°F for two nights in a row. However, in more recent history, there are two mega events that stand out. The December 1983 freeze event had statewide impact and lasted over two weeks. Six years later, the December 1989 freeze lasted two weeks with lows in the single digits and damage was everywhere. Ponds froze over, cattle and crops suffered and the zonal denial of the 1980s came to an end. It has been over thirty years since a really big freeze headline made the news. For many nurserymen and landscapers those events are only distant memories. While the February 2021 freeze lasted only a week, the record lows meant one thing. Texas has a brand-new benchmark for cold (Figure 1).

Objective

In the spring, a small group of horticulturists began a line of discussion that quickly concluded there should be an collaborative effort to gather freeze damage ratings for a wide range of ornamentals. After all, this was a 100-year freeze. We felt it would be prudent to put together a tome, one that describes the immediate and long-term impact of winter storm Uri on the landscape in Texas. Recording a list of plants that thrived, survived or died would be useful to future landscape planners. While the common commodities would be recorded, the focus would be on ornamentals rarely encountered. SFA Gardens is a perfect platform to deliver interesting freeze data

simply because it's a collector's garden. Hundreds of new plants are added to the landscape each year, the perfect crucible to test a wide variety of ornamentals in a freeze event. For the purposes of this paper, the focus is limited to a few select genera, particularly those with good numbers at SFA Gardens.

METHODS

For SFA Gardens, the decision was made not to prune any landscape plants after the freeze until they showed the true impact of the winter storm. Somewhat coincidentally, a kiwifruit adaptation study underway happened to have six locations with dataloggers at co-operator locations and that data was captured (Fig.2). Galveston was not in the kiwifruit study but is added here to provide a southern coastal location. The graph is a combination of datalogger and available NOAA data. Dr. Mengmeng Gu, TAMU Agrilife Extension Specialist, Adam Black, premier plantsman, and a gathering of like-minded souls are accumulating the treasure trove of data available. A simple damage rating system was created by Dr. Gu. Basically, we're recording what thrived, survived or died. Together, we intend to build a statewide tome on how Texas landscape plants fared after winter storm Uri left the scene. The damage rating scale is rather simple:

At its most basic, this project will identify the location, genus, species, variety, damage rating and comments. In the midst of death and destruction, there's data. For the botanical garden community, this is an opportunity to create a reference point document for characterizing ornamentals for Texas with freeze tolerance in mind. There is nothing like a record breaker to define the field.

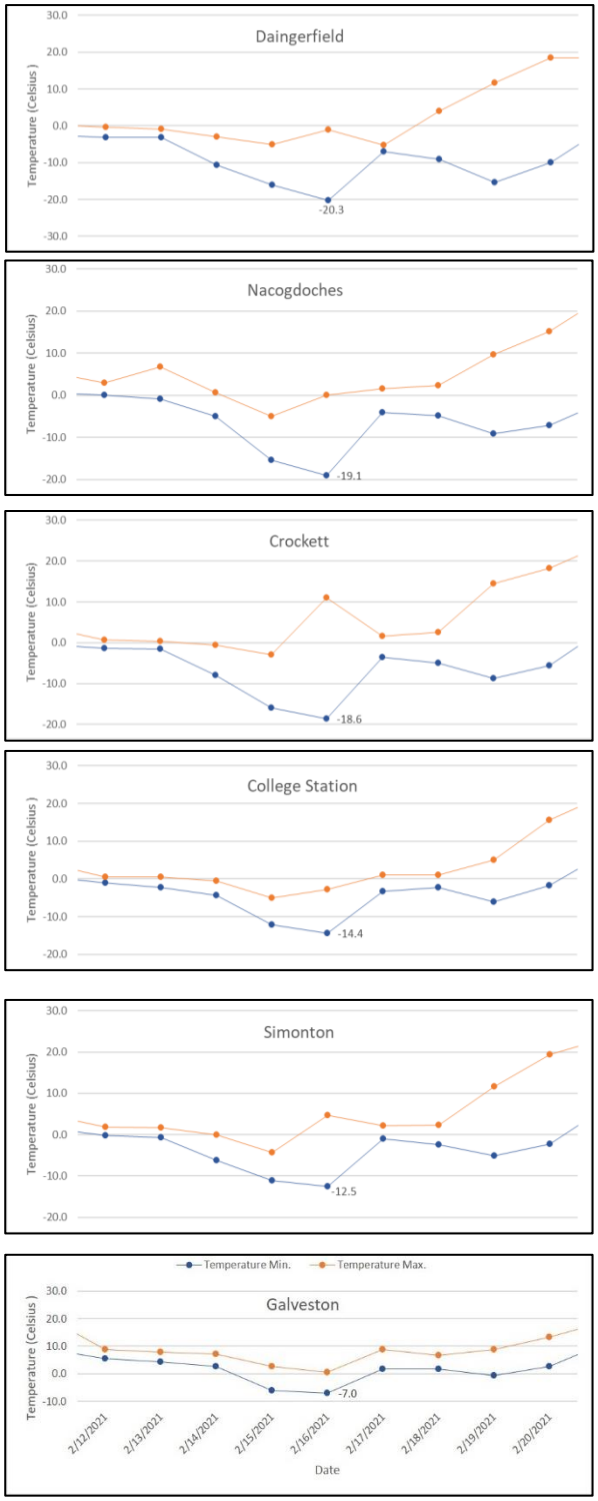

Figure 2. Maximum-minimum temperatures encountered in select Texas locations, 12-20 February 2021.

Table 1. Freeze damage rating system for woody plants

1: No damage
2: Minor foliar damage/partial defoliation, buds/stem survive
3: Near total foliar damage/defoliation, buds/stem push new growth
4: Outer branches dead, inner branches /main stem survive, likely to recover in 1-2 seasons without aesthetic disfigurement.
5: Major branches/main trunk damage, buds break usually from trunk, may have permanent aesthetic disfigurement
6: Total death

FREEZE IMPACT ON A FEW SELECT GENERA AT SFA GARDENS

Abelia – 16 cultivars, no damage – *A. chinensis*, no damage.

Acer species – The SFA Gardens Japanese maple collection is one of best in south and there's a good representation of rarely encountered Asian species. In general, most of the Acers suffered zero damage. Over 300 Japanese maples appeared to have emerged unscathed. However, the evergreen maples including *A. fabri*, *A. cinnamomifolium* and *A. oblongum* generally rated a 4 or 5 on the damage scale and are recovering. *Acer saccharum* ssp. s*kutchi*, the Mexico mountain sugar maple suffered very little damage.

Actinidia – SFA Gardens and Texas A&M Agrilife have cooperated on a kiwifruit evaluation project for a number of years. For the most part, golden kiwifruit survived the freeze better than green, and young plants fared worse than older vines. A trunk protection study happened to be in place with temperature dataloggers and the conclusion was little to no benefit.

Berberis – mostly *B. thunbergii* varieties, no damage

Callicarpa – varieties and genotypes of *C. americana* suffered no damage. *C. rubella* and *C. dichotoma* damaged trunks and branches. *C. salicifolia* and *C. longissimia* froze to ground but both recovered.

Camellia – 200 plus cultivars with a wide range of damage ratings. Most survived though many badly damaged. 'Frank Hauser, a favorite here, was killed outright in a number of locations. 'Yuletide' branches and tops died back on some, on others less. For many Camellia species, it was common to have the top alive with unthrifty new growth with considerable sprouting from base and lower trunk and branches. Many straight Asian species died to near ground. *C. yuhsienensis* fared well.

Conifers – In general, good survivability over a wide range of genera including *Taxus, Cephalotaxus, Thuja, Thujopsis, Cunninghammia,* and *Juniperus*. Some damage on our three *Keteleeria* species and some nomenclature debate on our collection. A large *K. evelyniana* was killed back to trunk and a few major banches. A very large *Araucaria araucana* var. *angustifolia* (40' survived with some damage and new growth sprouting from trunk and the crown appears unaffected. *Cunninghammia unicanaliculata* (botanically challenged as a subspecies of *C. lanceolata*), weathered severe ice load and rebounded to good form without damage.

Gardenia – wide collection of varieties, froze to ground or near ground and recovered. 'Wispering Pines' was unaffected

Hydrangea – *H. quercifolia* and *H. paniculata* were unaffected. All *H. macrophylla* varieties froze to ground but returned vigorously. *Dichroa* survived from under snow cover.

Ilex – a large holly collection, unaffected for the most part. *I. rotunda* damaged. *I. vietnamensis* froze back.

Illicium – extensive collection. All native derived varieties seem to survive well, even the variegated and golden foliage clones. Surprisingly, *I. mexicanum* was unaffected. *I. anisatum* damaged. *I. verum* killed.

Lagerstroemia – 136 varieties, good survival but some varieties showing die-back and unthrifty growth, verdict not in.

Lauraceae – a record large *Cinammomum chekiangensis* was unaffected, a surprise. *Phoebe shearei* killed. *Phoebe chekiangensis* froze to near ground.

Loropetalum – a surprise, with major damage on a wide range of varieties, most to ground.

Magnolia – an extensive collection of varieties. *M. grandiflora*, *M. acuminata*, *M. pyramidata*, *M. virginiana*, and *M. macrophylla*, no freeze damage. However, some damage from snow/ice load. Many Asian magnolias suffered. The two banana shrubs, *M. figo* and *M. skinneriana* damaged, with *M. figo* frozen to ground. Surprisingly, a *Parakmeria yunnanensis* was unaffected.

Osmanthus – an extensive collection of *O. fragrans*. Most survived well. 'Fudingzhu' and 'Apricot echo' damaged but 'Aurantiacus' was not. Three variegated forms damaged but recovered from low in the shrub. *Osmanthus yunnanensis* taken to ground.

Pittosporum – all *P. tobira* varieties froze to ground but are returning. Both the green and variegated *P. heterophylla* froze to ground, sprouting from base and from underground roots, an aggravation. Some rarely encountered Asian Pittosporum species all froze to ground but have returned from base.

Podocarpus – the collection of varieties at SFA Gardens varied from major damage to little.

Quercus – an extensive collection of species. Damage to post oaks and live oaks in the region, but quite random. Some trees affected, other not. Most Mexico oaks in our collection survived in the landscape and in containers. Exceptions included *Q. germana* which suffered limb die back and unthrifty growth. *Q. tarahumara* froze back to main trunk and some side limbs. *Q. insignis* froze to near ground but has returned. *Q. rysophylla*, *Q. polymorpha*, *Q. canbyi*, three somewhat common in the Texas trade, all survived. A very large *Q. acutissima* died with no attempt at resprouting.

Raphiolepis – mainly *R. indica* varieties, most froze to ground. Indian hawthorns are a commodity in Texas landscapes and were badly damaged or killed all the way into Houston. *R. umbellata* survived with minor damage.

Rhododendron – With four hundred azalea varieties, selections or genotypes represented in SFA Gardens, Sherry Randall and Barbara Stump, both with long term involvement in the Azalea Society of America and the Texas chapter, made on-the ground evaluation in late

spring. Esssentially no damage on native deciduous azaleas, Aromi hybrids, and other genetics in that arena. On *R. indicas,* it was typical to see alive but unthrifty tops with sprouting from base of plants. Encores in general were unaffected. 'Koromo shikibu', a signature azalea at SFA Gardens was unaffected. Badly damaged varieties were cut to a few feet above ground, fertilized and they have rebounded. Tables 1 and 2 present an example of the database used, sorted alphabetically by variety and by damage rating.

Schima – In the Theaceae, several species are now lumped into *S. wallichi.* Large tree at SFA Gardens that came to us as *S. superba* has damaged outer limbs, returned from trunk. Large *S. remotoseratta* died to ground but returned from base.

Styrax – The snowbells did well here. *Styrax japonica* varietries took the cold in stride, as did other Asian species, many rarely encountered. For example, *Styrax tonkinensis* was unscathed. A very large *Styrax formosanus* var. *formosanus* was killed to ground but vigorously sprouted from low on the trunks and from the root system. A large *Huodendendron tibeticum* (never flowered but grew well) was killed outright.

Taxodium – very large collection representing varieties and selection material of bald cypress, pond cypress, Monezuma cypress and the bald x Montezuma hybrids from the Nanjing Botanical Gardens Taxodium Breeding and Improvement program. No damage. This was a critical test of pure Montezuma genetics involving southern Mexico genotypes.

Ulmus parvifolia – Most *Ulmus* species were unaffected. However, in Texas, some large *U. parvifolia* trees were severely damaged with major limbs and trunk cracks.

CONCLUSIONS

Evaluating woody ornamentals for tolerance to a hard freeze event is more complicated than we originally envisioned. A few conclusions at this point can be made:

1. Patience is the rule. The impact of a freeze on a woody ornamental can take years to run its course. We have observed trees appear only modestly affected to observe them collapse.
2. With six inches of snow cover, many plants were protected and rebounded from below the snow line. A similar freeze without snow cover would have different results.
3. There's considerable variation in the data when multiple plants are involved. Whether seedlings or clones, there was obvious plant to plant variation. Assessing a variety's freeze tolerance on only a few plants may not be valid.
4. Numerous commodities need to be reconsidered. Loropetalum was introduced after the 1989 freeze, planted extensively in Texas and was badly damaged by the February 2021 freeze. While the species generally resprouted from the base, robust sprouts from the root system are a maintenance aggravation.
5. The final document will be available in .pdf format and placed on the web for future reference.