

# Damage on Ornamental Landscape Plants Resulting from the January 2007 Freeze in Arizona

*Ursula K. Schuch<sup>1</sup>, Jack J. Kelly<sup>2</sup>, and Steve Priebe<sup>3</sup>*

*<sup>1</sup>Plant Sciences Department, University of Arizona, Tucson, AZ 85721*

*<sup>2</sup>Pima County Cooperative Extension, 4210 N Campbell Ave., Tucson, AZ 85719*

*<sup>3</sup>City of Phoenix, Street Transportation Department, 200 W. Washington St, 5th Floor, Phoenix, AZ 85003*

## Abstract

*Severe freezing temperatures during January 2007 caused temporary and permanent damage in several species of ornamental landscape plants. The damage was exacerbated by three consecutive nights of frost and freezing temperatures lasting between 7 and 14 hours each day. Observations of frost damage and recovery in Phoenix and Tucson were recorded.*

## Introduction

Cold hardiness develops in plants in response to shortening days, decreasing night temperatures, and finally decreasing day temperatures. Plants adapted to temperate or cooler climates respond to these environmental changes and deciduous plants shed their leaves while evergreens slow in metabolism. Desert plants growing at low elevations generally do not slow their growth as long as temperatures are warm and soil moisture and nutrients are available. In southern Arizona conditions favorable for growth can occur as late as mid November. Sudden freezing temperatures after prolonged warm temperatures and fall moisture cause damage to young shoots and leaves that are not conditioned to the cold. Rapid changes in temperatures are common in the desert and proper plant selection and cultural management can prevent injury or loss of plants in the landscape due to cold temperatures.

## Freezing Events

On January 15, 2007 temperatures in southern Arizona in Tucson and the Phoenix metropolitan area dropped to record low temperatures of -8.8°C (16.2°F) and -4.2°C (24.2°F), respectively (AZMET, 2007). The severity of this cold snap was further exacerbated by freezing temperatures that persisted 14 and 12 hours respectively in Tucson and Phoenix. The previous night the low in Tucson reached -6.0°C (21.2°F) with freezing temperatures for 7 hours and the low in Phoenix was -4.4°C (21.1°F) with freezing temperatures lasting for 9 hours (Fig. 1). The Tucson area was exposed to a third consecutive night on January 16 with freezing temperatures persisting for 12 hours and a low of -5.9°C (21.4°F). Snow up to 5 cm (2 inches) was recorded in some locations in Tucson on January 21, 2007 and persisted on plants throughout the night. While freezing temperatures are common in Tucson and occur usually less severely and frequently in the Phoenix area, the low temperatures during this freeze event and the length of time of freezing temperatures were unusual for the area. Microclimates varied in different locations and temperatures lower than the ones recorded by the AZMET weather stations were recorded by homeowners near drainages and washes where cold air can stagnate.

From a historic perspective the freeze was similar to other historic low temperatures recorded by the National Weather Service in Tucson:  $-7.2^{\circ}\text{C}$  ( $19.0^{\circ}\text{F}$ ) on January 17, 1987 and on December 29, 2003 and  $-6.7^{\circ}\text{C}$  ( $20.0^{\circ}\text{F}$ ) on December 29, 1988 and January 15, 2007. The coldest record was  $-8.3^{\circ}\text{C}$  ( $17.0^{\circ}\text{F}$ ) on February 7, 1899. Lowest temperature records in Phoenix are reported by the National Weather Service for January 7, 1913 when temperatures dropped to  $-8.9^{\circ}\text{C}$  ( $16.0^{\circ}\text{F}$ ). The most recent low temperature recorded in Phoenix was  $-3.3^{\circ}\text{C}$  ( $26.0^{\circ}\text{F}$ ) on December 23, 1990. The freeze in January 2007 went into the record books for having the lowest maximum day temperature of  $7.8^{\circ}\text{C}$  ( $46.0^{\circ}\text{F}$ ) on January 14, but did not exceed the record low of  $-5.6^{\circ}\text{C}$  ( $22.0^{\circ}\text{F}$ ) which occurred in 1963 on that day.

## Frost Damage to Plants

Frost damage on plant tissue is the result of water freezing inside the tissue, and upon thawing, rupturing the cells. Once cells are ruptured they die and symptoms of brown tissue, that eventually dies, become evident on the plants. This can include leaves and branch tips, extend further down the shoot or affect the entire plant. Plants that harden or are conditioned to cold temperatures gradually decrease the amount of water in the cells or accumulate more ions in the cell that increases the osmotic potential, acting like antifreeze because it lowers the freezing point of the liquid. Although roots are less hardy than shoots, roots of plants in the soil are safe because soil temperatures in the low desert remain above freezing. Soil minimum daily temperatures in Tucson stayed at  $1.7^{\circ}\text{C}$  ( $35.0^{\circ}\text{F}$ ) at 10 cm (4 inches) depth during the coldest night on January 15, and at 50 cm (20 inches) depth never fell below  $6.7^{\circ}\text{C}$  ( $44.0^{\circ}\text{F}$ ) during the cold spell. Plants growing in larger pots have adequately protected roots because moist growing medium generally maintains temperatures above freezing. Plants growing in small pots with dry medium may have sustained damage during the January frost unless they were protected.

Damage to plants in Tucson and Phoenix was observed within the next few days, and over the following weeks and months. Potted plants that are known to have no resistance to freezing and that were unprotected usually showed symptoms rapidly, among them, browning of cactus and succulent shoots. Potted plants that were located close to a structure and partially under a roof and sustained damage in Tucson included pony tail palm (*Beaucarnea recurvata*), bougainvillea (*Bougainvillea* sp.), sago palm (*Cycas revoluta*), and adenium (*Adenium obesum*). Among the plants in the landscape that were severely damaged, many are of subtropical origin such as bougainvillea, sago palm and ficus (*Ficus microcarpa nitida*) (Table 1). Other plants such as Queen palm (*Syagrus romanzoffianum*) are poorly adapted to our climate and the two senna species (*S. artemisioides* and *S. phyllodenia*) are known to be sensitive to the low temperatures that occurred. Damage to hopbush (*Dodonea viscosa*) and willow acacia (*Acacia salicina*) were more severe than expected. Willow acacia in the Desert Legume Program (DELEP) collection in Tucson were reported to have two undamaged plants at one location and two plants from a different accession at a different location where all foliage was killed and twig dieback was observed (Johnson and Coppola, 2007).

Plants that experienced moderate to light damage from the frost (Table 1) are known to be sensitive to low temperatures. Some plants such as lantana (*Lantana spp.*), cape honeysuckle (*Tecomaria capensis*) and yellow oleander (*Thevetia peruviana*) are always expected to incur some damage in Tucson, but in mild winters survive intact in Phoenix. The cold temperatures were a reminder that the petite cultivars of oleander (*Nerium oleander* 'Petite Pink' or *N. oleander* 'Petite Salmon') are much less hardy than the larger cultivars ('Sister Agnes', 'Casablanca', 'Algiers') or some of the newer compact cultivars ('Little Red'). More frost damage was also observed on oleander plants that were continuously sheared compared to those retaining their natural shape. Similar observations were made for sheared senna, cape honeysuckle, and natal plum (*Carissa macrocarpa*). Sissoo trees (*Dalbergia sissoo*) are relative newcomers in large numbers to landscapes in Tucson and while there was some concern about their hardiness they lost their leaves in response to the freeze, but were completely refoliated within about six weeks.

Once frost damage occurs it is best to wait until the plant resumes active growth to determine the exact extent of damage and the best course to prune or possibly replace a plant. While new leaves and shoots emerged on many damaged plants during spring, some trees and shrubs were compromised beyond repair and required removal. Shrubs such as hopbush can be cut back 6-10 inches (15-25 cm) above the ground and will grow new shoots, while senna species generally do not respond well to this treatment. Large ficus trees that were heavily damaged can be difficult to train into aesthetically pleasing and structurally sound trees.

What precautions can be taken to prevent frost damage to plants? The most important action would be to select plant material that is hardy for a location. When plants with no tolerance to frost are planted in the Phoenix or Tucson area they can be protected from a few degrees of cold with blankets or lights emitting heat, but once they become large such as a *Ficus microcarpa nitida*, mature citrus trees, or a sprawling bougainvillea, frost protection becomes difficult or impossible. Giving plants the opportunity to harden off in late fall by terminating fertilization until spring and decreasing the amount and frequency of irrigation will stop new growth and make plants more tolerant to colder temperatures. The genetic makeup of a plant usually determines its general cold hardiness but plant maturity, the microclimate where a plant grows, and the amount of sunlight, water, and fertilizer it receives will affect its cold tolerance. Different accessions of plant material of one species often confer different degrees of cold hardiness (Johnson and Coppola, 2007).

### **Citations**

AZMET 2007. Arizona Meteorological Network, University of Arizona. <http://ag.arizona.edu/azmet/>

Johnson M.B. and K. Coppola. 2007. The January 2007 freeze – effects of cold on plants in DELEP’s fields. *Aridus* 19(1):1-4, 6.

Table 1. Location, time, and extent of freeze damage to ornamental plants in Arizona during the freeze of January 2007

**I. Severe damage:** Branch dieback to entire plant dead, severely damaged plants require extensive pruning, dead plants require removal.

| Latin Name                                    | Common name     | Description of damage   | Recovery  | Location* |
|---|-----------------|---|---|-----------|
| <i>Acacia salicina</i>                        | Willow acacia   | Some plants frozen to the ground  | None  | T         |
| <i>Agave angustifolia marginata</i>           | Caribbean agave | Plants dead   | None  | T         |
| <i>Antigonon leptopus</i>                     | Queen's wreath  | Above ground parts, some entire plants                                      | Some re-growth  | T, P      |
| <i>Beaucarnea recurvata</i>                   | Ponytail palm   | Leaves brown on potted plants, some plants died                             | Some plants grew new foliage  | T         |
| <i>Bougainvillea spectabilis</i>              | Bougain-villea  | Leaves and branches frozen to 60 cm above ground                            | Complete recovery   | P         |
| <i>Canna sp.</i>                              | Canna           | Above ground parts frozen   | Recovering slowly   | P         |
| <i>Cycas revoluta</i>                         | Sago palm       | Fronds brown on potted plants   | Some grew all new foliage by summer, others were dead                 | T         |
| <i>Dodonaea viscosa</i>                       | Hopbush         | Above ground parts frozen to the ground, some with partial dieback          | Cut back to 15 cm, new growth emerged by April                        | T         |
| <i>Ebanopsis ebano</i>                        | Texas ebony     | Stems frozen to 1.2 cm, leaves dead   | New growth on undamaged wood  | T         |
| <i>Ficus microcarpa nitida</i>                | Ficus           | Leaves all brown, partial to severe branch dieback, some entire plants dead | New foliage growing on undamaged wood                                 | T, P      |
| <i>Senna artemisioides, Senna phyllodenia</i> | Senna           | All foliage dead, branch dieback 40-100%, several plants dead               | New leaves emerged on undamaged branches in April, very slow recovery | T         |
| <i>Syagrus romanzoffianum</i>                 | Queen palm      | Younger plants with 2-5 fronds often killed                                 | None  | T         |

**II. Moderate to light damage:** Plants partially defoliated, none to little branch dieback. Light or no pruning required to restore plant appearance.

| Latin Name                  | Common name              | Description of damage       | Recovery                      | Location* |
|-----------------------------|--------------------------|-----------------------------|-------------------------------|-----------|
| <i>Acacia redolens</i>      | Prostrate acacia         | Leaf and twig dieback       | Complete to partial recovery  | T         |
| <i>Aloe vera</i>            | Aloe                     | Shoot tips brown            | No permanent damage           | T         |
| <i>Caesalpinia mexicana</i> | Mexican Bird of Paradise | Foliage brown, twig dieback | Regrowth of twigs and foliage | T         |

| <b>Latin Name</b>  | <b>Common name</b>   | <b>Description of damage</b>  | <b>Recovery</b>  | <b>Location*</b> |
|--|----------------------|---|--|------------------|
| <i>Callistemon viminalis</i>                             | Bottle brush         | Leaf dieback  | Complete recovery  | T                |
| <i>Carissa macrocarpa</i>                                | Natal plum           | Leaves frozen   | Complete recovery  | T, P             |
| <i>Cordia boissieri</i>                                  | Texas olive          | Leaves all crisp and brown  | Completely refoliated and flowered in spring                           | T                |
| <i>Citrus spp.</i>                                       | Citrus               | Leaf and twig dieback   | Regrowth of twigs, branches and leaves                                 | T, P             |
| <i>Dalbergia sissoo</i>                                  | Sissoo tree          | All leaves, minor branches on older plants frozen, terminal leader on new plants frozen to 1 m above ground | Completely refoliated after about 6 weeks, little branch dieback.      | T, P             |
| <i>Eucalyptus camaldulensis</i>                          | Red gum              | Leaves on outer canopy brown  | Complete recovery  | T                |
| <i>Jacaranda mimosifolia</i>                             | Jacaranda            | All leaves dead, branch dieback on mature trees several meters.   | Refoliated below dead, frozen branches. Needs trimming.                | T, P             |
| <i>Lantana camara</i>                                    | Lantana              | Above ground parts dead   | Complete recovery  | P                |
| <i>Merremia aurea</i>                                    | Yellow morning glory | Whole plant to just above ground  | Some completely recovered others did not recover...                    | P                |
| <i>Nerium oleander 'Petite Pink' and 'Petite Salmon'</i> | Dwarf oleander       | Leaves dead, moderate to severe branch dieback  | New foliage started to emerge by April, very slow recovery             | T                |
| <i>Pinus canariensis</i>                                 | Canary Island pine   | Light browning of needles   |  | T                |
| <i>Pedilanthus macrocarpus</i>                           | Lady slipper         | Tip to entire stem dieback  | Regrowth of new stems  | T                |
| <i>Portulacaria afra</i>                                 | Elephant's food      | Leaves and stems, some entire plants  | Established plants recovered slowly newly planted ones did not recover | P                |
| <i>Syagrus romanzoffianum</i>                            | Queen palm           | Older plants had damage on tip and margins of fronds  | Growth of healthy new fronds   | T                |
| <i>Tecomaria capensis</i>                                | Cape honeysuckle     | Above ground parts only   | Slow but full recovery   | P                |
| <i>Thevetia peruviana</i>                                | Yellow oleander      | Top 1 m of mature plant   | Slow recovery  | P                |
| <i>Washingtonia filifera</i>                             | Mexican fan palm     | Fronds partially to entirely brown  | New foliage emerged by April   | T                |
| <i>Wedelia trilobata</i>                                 | Wedelia              | Above ground parts  | Most recovered slowly  | P                |

\* T = Tucson, P = Phoenix area

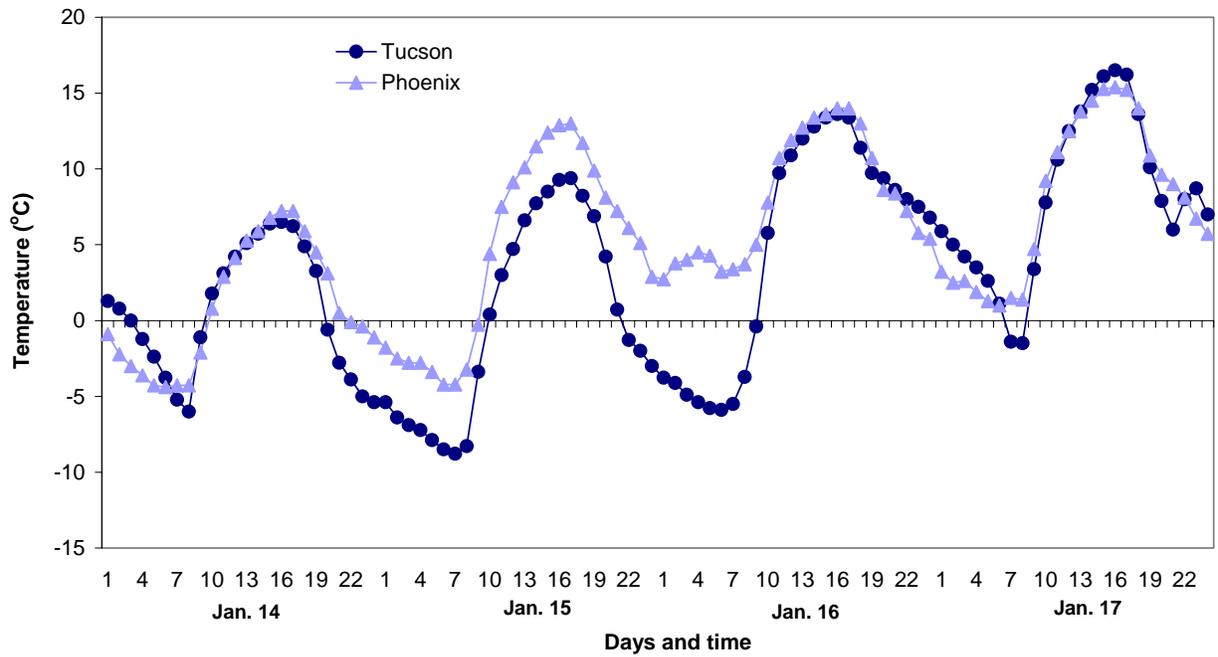


Fig. 1. Hourly temperatures in Tucson and Phoenix from January 14 – 17, 2007. (Source: Arizona Meteorological Network)