

Ornamental Winners and Losers in the Record Texas Freeze of February 2021

David Creech, Lais Machado and David Kulhavy

Stephen F. Austin Gardens, Arthur Temple College of Forestry and Agriculture,

PO Box 13000, Stephen F. Austin State University, Nacogdoches, Texas 75962

dcreech@sfasu.edu

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 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 16 February 2021. City and residential water lines broke, the electric grid failed and it was obvious Texas was not prepared for record cold. For landscapes, going from Zone 8b to a 5 was a bit much. If it was not the stress of low temperature, it was the heavy ice and snow load in much of the Pineywoods that proved too much for many plants. Patriarch pines, oaks, sweetgums and elms all suffered limb damage or total collapse.

THE STEPHEN F. AUSTIN GARDENS (SFA) GARDENS

For a background, SFA Gardens comprises 58 ha (128-ac) on-campus property at Stephen F. Austin State University in Nacogdoches, Texas. The SFA Gardens is the umbrella organization responsible for the activities, growth and development of five main theme gardens. The oldest garden is the 4.5 ha (10-ac) SFA Mast Arboretum which was initiated in 1985 and dedicated in 1997. It also includes the horticulture facility of the Agriculture Department. The second garden is the 3.2 ha (8-ac) Ruby M. Mize Azalea Garden, dedicated in April 2000, and – populated primarily with azaleas, camellias, Japanese maples and an assortment of rarely encountered species and varieties. The third garden is the 19 ha (42-ac) Pineywoods Native Plant Center (PNPC), which Lady Bird Johnson dedicated in April 2000. The fourth garden is the 31 ha (68-ac) SFA's Recreational Trail and Gardens, dedicated in March 2010, composed of mostly undisturbed forest. The fifth garden is the 3.2 ha (8-ac) Gayla Mize Garden, which features primarily woody ornamentals. Hence, SFA Gardens is a collectors garden and features a wide diversity of species, varieties and genotypes:

<https://dcreechsite.com/2020/04/13/plant-glossary/>.

PAST RECORD FREEZES IN TEXAS

The snowstorm of 14-17 February 1895 is still referred to as the Valentine's Day freeze, an event known for record snowfall on the Texas coast. Galveston reported snowfall of over 38 cm (15-in) - with Houston, Orange,

Stafford, and Columbus, Texas - all reporting 51 cm (20-in). Even Brownsville at the southern tip of Texas received 13 cm (5-in) 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 11–13 February 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. 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. In 2011 there was a single digit cold snap, and in January 2018, temperatures in Nacogdoches dipped to -12° C (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 (Fig. 1)!

OBJECTIVE

In the spring 2021, a small group of horticulturists organized a 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 is 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 cooperator 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 are 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 freeze damage rating system for woody trees and shrubs is simple, with a scale of:

- 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

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 is data. For the botanical garden community, this is an

opportunity to create a reference point document for characterizing freeze tolerance of ornamentals for Texas.

There is nothing like a record breaker to differentiate the field!

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 the South and there is 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. *skutchi*, 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 there 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. longissima* froze to ground but both recovered.
- Camellia – 200-plus cultivars with a wide range of damage ratings. Most survived though many were 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 the ground. *C. yuhsienensis* fared well.
- Conifers – In general, there was good survivability over a wide range of genera including Taxus, Cephalotaxus, Thuja, Thujopsis, Cunninghamia, and Juniperus. There was some damage on three

Keteleeria species - and some nomenclature debate continues with our collection. A large *K. evelyniana* was killed back to trunk and a few major banches. A very large *Araucaria araucana* var. *angustifolia* [12 m (40-ft) survived with some damage and new growth sprouting from the trunk and the crown appears unaffected. *Cunninghamia unicanaliculata* (botanically challenged as a subspecies of *C. lanceolata*), weathered severe ice load and rebounded to good form without damage.

- Gardenias – wide collection of varieties, froze to ground or near ground and recovered.
- Hydrangeas – *H. quercifolia* and *H. paniculata* were unaffected. All *H. macrophylla* varieties froze to ground but returned vigorously. *Dichroa* was protected from snow cover, and survived.
- Ilex – a large holly collection, was unaffected for the most part. *I. rotunda* was damaged, and *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* was damaged, and *I. verum* killed.
- Lagerstroemia – 136 varieties, good survival but some varieties showing dieback and unthrifty growth; the verdict is still out.
- Lauraceae – a record large *Cinammomum chekiangensis* was unaffected - a surprise. *Phoebe shearei* was killed, and *Phoebe chekiangensis* froze to the ground.
- Loropetalum – a surprise, with major damage on a wide range of varieties, froze to the ground.
- Magnolia – an extensive collection of varieties. *M. grandiflora*, *M. acuminata*, *M. pyramidata*, *M. virginiana*, and *M. macrophylla* showed no freeze damage. However, there was some damage from snow/ice load. Many Asian magnolias suffered. The two banana shrubs, *M. figo* and *M. skinneriana* were damaged, and *M. figo* froze to the ground. Surprisingly, a *Parakmeria yunnanensis* was unaffected.

- Osmanthus – an extensive collection of *O. fragrans*. Most survived well. ‘Fudingzhu’ and ‘Apricot echo’ were damaged but ‘Aurantiacus’ was not. Three variegated forms were damaged but recovered. *Osmanthus yunnanensis* was frozen to the ground.
- Pittosporum – all *P. tobira* varieties froze to the ground but are resprouting. Both the green and variegated *P. heterophylla* froze to ground, sprouting from base and from underground roots. Some rarely encountered Asian Pittosporum species all froze to the 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. There was random damage to post oaks and live oaks in the region. Some trees were affected and others 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 the main trunk and some side limbs. *Q. insignis* froze to the ground but has returned. All *Q. rysophylla*, *Q. polymorpha*, *Q. canbyi* survived; they are somewhat common in the Texas nursery industry. A very large *Q. acutissima* died, and did not resprout.
- Raphiolepis – mainly *R. indica* varieties, most froze to ground. Indian hawthorns are a commodity in Texas landscapes and were badly damaged or killed from north Texas locations to Houston. *R. umbellata* survived with minor damage.
- Rhododendron – In late spring, Sherry Randall and Barbara Stump, both with long term involvement in the Azalea Society of America and the Texas chapter, evaluated the the four hundred azalea varieties, selections or genotypes planted at the SFA Gardens. There was essentially no damage on native deciduous azaleas, Aromi hybrids, and genetically related cultivars. However, with *R. indicas*, it was typical to see alive but unthrifty tops and sprouting from the base of plants. Encore azaleas 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. See the examples of the database used, sorted alphabetically by variety and by damage rating (Tables 1 and 2).

- Schima – In the Theaceae, several species are now lumped into *S. wallichii*. A large *S. superba* tree at SFA Gardens had damaged outer limbs, but resprouted from the trunk. A large *S. remotoseratta* died to ground, but resprouted from its base.
- Styrax – The snowbells did well. *Styrax japonica* varieties tolerated the cold, as did other rarely encountered Asian species. 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 – A very large collection representing varieties and selection material of bald cypress, pond cypress, Montezuma cypress and the bald X Montezuma hybrids from the Nanjing Botanical Gardens Taxodium Breeding and Improvement program. There was 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 cracks in major limbs and the trunk.

CONCLUSIONS

Evaluating woody ornamentals for tolerance to a hard freeze event is more complicated than we originally envisioned. A few conclusions 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, then collapse much later.
2. With 15 cm (6-in.) of snow cover, many plants were protected and rebounded from below the snow line. A similar freeze without snow cover could have very different results.
3. There is 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 with only a few plants may not be valid.

4. Numerous plant usage in landscapes needs to be reconsidered. Loropetalum was introduced after the 1989 freeze and planted extensively in Texas; it 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 nightmare.
5. The final document will be available in .pdf format and placed on the web for future reference.

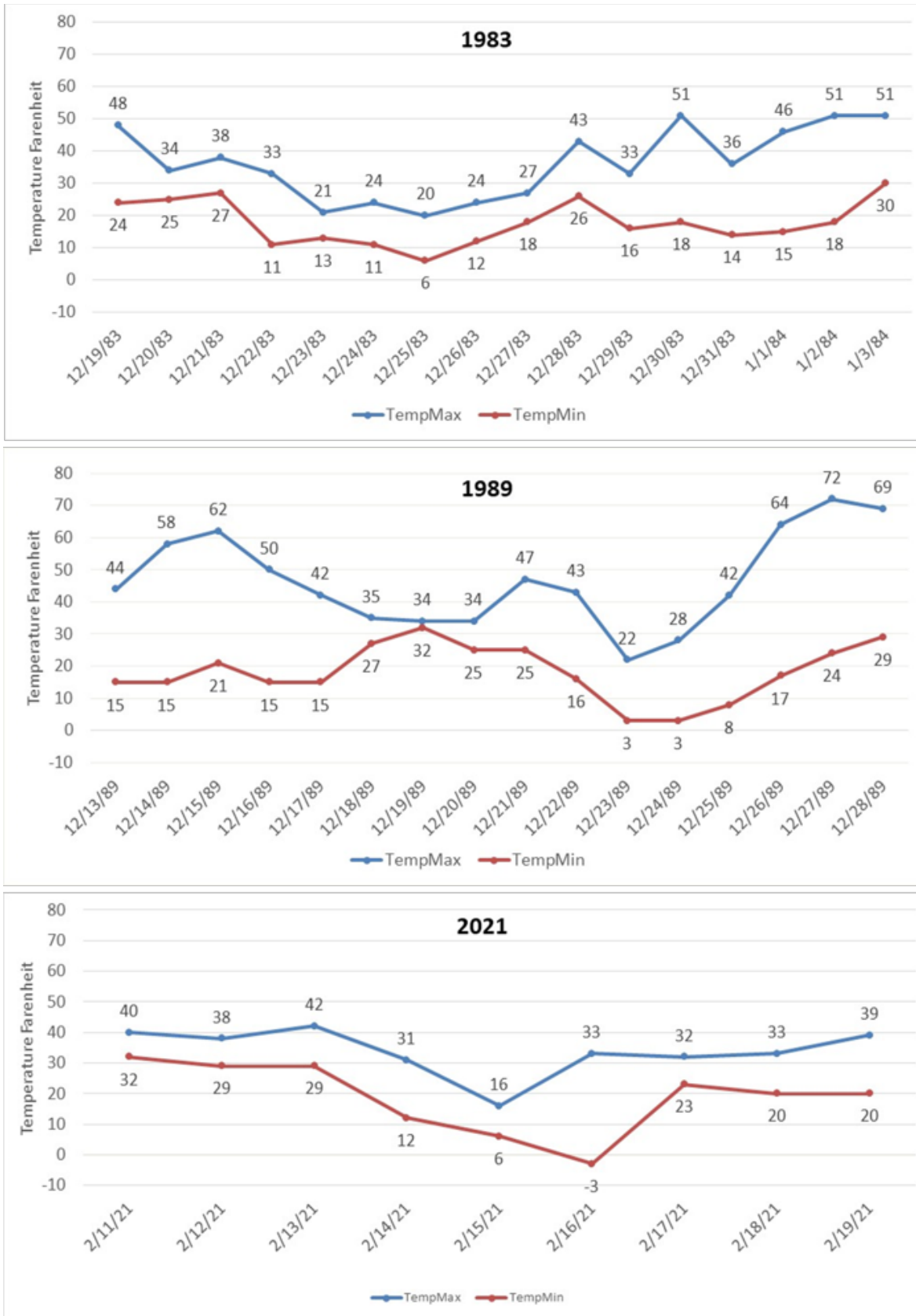


Figure 1. Temperatures encountered with three recent mega freezes in Nacogdoches, Texas.

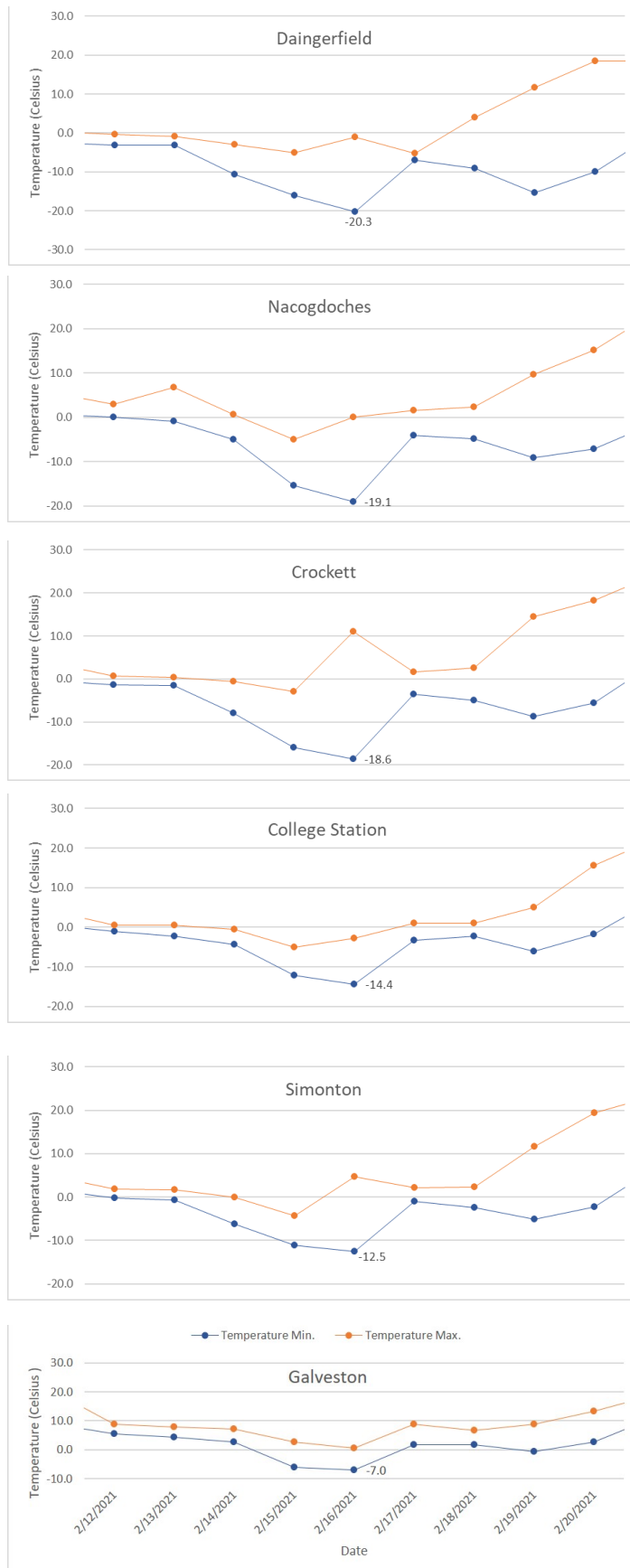


Figure 2. Maximum-minimum temperatures encountered in select Texas locations, 12-20 February 2021.

Table 1. Example of Azalea Freeze Damage Assessment database, May 25, 2021 reading, varieties with no or little damage.

Genus	Species	Cultivar	Garden Location	# Ident Plants	Healthy Prior	Damage Rating
Rhododendron		Autumn Belle	B45	25	0	0
Rhododendron		Illusions	B21	1	0	0
Rhododendron		Jeb Stuart	B26	1	0	0
Rhododendron		Nassau	B25	1	0	0
Rhododendron	nudiflorum	Alba	B25	1	1	1
Rhododendron	arborescens	Alba	B26	1	1	1
Rhododendron		Alba	B26	2	2	1
Rhododendron		Amoenum	B30	1	0	1
Rhododendron		Anna Kehr	B38	68	38	1
Rhododendron		Autumn Debutante	B40	6	3	1
Rhododendron		Autumn Empress	B45	3	3	1
Rhododendron		Autumn Royalty	B45	3	1	1

Damage rating: 1 = no damage.

Table 2. Example of Azalea Freeze Damage Assessment, May 25, 2021, varieties with major damage.

Genus	Species	Cultivar	Garden Location	# Ident Plants	Healthy Prior	Damage Rating
Rhododendron		Girard's Border Gem	B9	1	1	4,5
Rhododendron		Judge Solomon	B40		16	4,5
Rhododendron		Judge Solomon	B43	30	16	4,5
Rhododendron	Gartrell Hyb's	Tochi Nikari	B9	1	1	4,5
Rhododendron		Bergerette	B29	1	1	4,5,6
Rhododendron		Robin Hill Gillie	B22	52	52	5*
Rhododendron		Corry	B34	81	?	5,6
Rhododendron		H 3-15-61	B31	3	0	5,6
Rhododendron		Louise Sproul	B29	1	0	5,6
Rhododendron		Primitive Beauty	B30	2	1	5,6
Rhododendron		Red Formosa	B6	7		5,6
Rhododendron		Red Slippers	B34	0	0	5,6

Damage rating: 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.